

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

EEOS623 – Intro to ArcGIS

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## **Abstract**

This project examines the land use and protected open space in the towns in and around the North & South Rivers Watershed (NSRW). Land use and open space data from MassGIS is categorized, extracted, and analyzed.

The For Iterator process in ArcGIS ModelBuilder is used to run a series of geo-processing functions over: 13 individual town polygons; 12 clipped polygons located inside the NSRW—Cohasset is entirely outside the NSRW; and 12 polygons consisting of the remaining land in the towns outside the NSRW—Hanover is entirely inside the NSRW.

Additionally, parcel data for each town within the NSRW is compared with the land use and open space used to identify potential lots for conservation under Article 97 of the Massachusetts State Constitution.

## **Introduction/Background**

The inspiration for this project comes from a map of the NSRW created by Herb Heidt of MapWorks. The map displays areas of public-access, protected open space within the NSRW in addition to major roads and major hydrological features of the NSRW.

Under Article 97 of the Massachusetts State Constitution, land that is designated as protected for conservation purposes requires a two-thirds vote of the State Legislature, and in many cases, the approval of a majority of voters in the municipality in which the land is located.

Furthermore, many municipalities own undeveloped, vacant land designated as general purpose, without necessarily an intended purpose for these parcels. In Norwell, MA, land can easily be repurposed for conservation—10 signatures are required to bring an article before a town meeting, and the decision is made by town voters, not by any individual or elected committee.

The idea of this project is to establish a candidate list of vacant, non-protected, town-owned, “natural” land within the NSRW that is adjacent to land already designated protected open space, and to then rank the candidates by size and proximity to natural resources. Logic dictates that lots with the aforementioned quality should pass a majority decision with ease. The final goal, of course, is to add more protected open space to the map which inspired the project.

## **Methods –Part I**

For the first part of the project, datalayers used (all from MassGIS) were the following: Sub-Basins; Towns; Land Use layers for Plymouth & Norfolk counties; Statewide Open Space; and MassDEP Hydrology 25k. Individual towns with land in or around the NSRW are selected, and used to clip the other datalayers to reduce excess data. The towns are merged and assigned a local ID number, 1-13.

Three categories of Open Space are selected & dissolved for further examination: 1-Town owned Open Space; 2-Open Space owned by Land Conservation Trusts or Conservation Organizations; and 3-all protected Open Space.

Six more categories of Land Use are selected and dissolved for further examination: 4-Natural; 5-Agricultural; 6-Residential; 7-Recreational; 8-Developed; and 9-Water. [See Appendix A for the table of Land Use Codes used]

The For Iterator process is then used to perform the following functions on each of the nine above categories for each of the 13 towns. A town is selected by Local ID number, given a new field for area in hectares, and the area field is calculated with the Python 9.3 script “!shape.area@hectares!”. Then, the selected town is used as a clip for all nine categories. Each layer is assigned a corresponding area field, which is then calculated. A corresponding Local ID field is also assigned. The area fields from the layer clips are then joined to the current town layer, based on the Local ID field.

When the Iterator completes, the 13 output files are merged, and can then be symbolized with any of the nine area attributes normalized by the town area field, in order to be displayed as a percentage or ranking of percentages. [\[See Appendix B for the resulting data of this Iterator\]](#)

The Iterator is then used to perform the same processes, using the clipped area of the towns within the NSRW, and the erased area of the towns outside the NSRW. The three final datasets can then be displayed side-by-side, demonstrating some minor differences in results when the analysis is more in-depth.

## **Methods-Part II**

For the second part of the project, parcel data for each town within the NSRW is analyzed. First, vacant land in a town is selected using the query “BLDG\_AREA=0”. Next, the selected land natural land use layer from the first part of the project is used to clip the vacant lots data, and the open space layers is used to erase the resulting dataset of vacant lots, to select only “natural” land, and to eliminate land which is already protected.

Next, the resulting data is selected by proximity (within 100m) to a linear feature of the NSRW hydrology layer. The hydrology layer, which includes intermittent streams and lesser features, is used instead of the Rivers & Streams layer, since the list of candidate lots need not be artificially short.

Then, the owner field of the dataset is examined, to generate a series of strings (data) representing only town-owned land. The list is very long, and includes any variations and misspellings noticed in the attribute list (Example: “TOWN OF HANOVER”, “HANOVER, TOWN OF”, & “TOWN OF HANNOVER”).

The list of strings is used to query the dataset, extracting only town-owned land. The list of candidates is further narrowed down by examining the Department of Revenue Land Use Codes and selecting only parcels coded for City Council/Selectmen/General use (930/9300/931/9310), in order to not select land used for sports fields, campgrounds, etc. The vacant lots table is given an area field which is then calculated. The vacant lots table is then given a “rank” field.

Using the Certified- and Potential- Vernal Pools layers and the NHESP Priority Habitats of Rare Species layer from MassGIS, the target lots are assigned ranks. The one lot containing a Certified Vernal Pool is given a ranking of 4. The lots overlapping an NHESP Priority Habitat are given a ranking of 3. The lots containing a Potential Vernal Pool (there were none) would be given a ranking of 2. All other lots are given a ranking of 1.

The resulting parcels are then researched using online assessors’ databases in order to eliminate any lots which may be owned by Conservation Commissions but have not yet been added to the Open Space layer. Several target lots in the Cedar Swamp of Pembroke are owned by the Pembroke Conservation Commission and are eliminated. A landfill and vacant land adjacent to a wastewater/sewage treatment plant are also discovered and eliminated. The Parcel ID data for lots in the town of Duxbury is difficult to parse and will require further investigation.

