UNIVERSITY OF FLORIDA
IFAS EXTENSION

CIR 1448

Florida Springs Land Use Information Tool[1]

Thomas Obreza[2]

Blue Springs, Gilchrist County, Florida
Photo taken by Greg Means, UF Soil and Water Science Dept.

1. This document is CIR 1448, a circular of the Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date: April 2004. Visit the EDIS Web Site at **http://edis.ifas.ufl.edu**.
2. Thomas Obreza, Professor, Soil and Water Science Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611-0290.

Florida Springs Land Use Information Tool

Table of Contents

Introduction

Guidelines for Using the Information

Data Sources

Section 1: Nitrogen

Section 2a: Water Consumption – Agriculture and Horticulture

Section 2b: Groundwater Consumption – Residential

Section 3: Nitrogen Measured in Runoff

Section 4: Simulated Nitrogen Loading to Groundwater

Section 5: Simulated Effect of Best Management Practices (BMPs) on Nitrogen Loading to Groundwater

Section 6: Relative Pesticide Use

Section 7: Availability of Best Management Practices

Section 8: Glossary

Appendix: Land Uses Found Within the Florida Springs Study Area

Land Use Information Tool

Introduction

Purpose of this publication: To provide information about how land use influences the amount of nitrogen that may be imported as fertilizers or soil amendments, the amount of nitrogen that may be exported in the harvested portion of a crop, the amount of water that may be consumed, and the relative pesticide loading.

Intended audiences: State and local governments, land use planners, policymakers, consultants, land owners, and educators.

Scope: The information presented here applies to the "springs" area of north Florida. Florida's springs are classified by their average output (Table 1). Forty-one of Florida's 67 counties contain at least one 4th magnitude or greater spring. First magnitude springs are found in 20 north and north-central counties (Fig. 1). The defined study area for this project was comprised of the 35 counties listed in Table 2 and illustrated in Fig. 2.

Table 1. Classification system for springs according to average discharge.

Magnitude	Average flow	
	cubic ft per second	million gallons per day
1	100	65
2	10 – 100	6.5 – 65
3	1 – 10	0.65 – 6.5
4	< 1	< 0.65

Table 2. Florida counties defining the project study area.

Alachua	Dixie	Jackson	Madison	Suwannee
Bay	Gadsden	Jefferson	Marion	Taylor
Bradford	Gilchrist	Lake	Orange	Union
Calhoun	Gulf	Lafayette	Pasco	Volusia
Citrus	Hamilton	Leon	Putnam	Wakulla
Clay	Hernando	Levy	Seminole	Walton
Columbia	Holmes	Liberty	Sumter	Washington

Land uses within the study area were acquired using GIS coverages obtained from the Florida Geographic Data Library. Individual land use data files were generated by the Northwest, Suwannee River, and St. John's Water Management Districts. Most data were acquired between 1995 and 1999, with the Suwannee River Water Management District counties updated in 2002. A summary of land uses found is shown in the Appendix.

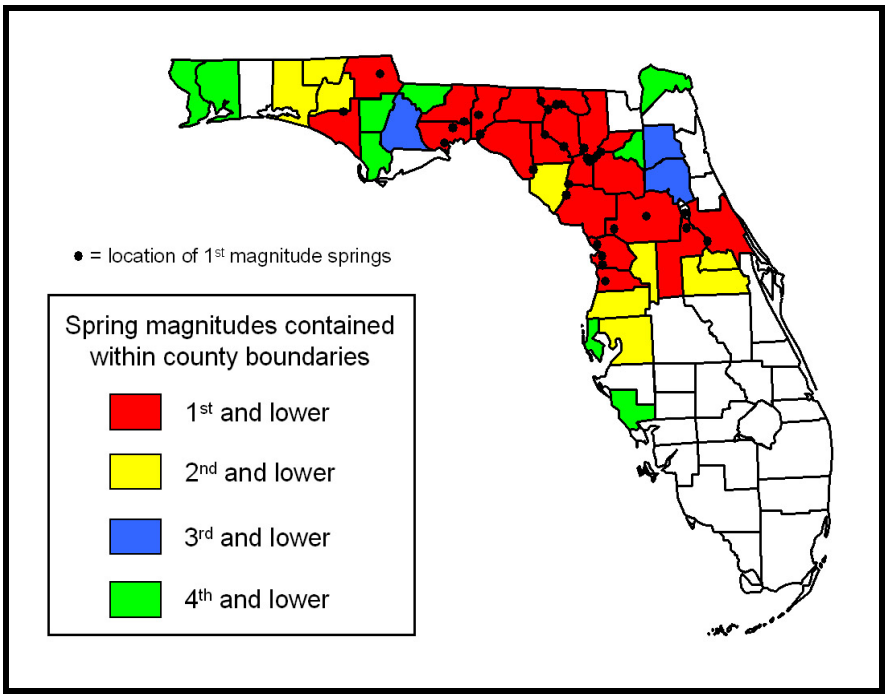

Fig. 1. Locations of Florida's springs.

