* Protected Open Space in the North & South Rivers Watershed



EEOS623 - Intro to ArcGIS Final Project 05/12/2014



*Introduction and Background

- *NSRWA Map of Open Space & Trails
- *Open Space Layer from MassGIS
- *Land Use Layers from MassGIS
- *Hydrology Layer from MassGIS
- *Sub-Basins Layer from MassGIS
- *Towns_Poly_M Layer from MassGIS (using only 13 local towns)
- *Assessors' Parcel Layers from MassGIS

*Source Maps & Layers



*Methodology

Sub-basins Layer

Select NSRW basins based on map and dissolve to form basin layer [NSRW_Basin]

CENSUS_TOWNS_POLYM

Select Towns with land in basin (and Cohasset for visual ease) Add field & edit LOCAL_ID numbers 1-13 in new field [LocalTownsID]

Protected Open Space Layers:

1. Select All Protected Open Space

- > Clip with Local_Towns - > Dissolve [Total_POS]

2. Select Town-Owned Protected Open Space

- > Clip with Local_Towns - > Dissolve [MUN_POS]

- 3. Select Land Conservation Trust & Conservation Organization Owned Protected Open Space
 - > Clip with Local_Towns > Dissolve [LCT_POS]

Land Use Layers:

Merge Plymouth & Norfolk County Layers Clip with Local_Towns Select, then Dissolve:

- 4. Natural Land
- 5. Agricultural Land
- 6. Residential Land
- 7. Recreational Land
- 8. Developed Land
- 9. Water



| Land Use Code | Land Use Description | Туре | | | |
|---------------|------------------------------|------|--|--|--|
| 1 | Cropland | AG | | | |
| 2 | Pasture | AG | | | |
| 3 | Forest | NAT | | | |
| 4 | Non-Forested Wetland | NAT | | | |
| 5 | Mining | DEV | | | |
| 6 | Open Land | AG | | | |
| 7 | Participation Recreation | REC | | | |
| 8 | Spectator Recreation | REC | | | |
| 9 | Water-Based Recreation | REC | | | |
| 10 | Multi-Family Residential | RESI | | | |
| 11 | High Density Residential | RESI | | | |
| 12 | Medium Density Residential | RESI | | | |
| 13 | Low Density Residential | RESI | | | |
| 14 | Saltwater Wetland | NAT | | | |
| 15 | Commercial | DEV | | | |
| 16 | Industrial | DEV | | | |
| 17 | Transitional | DEV | | | |
| 18 | Transportation | DEV | | | |
| 19 | Waste Disposal | DEV | | | |
| 20 | Water | WAT | | | |
| 23 | Cranberry bog | AG | | | |
| 24 | Powerline/Utility | DEV | | | |
| 25 | Saltwater Sandy Beach | NAT | | | |
| 26 | Golf Course | REC | | | |
| 29 | Marina | DEV | | | |
| 31 | Urban Public/Institutional | DEV | | | |
| 34 | Cemetery | DEV | | | |
| 35 | Orchard | AG | | | |
| 36 | Nursery | AG | | | |
| 37 | Forested Wetland | NAT | | | |
| 38 | Very Low Density Residential | RESI | | | |
| 39 | Junkyard | DEV | | | |
| 40 | Brushland/Successional | NAT | | | |

These are the codes used to select types of land from the county land use layers, colorized by type.

| Land Use Code | Land Use Description | Туре |
|---------------|------------------------------|------|
| 1 | Cropland | AG |
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| 38 | Very Low Density Residential | RESI |
| 20 | Water | WAT |

*Layers - Land Use Codes



*Iterators - the "For" loop

Insert -> Iterators -> For

-> This creates an Iterator process in the ModelBuilder with a variable.

-> The variable should be renamed from "Name" to something easy, like "X"

In the process properties menu, there are three fields which need to be set:

From: The value X will be assigned at the beginning of the loop.To: The value X will increase to over the course of the loopBy: The value by which X will increase each time the loop runs.

That's all the set up the For iterator requires.

The rest of the model can be created normally, with one major exception.

*Iterators - the "For" loop

Inline Variable Substitution

allows you to insert the value of a variable into queries & path names of output files.

Enclose the name of the variable in percentage (%) signs.

ArcGIS may encounter errors if a number or symbol (including the underscore!) occur adjacent to the variable, or if the variable is at the beginning (and/or sometimes the end) of the path name.

* Iterators - Inline Variable Substitution

There are many types of Iterators:

(Field Values, Feature Classes, Folders, Row Selections, Databases, etc.)

Only one Iterator can exist within a single model!

If multiple Iterators are needed, this can (theoretically) be accomplished by nesting models within models.

* Iterators - Other Iterators

I found the following Python 9.3 script on a support forum:

!shape.area@hectares!

which can be used in the Calculate Field process properties menu, instead of a normal SQL query.

The "hectares" can be replaced with any other common measurement of area (acres, etc).

