Land Use and Land Cover
Onondaga Creek Fact Sheet

INTRODUCTION

'Land Use' (LU) refers to *human* land use. Land use terminology tends to describe economic activity, and reflects cultural influence on the environment. The term 'Land Cover' (LC) is distinct from, but related to 'Land Use' by the fact that it describes material on the land surface rather than the activity. Land cover refers to both anthropogenic cover such as a building, and to naturally occurring cover such as a forest. Land Use is the interface between human society and the environment, and it can lead to changes in Land Cover. Together they are commonly referred to as LU/LC.

Humans have always settled near sources of water. As the population density has increased, and as technology allows more extreme modifications of the environment, human impacts have severly impacted the structure and reduced the functioning of natural waterways. In order to mitigate adverse impacts of altered land cover, it often becomes necessary to change land use.

Land use forms patterns on the landscape that typically reflect the most profitable economic land use; often with disregard for environmental consequences. In studying land use patterns within the Onondaga Creek Watershed we can see how the arrangement of the physical geography and the creek corridor determines the economic 'utility' of the land, which in turn determines where certain land use activities occur.

FINDINGS

The Sub-Watersheds of Onondaga Creek

There are four major subwatersheds within the Onondaga Creek watershed:

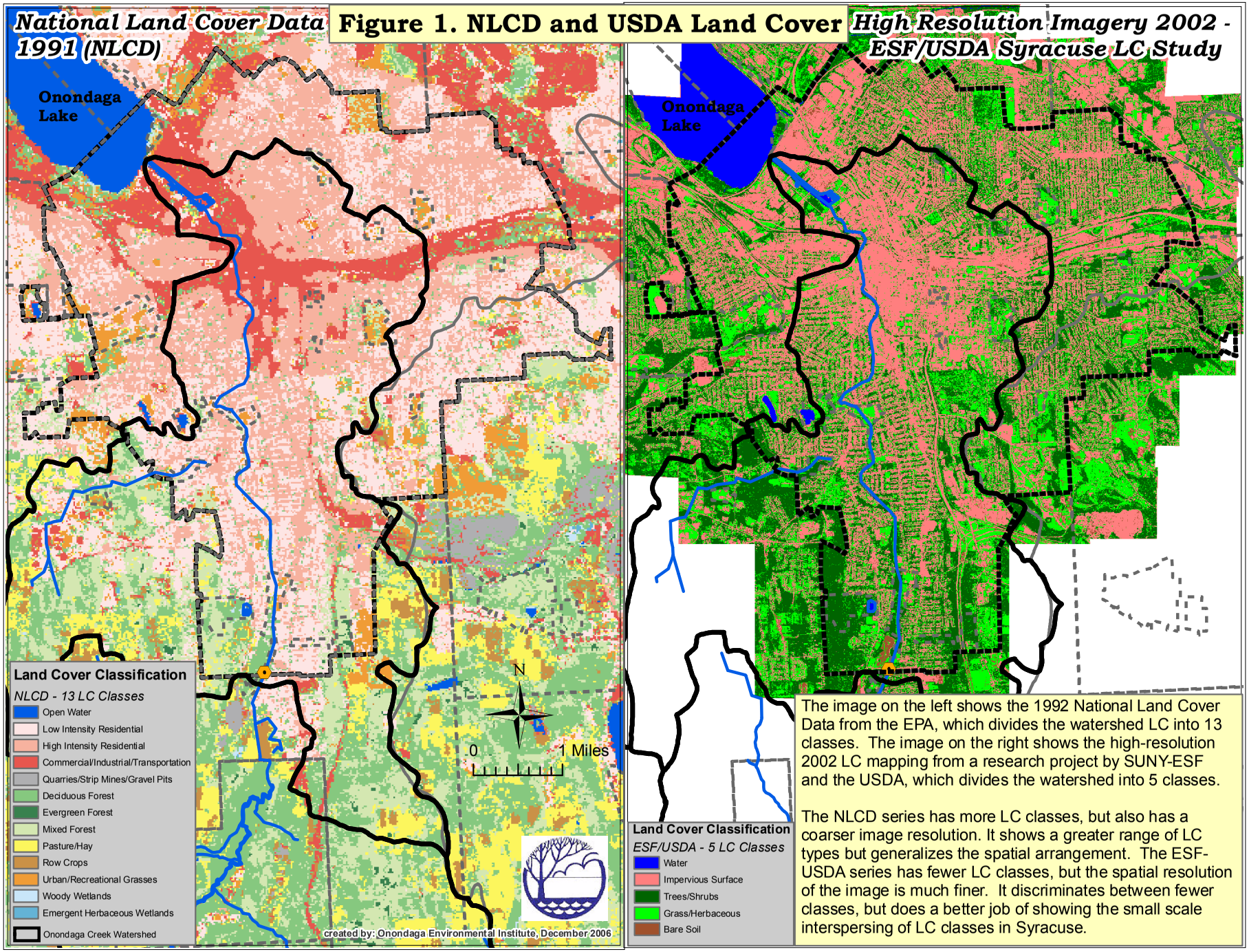
1. Upper Onondaga Creek: Tully Valley
2. Middle Onondaga Creek: Onondaga Nation and Nedrow
3. West Branch
4. Syracuse