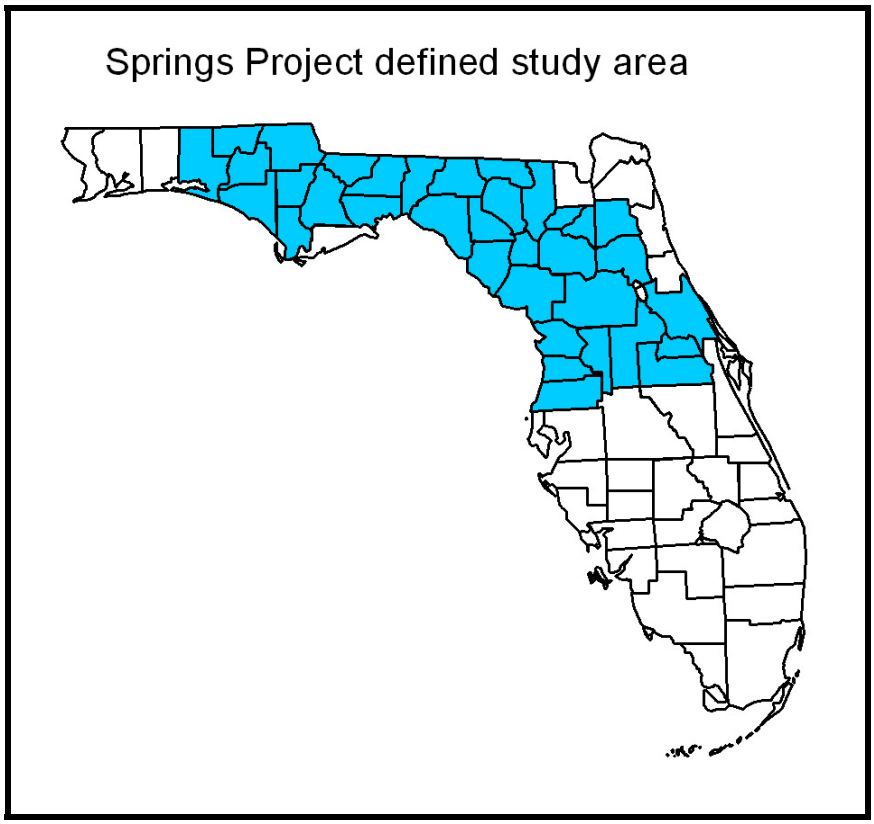

Fig. 2. The defined study area for this publication (35 counties).

Land Use Information Tool

Guidelines for Using the Information

Please review these guidelines before using the information.

Intent of the Tool

The intent of this tool is to provide information about how land use influences:

- The rate of nitrogen that may be applied to the land as fertilizers or soil amendments (nitrogen "imports").
- The rate or amount of nitrogen that may be removed from the land in the harvested portion of a crop (nitrogen "exports").
- The amount of water that may be consumed.
- The relative pesticide loading.

Nitrogen movement to groundwater is site-specific (Sections 1 and 2)

Knowing only nitrogen imports/exports and water consumption does not allow one to make valid comparisons between different land uses regarding contamination of groundwater by nitrate. Although these factors are important, they are only two components of nature's highly complex nitrogen cycle (Fig. 3).

What else can happen to nitrogen besides leaching to groundwater?

- Plants can absorb it.
- It can go off into the atmosphere as a gas.
- It can become part of the soil organic matter (humus).
- Soil microorganisms can use it.

Assuming that a site in question is within a springshed, other questions must be asked in order to use the information in this tool to help make decisions about it, such as:

- How much of the total land area receives nitrogen imports? For example, in residential areas only a portion of the lawns and landscapes may receive fertilizers.
- What level of management does the site receive? For example, "manicured" lawns and landscapes may receive high nitrogen fertilizer rates, while more "natural" landscapes may receive little or none.
- In the case of areas with septic tanks, what is the population density?
- Does the site receive supplemental irrigation? If yes, what type of irrigation system is used? Nitrogen fertilizer rates may differ depending on irrigation capacity.
- In the case of animal feeding operations, how many animals are there, and is manure exported off site or disposed of on site? If disposed of on site, how much area is available for land application?

Use of Best Management Practices (Section 7)

The key to preventing nitrogen from reaching groundwater lies with land use management. Where nitrogen imports are involved, best management practices (BMPs) have been developed that minimize the potential for groundwater contamination while maintaining economic viability. These BMPs were produced through the cooperative efforts of the Florida Dept. of Agriculture and Consumer Services, the Florida Dept. of Environmental Protection, the Univ of Florida,

Florida's Water Management Districts, and the industries involved. Perhaps the most important function of this tool is to identify the many different land uses for which BMPs exist.