Another field is then assigned & calculated—The area (in hectares) of the lot is multiplied by the rank, in order to give smaller parcels near natural resources a higher value while not eliminating larger parcels which are not near natural resources.

## **Results**

The final candidate list of target lots consists of 22 parcels in the towns of Marshfield, Pembroke, Scituate, Duxbury, Hanson, and Rockland. The parcel in Rockland, oddly enough, is owned by the Town of Whitman, and is quite large—nearly 13 hectares. The best candidate is located off Maryland Street in Marshfield, adjacent to Two Mile Farm, which is owned by The Trustees of Reservations. Other good candidate lots include an area on the Driftway (First Herring Brook) in Scituate, which already has some open space, an area off West Elm Street in Pembroke, and a large, 14 hectare parcel in Hanson near the Whitman line. [\[See Appendix C for the full list of candidates\]](#)

No candidates were identified in Norwell, which is not surprising, since Debbie Lenahan, a Director of the North & South Rivers Watershed Association, previously examined Assessor's data in Norwell and succeeded in designating much of the general-purpose land in Norwell as protected under Article 97. This is reflected in the Open Space & Land Use analysis maps—Norwell is in the 9<sup>th</sup> Duo-decile overall in the town-by-town analysis of Open Space, and is in the 12<sup>th</sup> (best) Duo-decile overall in the town-by-town analysis of Natural Land.

### **Conclusion/Future Work**

The results of the land use and open-space analysis indicate that some towns do better in regards to natural land and conservation inside the watershed, and some towns do better outside the watershed. The existence of Wompatuck State Park, a nearly 1500 hectare are of protected land located mostly in Hingham, with sections in Cohasset, Scituate, and Norwell, somewhat skews the analysis.

Rockland, Weymouth, and Abington do poorly, as these towns have a significantly higher population density than the rest of the towns examined. Weymouth and Abington, however, do not have much are inside the watershed at all. Rockland should be a high-priority town for finding land to protect—unfortunately, the only candidate in Rockland is owned by the Town of Whitman, which could make the legislation more complex.

Hanover, the one town located entirely within the NSRW, does about average overall. However, when not compared to towns with little or no area in the NSRW, Hanover ends up toward the bottom of the list in regards to both Natural Land and Open Space. Four candidates (although relatively low-ranked) are identified in Hanover, so Hanover may be the best town to focus on.

The next step is to approach the Hanover Conservation Commission or a resident of the Town of Hanover with an interest in conservation, and ask them to gather the signatures required to put a motion before the next town meeting. With any luck, Mr. Heidt may soon have to add a few more properties to his map of the North & South Rivers Watershed.

**Appendix A – Iterator Results**

Identification Fields			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

**Appendix B – Land Use Codes**

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

**Appendix C – Candidate List**

IDs		Relevant Information					Assessors' & Land Survey Information			
OBJECTID	TOWN_ID	OWNER1	Hectares	Rank	Rank Times Area	Address	MAP_PAR_ID	MAP_NO	LS_BOOK	LS_PAGE
1	171	TOWN OF MARSHFIELD	7.17	4	28.69	MARYLAND STREET REAR	B12-01-03	B12		
15	82	DUXBURY TOWN OF	8.33	3	25.00	UNKNOWN	8.201E+14	10	15653	299
14	264	SCITUATE TOWN OF	7.32	3	21.95	O DRIFTWAY		59		726
11	231	TOWN OF PEMBROKE	5.93	3	17.78	WEST ELM STREET		B14		
17	82	DUXBURY TOWN OF	4.72	3	14.16	UNKNOWN	8.209E+14	90	13453	345
27	123	HANSON TOWN OF	14.02	1	14.02	O WINTER & WHITMAN STREET	98_0_15_0	98	38411	206
3	171	TOWN OF MARSHFIELD	4.39	3	13.16	CHURCH STREET REAR	G14-01-22	G14		
19	82	DUXBURY TOWN OF	4.34	3	13.01	UNKNOWN	8.21E+14	100	1651	490
29	251	TOWN OF WHITMAN	12.58	1	12.58	BEECH STREET ROCKLAND	78-0-009	78	6067	119
4	171	TOWN OF MARSHFIELD	3.66	3	10.97	UNION STREET REAR	C11-02-93	C11	36939	323-32
24	122	TOWN OF HANOVER	8.23	1	8.23	WEST AVE		35	22119	303
16	82	DUXBURY TOWN OF	2.22	3	6.67	UNKNOWN	8.207E+14	70	30709	345
6	231	TOWN OF PEMBROKE	2.07	3	6.22	TAYLOR STREET	G9-1	G9		
25	122	TOWN OF HANOVER	6	1	6.00	HANOVER STREET REAR	48_17	48	18353	245
12	231	TOWN OF PEMBROKE	1.93	3	5.80	HILLVALE ROAD		E13		
18	82	DUXBURY TOWN OF	1.93	3	5.79	UNKNOWN	8.209E+14	90	13929	325
28	231	TOWN OF PEMBROKE	5.65	1	5.65	SUMMER PATH WAY		B13	29046	259
26	123	HANSON TOWN OF	4.71	1	4.71	UNKNOWN	98_0_10_0	98	15577	323
2	171	TOWN OF MARSHFIELD	1.49	3	4.48	EAMES WAY	F14-02-09	F14		
23	122	TOWN OF HANOVER	4.4	1	4.40	PONDEROSA DRIVE		13	27228	163
22	122	TOWN OF HANOVER	4.36	1	4.36	61 CLARK CIRCLE	75_15	75	14974	345
31	82	DUXBURY TOWN OF	4.25	1	4.25	UNKNOWN	8.207E+14	70	22788	6
8	231	TOWN OF PEMBROKE	1.4	3	4.21	BARKER STREET		D11		