The Upper Onondaga, Middle Onondaga, and West Branch subwatersheds are mainly put to agricultural and residential use, with the Middle Onondaga subwatershed also containing a majority of the Onondaga Nation's land. The Syracuse subwatershed is a mix of low and high intensity residential land use in the south part of the subshed and becomes high intensity commercial and industrial land use in the northern downstream part of the subshed.

Land Use and Land Cover Patterns Land cover echoes the land use pattern. Figure 1 shows land cover images of the city of Syracuse, created a decade apart in 1992 and 2002. The land cover map on the left side of Figure 1 was created using the EPA National Land Cover Data (NLCD) from 1992. The image on the right used high resolution imagery from the USDA taken in 2002. This image illustrates how land cover classification can be based upon different resolution images and using different classification criteria, yet the same basic pattern emerges.

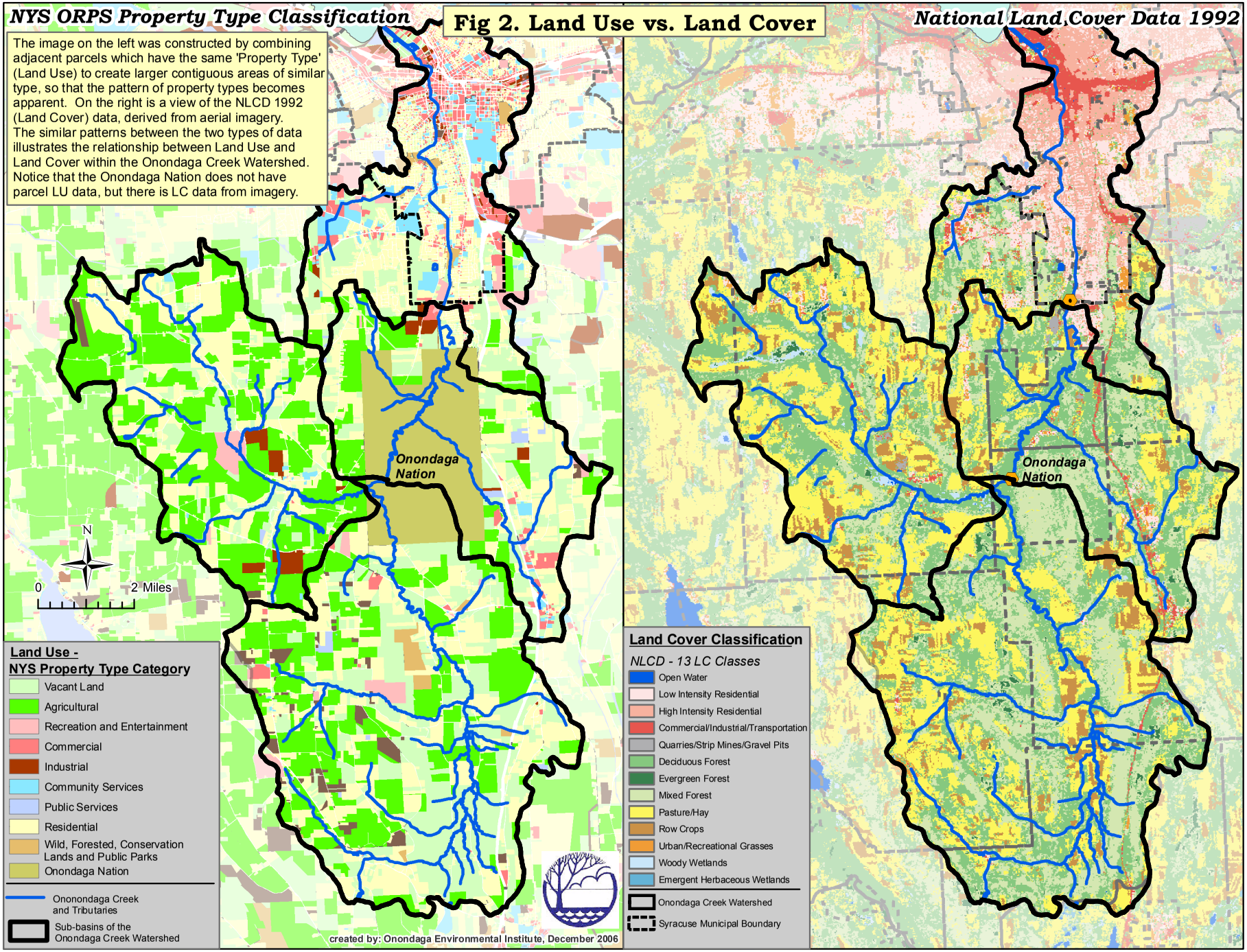
The side-by-side map in Figure 2 contrasts land use on the left with land cover on the right. The Upper, Middle, and West Branch subwatersheds have very similar land use and land cover patterns, while development within the Syracuse subshed is substantially different.