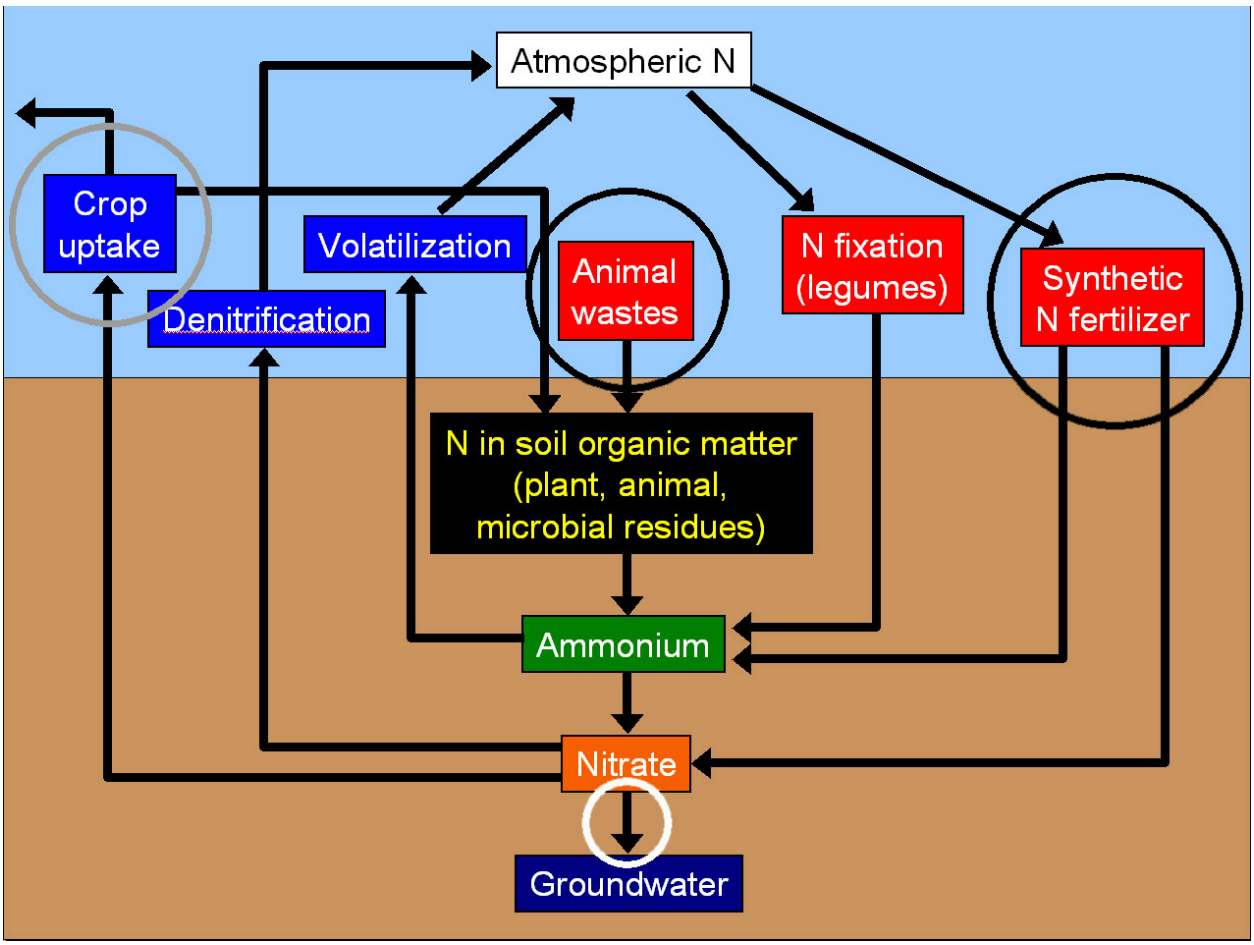

Fig. 3. A much-simplified version of the complex nitrogen cycle.

- **N imports as discussed in this tool are represented by the black circles.**
- **N export as discussed in this tool is represented by the grey circle.**
- **N leaching to groundwater is represented by the white circle.**

Land Use Information Tool

Data Sources

Arnold, C.E. and T.E. Crocker. 1998. Pecan production in Florida. Horticultural Sciences Dept. Circular 280D. Univ. of Florida, Gainesville, FL.

Augustin, B.J. 2000. Water requirements for Florida turfgrasses. Dept. of Environmental Horticulture Bulletin 200. Univ. of Florida, Gainesville, FL.

Blevins, D., H., L. Allen, S. Colbett, and W. Gardner. 1996. Nutrition management for longleaf pinestraw. Woodland Owner Notes No. 30. North Carolina Cooperative Extension Service. North Carolina State Univ., Raleigh, NC.

Crocker, T. E. 1997. Alternative Opportunities for Small Farms: Muscadine Grape Production Review. Horticultural Sciences Dept. fact sheet RFAC 016 (EDIS DLN AC016), Univ. of Florida, Gainesville, FL

Florida Geographic Data Library, University of Florida Geoplan Center.

Florida Dept. of Transportation. 1999. Florida land use, cover and forms classification system handbook, 3rd edition. Surveying and Mapping, Geographic Mapping Section, Florida Dept. of Transportation, Tallahassee, FL.

Harper, H. H. 1994. Stormwater loading rate parameters for central and south Florida. Environmental Research & Design, Inc. Orlando, FL.

Hochmuth, G.L., and D.N. Maynard. 2000. Vegetable Production Guide for Florida. IFAS Publication SP 170. Univ. of Florida, Gainesville, FL.

Hochmuth, G.J., and E.A. Hanlon. 2000. IFAS standardized fertilization recommendations for vegetable crops. Horticultural Sciences Dept. Circular 1152. Univ. of Florida, Gainesville, FL.

Jokela, E.J., and A.L. Long. 2000. Using soils to guide fertilizer recommendations for southern pines. School of Forest Resources and Conservation Circular 1230. Univ. of Florida, Gainesville, FL.

Kidder, G., C.G. Chambliss, and R. Mylavarapu. 2001. UF/IFAS standardized fertilization recommendations for agronomic crops. Soil and Water Science Dept. Fact Sheet SL 129. Univ. of Florida, Gainesville, FL.

Knox, G., T. Broschat, G. Kidder, E. Gilman, L. Trenholm, R. Black, T. Wichman, D. Palmer, R. Zerba, C. White, A. Hunsberger, G. Israel, J. Cisar, K. Ruppert, D. Culbert, C. Kelly-Begazo and S.P. Brown. 2002. Fertilizer recommendations for landscape plants. Environmental Horticulture Dept. Publication ENH 858. Univ. of Florida, Gainesville, FL.

May, J.T. 1984. Nutrients and fertilization. *In* C. W. Lantz (ed.). Southern Pine Nursery Handbook. USDA Forest Service, Atlanta, GA.

Sartain, J.B. 1998. Fertility considerations for sod production. Soil and Water Science Dept. Fact Sheet SL 52. Univ. of Florida, Gainesville, FL.

Sartain, J.B. 2000. General recommendations for fertilization of turfgrasses on Florida soils. Soil and Water Science Dept. Fact Sheet SL 21. Univ. of Florida, Gainesville, FL.

Sartain, J.B., and G.L. Miller. 2002. Recommendations for N, P, K and Mg for golf course and athletic field fertilization based on Mehlich 1 extractant. Soil and Water Science Dept. Fact Sheet SL 191. Univ. of Florida, Gainesville, FL.

Soil and Water Engineering Technology, Inc. (SWET). 1998. GIS watershed assessment final report. Part A – SR-WAM technical reference manual. Soil and Water Engineering Technology, Inc., Gainesville, FL.