*Python - A Quick Aside

STEP I

-> Select:

from [Local_TownsID] where "LOCAL_ID"= %X%

-> Output Layer:

named [LocalTown%X%Outline]

-> Add Field:

Town_Area to the current Town Outline layer

-> Calculate Field Value:

using the Python script "!shape.area@hectares!"

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Model Edit Insert View Windows Help

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Selecting a Town Outline using Inline Variable Substitution

*Iterators - Application in a Model

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Calculating the area of a shapefile using a python script

STEP II

i. Clip each input layer with the Town%X%Outline.

ii. Add Field (ex: Natural_Area) for the type of layer in the layer clip.
-> Calculate Field Value for the layer clip.

iii. Add Field Local_ID field to the layer clip
 -> Calculate Field Value with "Local_ID"=%X%

This is the most tedious step-

I had to copy and paste each function for all 9 input layers.

Changing the names of the fields has to be done with **EXACT PRECISION** otherwise you can end up running the iterator (depending on what you're doing, it can take hours to days) only to find you've wasted all that time.

CHECK YOUR WORK AT LEAST THREE TIMES. SERIOUSLY.

STEP III

Join the area field from the layer clip to the current Town Outline, based on the corresponding Local_ID fields.

At the end of the loop, the X variable will increase by 1. Steps I-III will repeat for each value of X through 13.

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| | | | Cal | Iculate Field | - |
|---|------------|--|-------------------------|----------------|---|
| ~ | Join Field | | × | | |
| Input Table Town%V%Outline (2) Input Join Field LOCAL_ID Join Table TotalPOS_%V%_CLIP (2) Output Join Field LOCAL_ID Join Fields (optional) SHAPE_Length SHAPE_Area Imput Doc AL_ID Select All Unselect All OK | | Join Field Joins the contents of a table to another table based on a common attribute field. The input table is updated to conta the fields from the join table. You can select which fields from the join table will be added to the input table. The records in the Input Table are matched to the records in the Join Table based on the values of Input Join Field and the Output Join Field. Optionally, only desired fields can be selected fir the Join Table and appended to the Input Table during the join. | ain n e e e | Join Field (2) | |

Joining fields based on the LOCAL_ID field

A look at the full model



Finishing Up:

Assuming ArcGIS encounters no errors (user-error or otherwise), all that remains to do is Merge the Town Outline output files, and symbolize the layer.

I also added and calculated another field, called "Other Protected Open Space" by subtracting the sum of Municipal and Conservation Organizationowned Open Space from the total area of open space in each town.

No matter where you're looking at land conservation in Massachusetts, there's a lot more freedom to do it on a local level.

| Id | entification Fie | lds | Area Fields (all values in hectares) | | | | | | | | | | |
|---------|------------------|----------|--------------------------------------|---------------------|---------|--------------|-----------|-------------|--------|--------------|-------------------------|-------------------|---------------------|
| TOWN_ID | TOWN | LOCAL_ID | Town Area | Total Open Space | Natural | Agricultural | Developed | Residential | Water | Recreational | Municipal Open Space | LCT Open Space | Other Open Space |
| 1 | ABINGTON | 1 | 2634.01 | 347.26 | 1323.27 | 36.52 | 265.18 | 899.83 | 66.81 | 42.40 | 102.71 | 0.00 | 244.56 |
| 65 | COHASSET | 2 | 2604.26 | 738.64 | 1219.48 | 43.27 | 107.92 | 729.01 | 94.73 | 57.34 | 81.52 | 267.95 | 389.17 |
| 82 | DUXBURY | 3 | 6272.98 | 1441.60 | 4070.86 | 317.24 | 226.57 | 1358.51 | 162.75 | 103.44 | 1063.64 | 143.15 | 234.81 |
| 122 | HANOVER | 4 | 4059.56 | 584.47 | 2230.98 | 65.25 | 327.47 | 1345.84 | 48.13 | 41.88 | 532.93 | 32.02 | 19.52 |
| 123 | HANSON | 5 | 4072.37 | 631.49 | 2567.34 | 267.21 | 150.06 | 881.95 | 182.17 | 23.65 | 239.97 | 5.88 | 385.64 |
| 131 | HINGHAM | 6 | 5892.40 | 1806.85 | 3223.88 | 171.64 | 462.27 | 1686.37 | 97.80 | 239.75 | 654.21 | 200.75 | 951.88 |
| 171 | MARSHFIELD | 7 | 7446.36 | 1811.82 | 4663.58 | 230.08 | 300.12 | 1980.41 | 138.25 | 125.00 | 1094.95 | 457.09 | 259.78 |
| 219 | NORWELL | 8 | 5490.36 | 1183.44 | 3716.95 | 124.65 | 261.17 | 1272.96 | 87.92 | 26.71 | 756.51 | 90.74 | 336.19 |
| 231 | PEMBROKE | 9 | 6100.43 | 810.18 | 3662.49 | 288.63 | 263.04 | 1322.63 | 494.52 | 69.13 | 508.71 | 122.72 | 178.75 |
| 251 | ROCKLAND | 10 | 2623.87 | 107.57 | 1256.72 | 40.60 | 367.89 | 856.55 | 43.32 | 58.79 | 69.64 | 30.18 | 7.75 |
| 264 | SCITUATE | 11 | 4474.81 | 817.93 | 2501.60 | 98.81 | 143.97 | 1511.50 | 90.92 | 114.12 | 747.92 | 7.89 | 62.12 |
| 336 | WEYMOUTH | 12 | 4581.06 | 427.21 | 1548.36 | 28.60 | 685.34 | 2022.93 | 223.84 | 70.90 | 379.64 | 0.00 | 47.57 |
| 338 | WHITMAN | 13 | 1799.77 | 150.79 | 864.24 | 64.26 | 162.23 | 659.58 | 12.73 | 36.74 | 148.94 | 1.84 | 0.00 |