Urban versus rural land use is the major distinction between the upper watershed in Tully to the lower watershed where Onondaga Creek empties into the Lake. The land in the upper watershed is rural and the pattern is one of larger plots of land used for agriculture, left vacant, wooded, or increasingly, residential. The parcels on this map are colored by NYS Office of Real Property Services (ORPS) land use 'property type'. Note that since the real property data is updated periodically, the information may **not** be counted on to be absolutely accurate for any one parcel at any one time. When viewed as a group however the trends in data are reliable. Much of the Onondaga Creek watershed is in municipalities that update their assessment inventory every 1 or 3 years, so it is estimated that about 85% of the parcel records for Onondaga County are current and accurate at any one time (Karen Karney, Onondaga County Office of Real Property Tax Services, pers. comm.).



The image on the left shows the 1992 National Land Cover Data from the EPA, which divides the watershed LC into 13 classes. The image on the right shows the high-resolution 2002 LC mapping from a research project by SUNY-ESF and the USDA, which divides the watershed into 5 classes.

The NLCD series has more LC classes, but also has a coarser image resolution. It shows a greater range of LC types but generalizes the spatial arrangement. The ESF-USDA series has fewer LC classes, but the spatial resolution of the image is much finer. It discriminates between fewer classes, but does a better job of showing the small scale interspersing of LC classes in Syracuse.