United States Geological Survey, Tallahassee, FL.

Van Horn, H.H., D.R. Bray, R.A. Nordstedt, R.A. Bucklin, A.B. Bottcher, R.N. Gallaher, C.G. Chambliss, and G. Kidder. 1993. Water budgets for Florida dairy farms. Dairy Science Dept. Circular 1091. Univ. of Florida, Gainesville, FL.

Van Horn, H. H., G. L. Newton, R. A. Nordstedt, E. C. French, G. Kidder, D. A. Graetz, and C. G. Chambliss. 1998. Dairy manure management: Strategies for recycling nutrients to recover fertilizer value and avoid environmental pollution. Dairy and Poultry Sciences Dept. Circular 1016. Univ. of Florida, Gainesville, FL.

Whitty, E.B., and C.G. Chambliss. 2002. Water use and irrigation management of agronomic crops. Agronomy Dept. Publication SS-AGR-155. Univ. of Florida, Gainesville, FL.

Williamson, J. G., and P. Lyrene. Commercial blueberry production in Florida. IFAS Publication SP 179, Univ. of Florida, Gainesville, FL.

Williamson, J. G., and T.E. Crocker. 2000. Peaches and nectarines for Florida. Horticultural Sciences Dept. Circular 299D. Univ. of Florida, Gainesville, FL.

Land Use Information Tool

Section 1: Nitrogen

Imports and Exports

General comments

1. Imports refer to nitrogen applied as commercial fertilizers, animal manures, biosolids, or wastewater.
2. Import rates are shown in lbs per acre on a treated area basis.
3. Exports refer to nitrogen removed from a site in the harvested portion of a crop.

Land use	Nitrogen imports	Nitrogen exports
Residential and Commercial		
	lbs N per acre per year	lbs N per acre per year
Residential, low and medium density	Lawns: **0 – 220** Landscape Plants: **0 – 264** Septic Tanks**: 5 – 14** lbs N per person per year	**0**
Residential, high density	Lawns: **0 – 220** Landscape Plants: **0 – 264**	**0**
Commercial		
Comments on residential and commercial: 1. Low density residential is less than one dwelling unit per acre. Medium density residential is one to five dwelling units per acre. High density residential is greater than five dwelling units per acre. 2. Nitrogen is imported primarily as fertilizer used in landscape maintenance, plus nitrogen discharged from septic tanks if present. 3. The range of nitrogen fertilization rates for lawns and landscapes represents low to high maintenance.		
Recreation and Golf Courses		
	lbs N per acre per year	lbs N per acre per year
Parks and other recreation areas	Lawns and Landscapes: **See Residential** Athletic Field: **87 – 220**	**0**
Golf Courses	Greens: **174 – 348** Tees: **131 – 261** Fairways: **174 – 218** Rough: **87**	**0**
Comments on parks and golf courses: 1. As the quality of a golf course increases, the nitrogen fertilizer rates applied tend to increase.		

Land use	Nitrogen imports	Nitrogen exports
Pasture and Range		
	lbs N per acre per year	See unit below
Improved Perennial Grass	**120 – 160**	**10 – 41** lbs N per **ton** hay
Bahiagrass Pasture	**50 – 180**	**8 – 27** lbs N per **ton** hay
Unimproved Pasture	**0**	**0** lbs N per acre
Native Range	**0**	**0** lbs N per acre
Comments on pasture: 1. Manure deposition by animals is not included in the nitrogen imports column. 2. The range of nitrogen fertilization rates for pasture represents low to high maintenance. 3. Hay yield must be known before a nitrogen export rate can be estimated.		
Field Crops		
	lbs N per acre per cropping season	See yield unit below
Corn	**210**	**0.8** lbs N per **56-lb bu**
Sorghum	**150**	**1.7** lbs N per **cwt**
Cotton	**60**	**0.03** lbs N per **lb** of seed+lint
Wheat	**80**	**1.2** lbs N per **60-lb bu**
Tobacco	**80**	**1.7** lbs N per **cwt**
Peanuts, Soybeans	**0**	Peanuts: **80** lbs N per **ton** Soybeans: **3.5** lbs N per **60-lb bu**
Tomato, potato, pepper	**200**	**4** lbs N per **ton**
Beans	**60 – 100**	**0.1** lbs N per **28-lb bu**
Cucumbers, Watermelons	**150**	**0.026** lbs N per **cwt**
Comments on field crops: 1. Cropping seasons usually range from 3 to 6 months. 2. Nitrogen imports listed are the maximum recommended fertilizer rates. The actual rate applied by a grower could be more or less. 3. Crop yield must be known before nitrogen export can be estimated. 4. Yield unit abbreviations: bu = bushel; cwt = hundredweight.		
Fruit Crops		
	lbs N per acre per year	See yield unit below
Citrus	**50 – 240**	**0.13** lbs N per **90-lb box**
Peaches	**80 – 100**	**2.4** lbs N per **ton**
Comments on fruit crops: 1. Nitrogen imports listed are the maximum recommended fertilizer rates. The actual rate applied by a grower could be more or less. 2. Crop yield must be known before nitrogen export can be estimated.		