*Results

Land Use & Open Space In & Around the North & South Rivers Watershed



*Results

I repeated my Iterator using the NSRW Basin as both a Clip and an Erase, then merged the results, so I could compare the land use inside and outside the watershed.

I found that only Scituate, Marshfield and Duxbury have a significantly greater percentage of Open Space within the Watershed than without.

I also found that only Norwell, Hanson, and Abington have a greater percentage of Natural Land Area outside the Watershed than inside it.



I ran an additional series of processes on the Assessor Parcel Layers for each town within the watershed in order to find potential targets for conservation restriction.

I selected:

- -> Vacant Lots (select by attributes "BLDG_AREA"=0)
- -> in Natural Land (Intersect with Natural Land Use layer)
- -> not currently Protected Open Space (Erase with Open Space layer)
- -> adjacent to current Open Space (select by location)
- -> currently owned by Municipal entities (search through attribute table, build a list of queries, select by attributes)
- -> nearby linear hydrological features, certified or potential vernal pools, and rare species habitats. (select by location)



Identifying Properties in the North & South Rivers Watershed for Article 97 Designation

Map by Justin Ivas May 12, 2014 All source data from MassGIS Inset Maps not to scale



















| OBJECTID * | Owner | Hectares | Quality | Address |
|------------|--------------------|----------|---------|---------------------------|
| 1 | TOWN OF MARSHFIELD | 7.17 | 28.69 | MARYLAND STREET REAR |
| 2 | TOWN OF MARSHFIELD | 1.49 | 4.48 | EAMES WAY |
| 3 | TOWN OF MARSHFIELD | 4.39 | 13.16 | CHURCH STREET REAR |
| 4 | TOWN OF MARSHFIELD | 3.66 | 10.97 | UNION STREET REAR |
| 6 | TOWN OF PEMBROKE | 2.07 | 6.22 | TAYLOR STREET |
| 8 | TOWN OF PEMBROKE | 1.4 | 4.21 | BARKER STREET |
| 11 | TOWN OF PEMBROKE | 5.93 | 17.78 | WEST ELM STREET |
| 12 | TOWN OF PEMBROKE | 1.93 | 5.80 | HILLVALE ROAD |
| 14 | SCITUATE TOWN OF | 7.32 | 21.95 | 0 DRIFTWAY |
| 15 | DUXBURY TOWN OF | 8.33 | 25.00 | UNKNOWN |
| 16 | DUXBURY TOWN OF | 2.22 | 6.67 | UNKNOWN |
| 17 | DUXBURY TOWN OF | 4.72 | 14.16 | UNKNOWN |
| 18 | DUXBURY TOWN OF | 1.93 | 5.79 | UNKNOWN |
| 19 | DUXBURY TOWN OF | 4.34 | 13.01 | UNKNOWN |
| 22 | TOWN OF HANOVER | 4.36 | 4.36 | 61 CLARK CIRCLE |
| 23 | TOWN OF HANOVER | 4.4 | 4.40 | PONDEROSA DRIVE |
| 24 | TOWN OF HANOVER | 8.23 | 8.23 | WEST AVE |
| 25 | TOWN OF HANOVER | 6 | 6.00 | HANOVER STREET REAR |
| 26 | HANSON TOWN OF | 4.71 | 4.71 | UNKNOWN |
| 27 | HANSON TOWN OF | 14.02 | 14.02 | 0 WINTER & WHITMAN STREET |
| 28 | TOWN OF PEMBROKE | 5.65 | 5.65 | SUMMER PATH WAY |
| 29 | TOWN OF WHITMAN | 12.58 | 12.58 | BEECH STREET ROCKLAND |
| 31 | DUXBURY TOWN OF | 4.25 | 4.25 | UNKNOWN |







otected Open Space - Basin





*Image Credits: Marshfield Airport, NSRWA, Wikimedia Commons

*Layer Credits: MassGIS







*"For" Iterator 1, 351, 1: Results