NYS ORPS Property Type Classification
Fig 2. Land Use vs. Land Cover
National Land Cover Data 1992
The image on the left was constructed by combining adjacent parcels which have the same 'Property Type' (Land Use) to create larger contiguous areas of similar type, so that the pattern of property types becomes apparent. On the right is a view of the NLCD 1992 (Land Cover) data, derived from aerial imagery. The similar patterns between the two types of data illustrates the relationship between Land Use and Land Cover within the Onondaga Creek Watershed. Notice that the Onondaga Nation does not have parcel LU data, but there is LC data from imagery.
Onondaga Nation
Onondaga Nation
N
0
2 Miles
Land Use - NYS Property Type Category
Vacant Land
Agricultural
Recreation and Entertainment
Commercial
Industrial
Community Services
Public Services
Residential
Wild, Forested, Conservation Lands and Public Parks
Onondaga Nation
Onondaga Creek and Tributaries
Sub-basins of the Onondaga Creek Watershed
created by: Onondaga Environmental Institute, December 2006
Land Cover Classification
NLCD - 13 LC Classes
Open Water
Low Intensity Residential
High Intensity Residential
Commercial/Industrial/Transportation
Quarries/Strip Mines/Gravel Pits
Deciduous Forest
Evergreen Forest
Mixed Forest
Pasture/Hay
Row Crops
Urban/Recreational Grasses
Woody Wetlands
Emergent Herbaceous Wetlands
Onondaga Creek Watershed
Syracuse Municipal Boundary

The side-by-side maps in Figure 2 show a land cover pattern which follows that of land use, thereby demonstrating the empirical relationship between land use and land cover. At the northern part of the watershed, from Nedrow through Syracuse, the pattern becomes urban. Lot sizes are much smalleer in the urban areas than parcels in the southern rural part of the watershed.

Within the city of Syracuse there are two distinct types of urban areas. From Nedrow to Syracuse's central business district (CBD) the land use is predominately residential and this is where the greatest density and number of people live near the creek. Onondaga Creek then flows through the CBD urban area of Syracuse, with less tree canopy and more impervious hard surfaces. The CBD is active during business hours but few people reside downtown. So not only is the land cover different amongst the urbanized areas, but the times when the heaviest human activity occurs are also different.

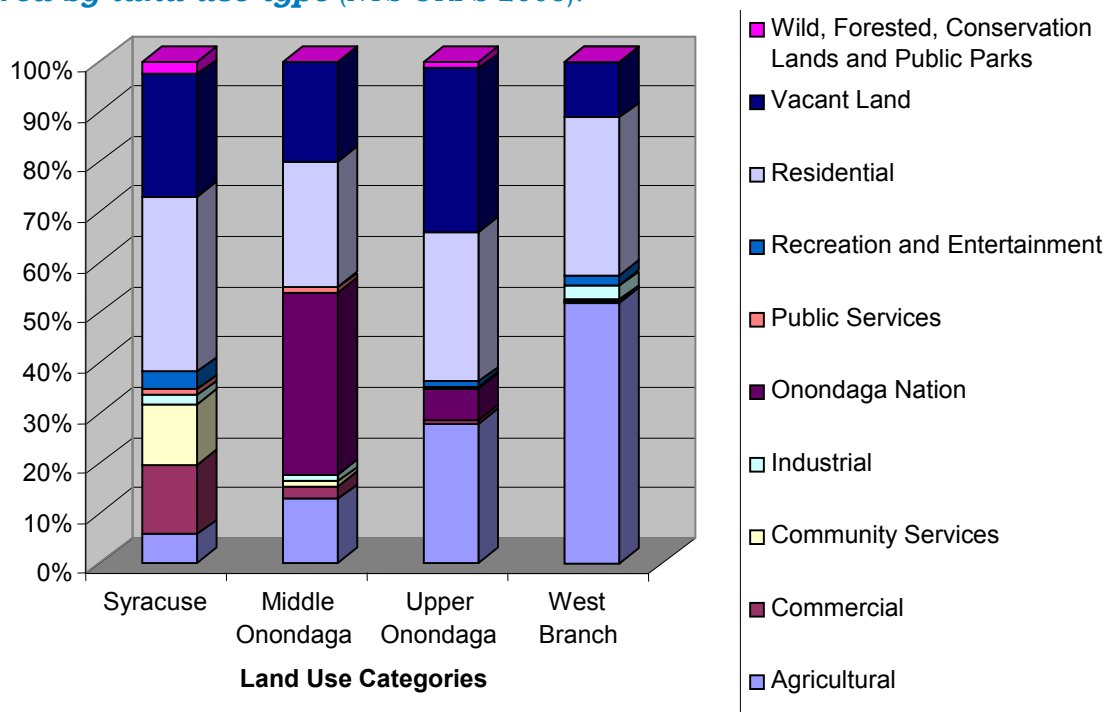
Variations within Land Use Types Different land use types possess different dynamics. Table 1 breaks down the four subwatersheds of Onondaga Creek by ORPS land use categories. Figure 3 shows this same information in graph form. Agricultural land use for economic production of crops or livestock is probably dependent on some economy of scale where a farm must be of a certain size to be profitable. According to Table 1, irrespective of which Onondaga Creek subwatershed,the average agricultura parcle size is about 40 acres.