Land use	Nitrogen imports	Nitrogen exports
Animal Feeding Operations		
	See unit below	-----
Cattle Feedlots	**124** lbs N per **1000** lb animal per year	Unknown
Dairy	**234 – 273** lbs N per **1400** lb cow per year	Unknown
Laying Hens	**1.0** lbs N per **4** lb animal per year	Unknown
Broiler Chickens	**0.9** lbs N per **2** lb animal per year	Unknown
Comments on animal feeding operations: 1. The imports in this section represent nitrogen in animal manure production. 2. The number of animals must be known before the total quantity of manure nitrogen imported can be estimated. 3. More information about the feeding operation, particularly where the manure is being applied, must be known before nitrogen export can be estimated.		
Horticulture		
	lbs N per acre per year	See unit below
St. Augustine grass sod	**260**	Unknown
Bahiagrass sod	**180**	Unknown
Leatherleaf ferns	**100 – 350**	**52 – 164** lbs N per acre per year
Vineyards	**100**	**2.2** lbs per **ton**
Comments on horticulture: 1. Nitrogen imports listed are the maximum recommended fertilizer rates. The actual rate applied by a grower could be more or less. 2. For vineyards, crop yield must be known before nitrogen export can be estimated.		
Forestry		
	lbs N per acre per growing cycle	See yield unit below
Pine Tree Nursery	**200**	**125** lbs N per acre
Pine Tree Plantations	**40 – 50** (Young stands) **150 – 200** (Established stands)	Whole tree harvesting: **19** lbs per N acre per year Pine straw harvesting: **2 – 6** lbs N per **1000** lbs of pine straw
Comments on forestry: 1. Established pine tree stands receive the above nitrogen imports once every 6 to 8 years.		

Land Use Information Tool

Section 2a: Water Consumption – Agriculture and Horticulture

General comments

1. Water consumption is comprised of water obtained from a surface or groundwater source; it does not include rainfall.
2. Water consumption data (columns 2, 3, and 4) are from the year 2000, and represent volumes consumed for specific land uses within the Northwest Florida, Suwannee River, St. John's River, and Southwest Florida Water Management Districts.
3. If a wide range in water consumption for a particular land use is shown, it is likely due to a large difference in irrigation system efficiency, e.g. seepage irrigation vs. drip irrigation.
4. Typical water use (right-hand column) is the projected amount of irrigation needed for an average growing season.

Land Use	Water consumption			Typical water use
	Lowest observed	Highest observed	Average	
	gallons per acre per day			
Soybeans	423	677	550	7 in/season
Sorghum	585	621	603	6 in/season
Cotton	521	1156	839	
Peanuts	602	1405	947	7 in/season
Corn	803	1685	1135	12 in/season
Tobacco	1065	1308	1187	7 in/season
Wheat	1029	1420	1225	
All field crops	**584**	**1261**	**946**	
Watermelon	649	1919	1104	10 in/season
Tomato	757	4574	2666	10 in/season
All vegetables	**668**	**2893**	**1463**	
Peaches	2000	2000	2000	
Citrus	1349	3515	2415	15–20 in/year
All fruit crops	**977**	**3505**	**1710**	
Pasture hay	730	1834	1309	
Field-grown ornamentals	1298	2965	2230	
Sod	1002	4675	2474	
Container-grown ornamentals	2299	9638	4912	
Greenhouse-grown ornamentals	2143	9444	5794	
All ornamentals/grasses	**1386**	**2479**	**1875**	
Other grass and landscape	1312	1996	1654	
Golf courses	1845	4374	2506	
All golf course and landscape	**1486**	**2575**	**1916**	
Dairy			175 – 400 gal per animal per day	

Land Use Information Tool

Section 2b: Groundwater Consumption – Residential

General comments

1. Water consumption is comprised of water obtained from groundwater sources only.
2. Data were reported by the US Geological Survey in January, 2003.

County	Population			Groundwater use				Total groundwater use
				Total used		Per capita		
	Total	Public supply	Self supply	Public supply	Self supply	Public supply	Self supply	
				million gal/day		gal/day		mgd
Alachua	217,955	179,118	38,837	28.26	4.12	158	106	32.38
Bay	148,217	129,300	18,917	6.28	2.01	49	106	8.29
Bradford	26,088	8,338	17,750	1.38	1.89	166	106	3.27
Calhoun	13,017	4,224	8,793	0.75	0.93	178	106	1.68
Citrus	118,085	66,234	51,851	13.97	7.20	211	139	21.17
Clay	140,814	100,785	40,029	14.77	4.24	147	106	19.01
Columbia	56,513	21,235	35,278	3.67	3.74	173	106	7.41
Dixie	13,827	4,622	9,205	0.67	0.98	145	106	1.65
Gadsden	45,087	27,632	17,455	3.06	1.85	111	106	4.91
Gilchrist	14,437	1,850	12,587	0.27	1.33	146	106	1.60
Gulf	13,332	10,338	2,994	1.47	0.32	142	107	1.79
Hamilton	13,327	6,366	6,961	0.95	0.74	149	106	1.69
Hernando	130,802	116,025	14,777	20.26	1.41	175	95	21.67
Holmes	18,564	5,860	12,704	1.38	1.35	235	106	2.73
Jackson	46,755	16,348	30,407	2.46	3.22	150	106	5.68
Jefferson	12,902	5,010	7,892	0.72	0.84	144	106	1.56
Lafayette	7,022	1,264	5,758	0.20	0.61	158	106	0.81
Lake	210,528	171,137	39,391	39.92	4.29	233	109	44.21
Leon	239,452	198,937	40,515	35.70	4.29	179	106	39.99
Levy	34,450	11,066	23,384	2.16	3.95	195	169	6.11
Liberty	7,021	2,764	4,257	0.39	0.45	141	106	0.84
Madison	18,733	7,166	11,567	1.65	1.23	230	106	2.88
Marion	258,916	136,842	122,074	27.99	16.42	205	135	44.41
Orange	896,344	813,152	83,192	186.15	8.82	229	106	194.97
Pasco	344,765	275,800	68,965	35.23	4.50	128	65	39.73
Putnam	70,423	23,311	47,112	3.20	4.99	137	106	8.19
Seminole	365,196	339,403	25,793	66.90	2.73	197	106	69.63
Sumter	53,345	28,243	25,102	4.44	4.57	157	182	9.01
Suwannee	34,844	9,393	25,451	1.40	2.70	149	106	4.10
Taylor	19,256	10,289	8,967	1.73	0.95	168	106	2.68
Union	13,442	3,155	10,287	0.36	1.10	114	107	1.46
Volusia	443,343	414,851	28,492	54.90	3.02	132	106	57.92
Wakulla	22,863	9,285	13,578	2.19	1.44	236	106	3.63
Walton	40,601	39,024	1,577	7.35	0.17	188	108	7.52
Washington	20,973	7,565	13,408	1.16	1.42	153	106	2.58
Totals	**4,131,239**	**3,205,932**	**925,307**	**573.34**	**103.82**			**677.16**
Average						**166**	**110**	

Land Use Information Tool

Section 3: Nitrogen Measured in Runoff

Comment

In the 1990s, Environmental Research & Design, Inc. of Orlando compiled results of an extensive literature search and analysis of measured nitrogen loading rates during runoff events from various land uses in central and south Florida (Harper, 1994). The values in this table represent runoff nitrogen (i.e. surface water movement to streams and lakes), not leached nitrogen. However, nitrogen loss from different land uses can still be compared. Note that land uses with greater amounts of impervious surfaces lose more nitrogen to runoff than land uses where water infiltration dominates.

Land use	Mass loading of total N lbs per acre per year
Recreation/Open Space	2.4
Wetlands	4.0
Mining/Extractive	4.9
Agriculture – Row Crops	6.2
Residential, Low Density	6.4
Agriculture – Citrus	6.4
Open Water/Lakes	7.1
Agriculture – General	7.9
Agriculture – Pasture	9.9
Residential, Single Family	10.4
Commercial, Low-Intensity	11.5
Highway	14.8
Industrial	16.1
Residential, Multi-Family	18.8
Commercial, High Intensity	28.7

Land Use Information Tool

Section 4:
Simulated Nitrogen Loading to Groundwater

Comment

In the late 1990s, Soil and Water Engineering Technology, Inc. performed a watershed assessment with respect to water quality for the Suwannee River Water Management District (SWET, 1998). They used mathematical modeling to simulate the relative impacts of different land uses on nitrogen loading to groundwater. The values in this table should be interpreted with caution since they do not represent measured values. However, it is easy to see that some land uses have more of a predicted impact than others.

Land Use	Nitrogen Loading to Groundwater lbs per acre per year
Managed landscapes	11
Agriculture – Sod farm	16
Residential, low density	19
Agriculture – Peach orchard	36
Agriculture – Pecan orchard	36
Agriculture – Row crops	38
Agriculture – Poultry feeding operation	43
Horse farm	46
Agriculture – Blueberries	54
Agriculture – Dairy	62
Animal race tracks	64
Residential, medium density	66
Nursery – Trees	157
Zoo	158
Nursery – Ornamentals	188

Land Use Information Tool

Section 5:
Simulated Effect of Best Management Practices (BMPs) on Nitrogen Loading to Groundwater

Comment

In this exercise, SWET used their simulation model to predict nitrogen loading to groundwater for several land uses in their current condition, and then re-ran the simulation after implementing recommended BMPs (SWET, 1998). The model predicted that by implementing BMPs, the nitrogen loading would be reduced from 17 to 72% compared with the current condition.

Land Use	Nitrogen Loading to Groundwater		
	Existing condition	After implementation of BMPs	Reduction due to BMP implementation
	lbs per acre per year		%
Horse farms	39	11	72
Agriculture – Peach and pecan orchards	42	29	31
Agriculture – Row crops	46	19	59
Agriculture – Poultry feeding operations	46	20	57
Agriculture – Blueberries	59	40	32
Agriculture – Dairy	62	29	53
Residential – Medium density	66	55	17
Nursery – Ornamentals	200	131	35

Land Use Information Tool

Section 6: Relative Pesticide Use

Pesticides include insecticides, miticides, herbicides, and fungicides.

Comment

Pesticides are expensive, so they are used sparingly where the value of the crop or plant production is low. They tend to be applied more where crop value is high or visual aesthetics are important. In general, the more highly-valued the product or plant, the more likely that pesticides will be used.

Rating Scale

None: Pesticides not likely used.
Low: Pesticides applied less than once per month.
Medium: Pesticides applied one to four times per month.
High: Pesticides applied more than once per week.

Land Use	Relative Pesticide Use	Comments
Residential and Commercial	None to Medium	Pesticide application depends on maintenance level desired by landscape manager.
Parks and Recreation	None to Medium	Pesticides more likely to be applied to high maintenance turf situations like athletic fields.
Golf Courses	Medium	As the quality of a golf course increases, the amount of pesticides applied tends to increase.
Pasture and Range	None to Low	Difficult to justify pesticide applications to low value crops.
Field Crops	Low to Medium	Pesticide application depends on crop value and pest pressure.
Fruit Crops	Low	Pesticide application depends on crop value and pest pressure.
Animal Feeding Operations	None to Low	
Horticulture	Medium to High	Pesticide application depends on crop value and pest pressure.
Forestry	None to Low	Difficult to justify pesticide applications to low value crops.

Land Use Information Tool
Section 7:
Availability of Best Management Practices (BMPs)

Comment

BMPs are available for most of the land uses found in the Florida Springs project study area.