Residential land use, on the other hand, has a parcel size that varies with the density of development within the subwatersheds. Thus, residential parcels are an average size of 0.25 acres in the Syracuse subwatershed, and range up to 8.05 acres on average in the upper watershed in the Tully Valley. Table 1 provides evidence that the vast majority of commercial activity is located in the city of Syracuse, with 2,935 commercial parcels vs. 77 commercial parcels in the Middle Onondaga Creek subwatershed, which is the next most commercially developed subwatershed. Consequently, commercial land use in Syracuse is likely a regional resource and probably generates trips between the city and surrounding areas. Thus, how a community is structured can determine how it functions, in particular, based upon the arrangement and allocation of land to particular land uses.

Land Cover Impacts of Land Use Types An understanding of land use pattern helps us establish relationships between land cover and water quality in Onondaga Creek and its tributaries.

Land is typically cleared for agricultural and residential use, as is much of the upper watershed and West Branch watershed. Forest canopy has been removed and replaced with expanses of a single type of plant, such as turf or rows of the same crop. Fertilizer and herbicides can runoff more easily due to reduced tree cover, tilling the soil can increase sediment mobility, and animal waste can more easily reach the creek.

Figure 3. Relative percentages of Onondaga Creek subwatershed area by land use type (NYS ORPS 2005).