Land Use	Applicable BMP manual or publication
Residential and Commercial	Florida Dept. of Environmental Protection. 2002. **Florida Green Industries Best Management Practices for Protection of Water Resources in Florida**. Florida Dept. of Environmental Protection, Tallahassee, FL.
Parks and Recreation	Florida Dept. of Environmental Protection. 2002. **Florida Green Industries Best Management Practices for Protection of Water Resources in Florida**. Florida Dept. of Environmental Protection, Tallahassee, FL.
Golf Courses	Elliott, M. L., and J. B. Unruh. 1998. **Best Management Practices for Florida Golf Courses**. Institute of Food and Agricultural Sciences, Univ. of Florida, Gainesville, FL.
Pasture and Range	Florida Cattlemen's Association. 1999. **Water Quality Best Management Practices for Cow/Calf Operations in Florida**. Florida Cattlemen's Association, Kissimmee, FL.
Field Crops	Florida Dept. of Agriculture and Consumer Services, Office of Agricultural Water Policy. 2003. **Florida Vegetable and Agronomic Crop Water Quality and Quantity Best Management Practices Manual**. Florida Dept. of Agriculture and Consumer Services, Tallahassee, FL. (In development.)
Fruit Crops	Florida Dept. of Agriculture and Consumer Services, Office of Agricultural Water Policy. 2002. **Nitrogen Best Management Practices (BMPs) for Florida Citrus**. Florida Dept. of Agriculture and Consumer Services, Tallahassee, FL.
Animal Feeding Operations	Van Horn, H. H., G. L. Newton, R. A. Nordstedt, E. C. French, G. Kidder, D. A. Graetz, and C. G. Chambliss. 1998. **Dairy manure management: Strategies for recycling nutrients to recover fertilizer value and avoid environmental pollution**. Dairy and Poultry Sciences Dept. Circular 1016. Univ. of Florida, Gainesville, FL.
Horticulture	Stamps, R. H. 1995. **Irrigation and Nutrient Management Practices for Commercial Leatherleaf Fern Production in Florida**. Univ. of Florida, IFAS, Gainesville, FL. Florida Dept. of Agriculture and Consumer Services, Office of Agricultural Water Policy. 2003. **Interim Measure for Florida Producers of Container-Grown Plants**. Florida Dept. of Agriculture and Consumer Services, Tallahassee, FL.
Forestry	Florida Dept. of Agriculture and Consumer Services, Division of Forestry. 2000. **Silviculture Best Management Practices**. Florida Dept. of Agriculture and Consumer Services, Tallahassee, FL.

Land Use Information Tool
Section 8: Glossary

- **Abbreviations**
  - bu – bushel.
  - cwt – hundredweight (a 100-lb unit).

- **Animal Waste** – Manure and urine produced by farm animals.

- **Crop Uptake** – Nutrients taken up from the soil by roots and incorporated into plant tissues.

- **Denitrification** – Biological conversion of soil nitrate (NO_3^-) to gaseous forms of N. This reaction occurs only in the absence of oxygen.

- **Fertilizer** - Any substance containing one or more recognized plant nutrients that is applied for its plant nutrient content.

- **Land Use Categories**

  - **Low-Density Residential** – A rural area with lot sizes greater than 1 acre or less than one dwelling unit per acre. *Another term for this category is "Rural Residential."*

  - **Medium-Density Residential** – A density of one to five dwellings per acre. *Another term for this category is "Suburban Residential."*

  - **High-Density Residential** – A density of greater than five dwellings per acre. *Another term for this category is "Urban Residential."*

  - **Single-Family Residential** – Typical detached home community with lot sizes generally less than 1 acre and dwelling densities greater than one dwelling unit per acre; duplexes constructed on one-third to one-half acre lots are also included in this category.

  - **Multi-Family Residential** – Residential land use consisting primarily of apartments, condominiums, and cluster homes.

  - **Low-Intensity Commercial** – Areas that receive only a moderate amount of traffic volume in areas where cars are parked during the day for extended periods of time. These areas include universities, schools, professional office sites, and small shopping centers.

  - **High-Intensity Commercial** – Land use consisting of commercial areas with high traffic volume with constant traffic moving in and out of the area. These areas include downtown areas, commercial office sites, regional malls, and associated parking lots.

  - **Industrial** – Land uses include manufacturing, shipping and transportation services, sewage treatment facilities, water supply plants, and solid waste disposal.

  - **Highway** – Includes major road systems such as interstate highways and major arteries and thoroughfares. Roadway areas associated with residential, commercial, and industrial land uses are included with those particular categories.

  - **Agriculture** – Activities include animal production, grazing, row crops, citrus, and related activities.

  - **Recreation/Open Space** – Includes recreational land such as parks and ball fields, open space, barren land, undeveloped land that may be occupied by native vegetation, rangeland, and power lines. *This land does not include golf course areas that are heavily fertilized and managed; golf course areas have runoff characteristics similar to single-family residential areas*.

  - **Mining/Extractive** – A wide variety of mining activities for resources like phosphate, sand, gravel, clay, and shell.

  - **Wetlands** – A wide range of diverse wetland types such as hardwood wetlands, cypress stands, grassed wetlands, freshwater marsh, and mixed wetland associations.

  - **Open Water/Lakes** – Open water and lakes, rivers, reservoirs, and other open water bodies.

- **Nitrogen Export** – Nitrogen that may be removed from the land in the harvested portion of a crop.

- **Nitrogen Fixation** – Biological conversion of atmospheric N_2 gas to plant-available N by *Rhizobia* associated with the root system of leguminous plants.

- **Nitrogen Import** – Nitrogen that may be applied to the land as fertilizers or soil amendments.

- **Pesticides** – Includes herbicides (weed killers), insecticides (bug killers), nematicides, and fungicides.

- **Soil Amendment** – A material applied to improve or enhance soil characteristics for plant growth. A soil amendment may also contain required plant nutrients.

- **Volatilization** – Conversion of ammonium (NH_4^+) from manure, fertilizer, or the soil to gaseous ammonia (NH_3), which enters the atmosphere.

Appendix

Land uses found within the Florida springs study area.

Urban and Built-Up			
Residential, Low Density	Oil and Gas Storage	Other Light Industry	Governmental
Ranchettes Fixed (>5 AC/DU)	Mixed Commercial and Services	Plastic Pipe Plant	Correctional
Low Density Residential Mobile	Cemeteries	Cement Plant	Municipal Prison
Mobile Home Units	Commercial Under Construction	Chemical Processing	State Prison
Ranchettes Mobile	Industrial	Other Heavy Industrial	Other Institutional Facility
Low Density Residential Mixed	Food Processing	Pre-Stressed Concrete Plants	Institutional under Construction
Ranchettes Mixed	Grain and Legume Processing	Extractive	Recreational
Residential, Medium Density	Meat Packing Facility	Heavy Mineral Mine	Swimming Beach
Mobile Home Units, Medium Density	Poultry and/or Egg Processing	Peat	Golf Courses
Medium Density Residential Mixed	Seafood Processing	Strip Mines	Automobile Racing Track
Residential, High Density	Log Home Prefabrication	Sand and Gravel Pits	Dog Racing Track
High Density Residential Mobile	Plywood and Veneer Mill	Dolomite Quarry	Horse Racing Track
Mobile Home Units, High Density	Pulp and Paper Mill	Inactive Strip Mine/Rock Quarry	Race Tracks
Multiple DU Low Rise (<= 2 Stories)	Saw Mill	Limerock Quarry	Marinas and Fish Camps
Multiple DU High Rise (>= 3 Stories)	Timber Processing	Phosphate Mine	City Park
High Density Residential Mixed	Wood Yard	Rock Quarries	Parks and Zoos
Commercial and Services	Clays	Oil and Gas Fields	Zoo
Commercial, Retail Sales and Serv.	Limerock Processing	Old Field	Community Recreational Facilities
Shopping Center	Mineral Processing	Reclaimed land	Stadium
Junk Yards	Phosphate Processing	Holding Ponds	Historic Sites
Wholesale Sales and Services	Asphalt Plant	Institutional	Other Recreational
Cultural and Entertainment	Oil and Gas Processing	Educational Facilities	Open Land
Open Air Theater	Aircraft Building and Repair	Religious	Open Land (Urban)
Campground	Boat Building and Repair	Military	Undeveloped Urban Land
Motel	Container Manufacturer	National Guard Installation	Inactive Development Land
Tourist Services	Electronics	Hospital	Urban Land in Transition
Travel Trailer Park	Maintenance Yard	Medical and Health Care	Other Open Lands
Liquified Gases	Mobile Home Manufacturer	Nursing Home	

Agriculture			
Improved Pasture	Fruit Orchard	Nurseries and Vineyards	Horse Farm
Unimproved Pasture	Peaches	Ornamental Nursery	Dairy
Woodland Pasture	Other Groves	Tree Nursery	Kennel
Blueberries	Pecans	Sod Farm	Aquaculture
Corn	Abandoned Tree Crops	Ornamentals	Other Open Lands (Rural)
Row Crops	Feeding Operations	Vineyards	
Field Crops	Cattle Feeding Operations	Floriculture	
Tree Crops	Poultry Feeding Operation	Other Specialty Farm	
Citrus Groves	Swine Feeding Operations	Specialty Farms	

Rangeland			
Herbaceous	Shrub and Brushland	Coastal Scrub	Mixed Rangeland
Other Shrubs and Brush	Palmetto Prairie		

Upland Forest			
Upland Coniferous Forests	Other Pine Upland Forests	Hardwood-Coniferous Mixed	Tree Plantation
Pine Flatwoods	Upland Hardwood Forests	Dead Trees	Coniferous Plantations
Longleaf Pine - Xeric Oaks	Oak - Pine - Hickory	Oak Scrub	Forest Regeneration Areas
Longleaf Sandhill	Temperate Hardwood	Sand Pine Scrub	
Mesic Flatwoods	Beech - Magnolia	Sand Pines	
Pine - Mesic Oaks	Oak Sandhill	Australian Pine	

Water		
Streams and Waterways	Bays and Estuaries	Major Springs
Lakes	Embayments Opening Directly into the Gulf	Slough Waters
Reservoirs	Embayments not Opening Directly into the Gulf	Oceans, Seas, and Gulfs

Wetlands			
Wetland Hardwood Forests	Inland Ponds and Sloughs	Wetland Forested Mixed	Emergent Aquatic Vegetation
Bay Swamps	Mixed Wetland Hardwoods	Mixed Scrub-Shrub Wetland	Submerged Aquatic Vegetation
Mangrove Swamps	Wetland Coniferous Forests	Shrub Swamp	Non-Vegetated
Gum Swamp	Cypress	Wetland Shrub	Tidal Flats
Titi Swamps	Pond Pine	Vegetated Non-forested Wetlands	Intermittent Ponds
Bottomland Hardwood Swamp	Atlantic White Cedar	Freshwater Marshes	Oyster Bar
River/Lake Swamp (Bottomland)	Cypress - Pine - Cabbage Palm	Saltwater Marshes	

Stream and Lake Swamps	Wet Flatwoods	Wet Prairies	

Barren Land		
Beaches	Disturbed Land	Borrow Areas
Sand other than Beaches	Rural Land in Transition	Spoil Area

Transportation, Communication, and Utilities			
Transportation	Truck Terminal	Oil, Water, or Gas Lines	Electrical Power Facilities
Transportation Corridor	Divided Highway (Federal - State)	Auto Parking Facilities	Electrical Power Substation
Airports	Highways	Highway Rest Area	Gas Turbine Power Plant
Commercial Airport	Limited Access Highway	Facilities under Construction	Thermal Electrical Power Plant
General Aviation	Roads and Highways	Communications	Electric Power Transmission Lines
Private Airport	Two Lane Highway	Transmission Towers	Water Supply Plant
Railroads	Port Facilities	Communications Facilities	Sewage Treatment
Bus Terminal	Canals and Locks	Utilities	Solid Waste Disposal