Land Use (NYS ORPS)	Number of Parcels	Total Acres	Avg Parcel Size	% of SubShed
Syracuse	**22,241**	**11,284.657**	**0.51**	**100.00%**
Agricultural	16	648.865	40.55	5.75%
Commercial	2,935	1,560.222	0.53	13.83%
Community Services	349	1,366.357	3.92	12.11%
Industrial	86	186.842	2.17	1.66%
Public Services	63	132.717	2.11	1.18%
Recreation and Entertainment	41	413.793	10.09	3.67%
Residential	15,959	3,933.335	0.25	34.86%
Vacant Land	2,736	2,745.786	1.00	24.33%
Wild, Forested, Conservation Lands and Public Parks	56	296.740	5.30	2.63%
Middle Onondaga Creek, Onondaga Nation, and Nedrow	**1,868**	**12,260.323**	**6.56**	**100.00%**
Agricultural	38	1,558.934	41.02	12.72%
Commercial	77	320.224	4.16	2.61%
Community Services	17	113.296	6.66	0.92%
Industrial	8	171.952	21.49	1.40%
Onondaga Nation	3	4,433.851	1477.95	36.16%
Public Services	14	119.310	8.52	0.97%
Recreation and Entertainment	9	43.495	4.83	0.35%
Residential	1,332	3,061.396	2.30	24.97%
Vacant Land	369	2,433.893	6.60	19.85%
Wild, Forested, Conservation Lands and Public Parks	1	3.972	3.97	0.03%
Upper Onondaga Creek Tully Valley	**1,568**	**24,885.627**	**15.87**	**100.00%**
Agricultural	167	6,915.264	41.41	27.79%
Commercial	17	172.827	10.17	0.69%
Community Services	21	27.574	1.31	0.11%
Industrial	1	1.694	1.69	0.01%
Onondaga Nation	1	1,519.493	1519.49	6.11%
Public Services	10	105.069	10.51	0.42%
Recreation and Entertainment	5	276.638	55.33	1.11%
Residential	918	7,390.454	8.05	29.70%
Vacant Land	414	8,119.412	19.61	32.63%
Wild, Forested, Conservation Lands and Public Parks	14	357.201	25.51	1.44%
West Branch	**1,533**	**15,993.091**	**10.43**	**100.00%**
Agricultural	193	8,298.157	43.00	51.89%
Commercial	10	31.324	3.13	0.20%
Community Services	17	67.775	3.99	0.42%
Industrial	7	441.599	63.09	2.76%
Public Services	9	27.686	3.08	0.17%
Recreation and Entertainment	3	309.933	103.31	1.94%
Residential	1,036	5,017.701	4.84	31.37%
Vacant Land	258	1,798.917	6.97	11.25%

Table 1. Onondaga Creek subwatersheds information based on land use type.

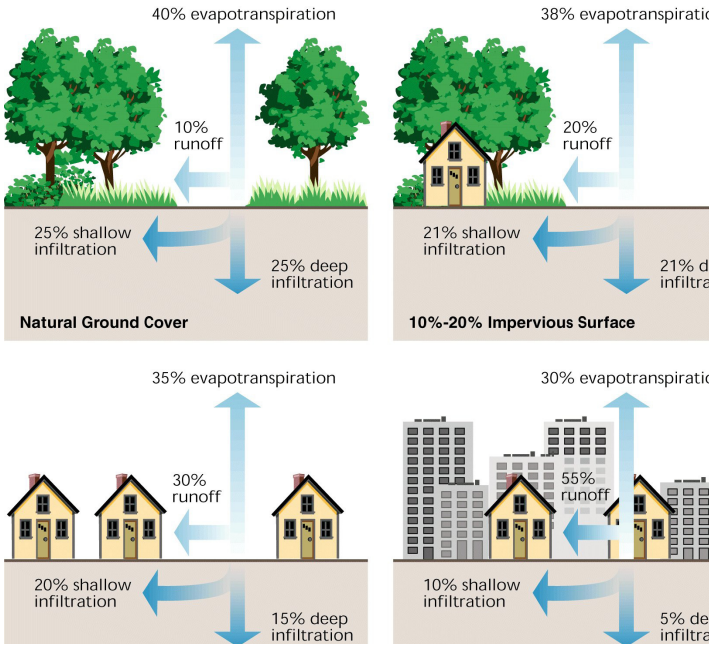
Monocultures of turf or crops reduce habitat diversity and the variety of wildlife that can be supported, which affects the riparian and aquatic food web[1]. Little or no buffer of natural vegetation in the riparian corridor allows runoff to carry pollutants and excess nutrients unimpeded to the creek.

Rural residential development in the upper watershed means adding houses, roads, driveways, wells, and septic systems to the environment. The impervious surfaces of roofs and roads reduce or prevent precipitation from percolating into the ground, and the impervious surfaces also dramatically increase the speed with which water can travel over the surface of the land in the form of runoff, eventually reaching surface waters. Both of these impacts of impervious surfaces eliminate the filtering effect of well-vegetated land cover. See Figure 4[2], which illustrates the effect of increasing impervious cover.

1 FISRWG, 1998, Stream Corridor Restoration: Principals, Processes, and Practices, p 3-14.
2 Ibid., p 3-22.

Figure 4. "Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface runoff. As little as 10 percent impervious cover in a watershed can result in stream degradation."

(Image and caption: FISWRG, 1998, p. 3-23.)



Roads are impervious networks that act as non-point sources of rubber, oil, and petroleum from vehicles, and salt that is applied in the winter. Roads can have deleterious effects on surface waters.

Slope of the land influences how land use affects water quality. Vegetative land cover, even turf and crops, are better at slowing runoff, and provide better ground water recharge, than impervious surfaces such as roads and roofs. However, the slopes of the valley walls in the upper watershed are steep in comparison to the valley floor, and the urbanized areas of Syracuse are even flatter. The steep slopes in the upper watershed cause runoff to travel more quickly, which causes greater erosion and less opportunity for the water to percolate into the ground. The time needed for runoff to reach its discharge or collection point is called the *concentration time.* Short concentration time, as results from steep slopes and large amounts of impervious cover, results in a 'flashy' hydrograph where water levels in streams can rise quickly.

Steep slopes in the Tully Valley account for fast concentration times and therefore, it becomes important to minimize certain types and densities of land use in order to minimize the amount of impervious surfaces, and even more important to insure sufficient riparian buffer exists to slow and filter runoff before reaching the creek.

Land use mix and similar uses The range and pattern of human land uses is not random. Landform, geology, and location are important factors which determine land use. Soils, slope, surface water, and the distance to other related land uses are strong determinants of how a particular piece of land will be used. Since two adjacent parcels of land are more likely to share the same slope, soils, and other factors than two distant parcels of land, it stands to reason that adjacent parcels will likely be suitable for similar land uses. This is why land use patterns commonly show areas that are primarily residential, or that are primarily commercial, industrial, agricultural, and so on.[3]

3 The concept that human use among near parcels of land are more similar than that of distant parcels is refered to as *proximal homogeneity.*

Land use planning and zoning Land use planning is the purposeful application of the principal that parcels of land near each other are more likely to be similar, and suited for similar land use, than parcels that are far from each other. This principle is used to establish 'zones' of similar land use, or of an array of suitable or permissible land uses. It logically assumes that adjacent land will have similar suitability for use and a group of adjacent parcels can therefore be regulated as a district or 'zone'.

Wise land use planning takes into account the environmental conditions of soils, slope, water, geology and other natural factors; and the economic and social arrangement of related, dependent, or conflicting land uses; in order to determine the most suitable social use of the land while maintaining ecosystem health and function. If a narrow set of criteria is used in selecting a use for a land parcel then it can lead to a loss in one of the other unconsidered factors. Past land use decisions have often emphasized the economic criteria, with resultant environmental degradation and diminished ecological function. Later generations have had the burden of correcting, as best is possible, the poor land use decisions of the past. This is part of the legacy of Onondaga Creek today – land use decisions in the past, made with only economic and human centric criteria as a guide, have resulted in an impacted stream ecosystem.

Today we have a deeper understanding of the balance needed between mankind's use of the land and the requirements for sustainable natural ecological function within a watershed. In order to revitalize Onondaga Creek we will have to change the land use and the resultant land cover within the watershed, with particular emphasis on those areas closer to the creek, on steep slopes, or having a large degree of impervious cover.

REFERENCES

Federal Inseragency Stream Resoration Working Group (FISRWG) (Oct. 1998) *Stream Corridor Restoration: Principals, Process, Practices*. National Technical Information Service.

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The Onondaga Lake Partnership (OLP) sponsors the Onondaga Creek Revitalization Plan project with funds from the U.S. Environmental Protection Agency. Visit www.onlakepartners.org for more information about the OLP.

This fact sheet and additional information about the Onondaga Creek Revitalization Plan project can be found on the World Wide Web at www.esf.edu/onondagacreek/.