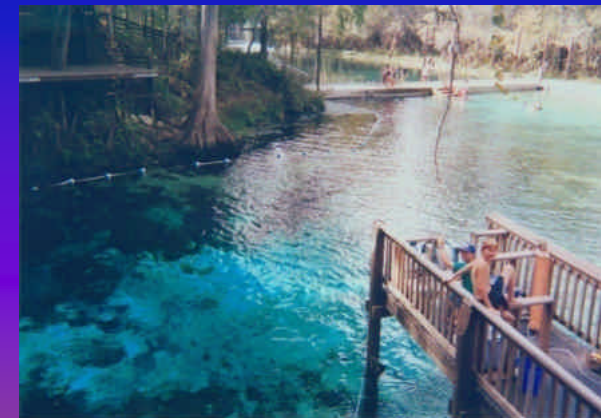


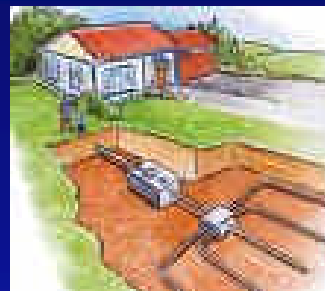
Chemicals from Pharmaceuticals in Florida Springs



Brian G. Katz, PhD
USGS
Tallahassee, FL
bkatz@usgs.gov



Chemicals we use or consume every day in small amounts



can be concentrated in the waste stream and enter the environment in measurable amounts.

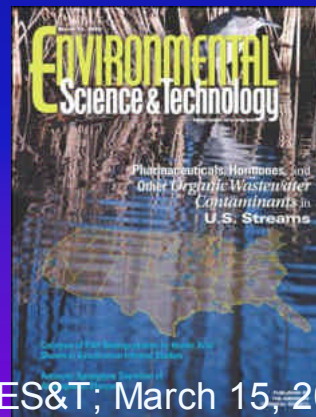
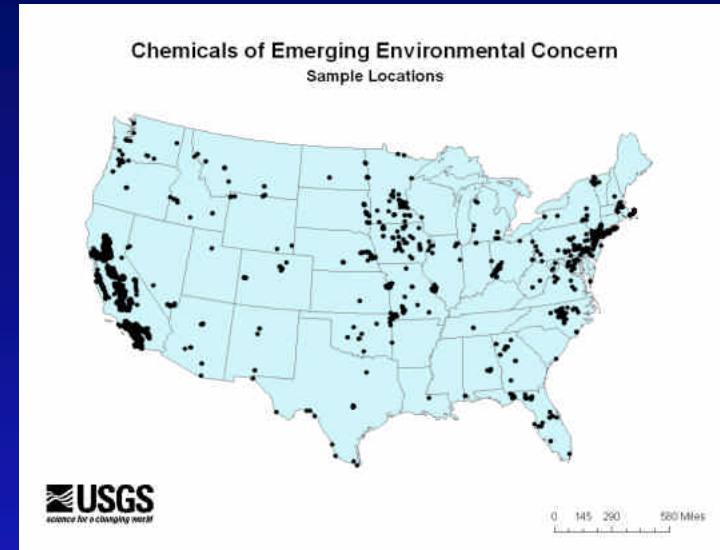
Occurrence of Pharmaceuticals and other organic wastewater compounds – National Reconnaissance Studies

Streams (1999-2000)

Ground Water (2000)

Sources of Drinking Water (2001)

Streambed Sediment (2002)



ES&T; March 15, 2002
v. 36, no. 6, p. 1202-1211

- >1500 Sites
- >400 Streams
- >1,000 Wells
- >75 WWTPs

64 Wastewater Indicator Compounds Analyzed (USGS National Water Quality Laboratory)

<p>Fragrances and Flavorants</p> <ul style="list-style-type: none"> AHTN HHCB 3-Methyl-1H-indole (skatol) Acetophenone Camphor Isoborneol Isoquinoline Menthol <p>Flame Retardants</p> <ul style="list-style-type: none"> Tris(2-chloroethyl) phosphate Tris(dichlorisopropyl) phosphate Tributyl phosphate <p>Antioxidants</p> <ul style="list-style-type: none"> 5-Methyl-1H-benzotriazole 3-<i>tert</i>-butyl-4-hydroxyanisole (BHA) <p>Fuel-Related Compounds</p> <ul style="list-style-type: none"> 1-Methylnaphthalene 2,6-Dimethylnaphthalene 2-Methylnaphthalene Isopropylbenzene (cumene) 	<p>Detergent Metabolites</p> <ul style="list-style-type: none"> <i>p</i>-Cumylphenol <i>p</i>-<i>n</i>-Octylphenol <i>p</i>-Nonylphenol diethoxylate (NPEO2) <i>p</i>-Octylphenol diethoxylate (OPEO2) <i>p</i>-Octylphenol monoethoxylate (OPEO1) <i>p</i>-<i>tert</i>-octylphenol <i>p</i>-Nonylphenol (total, NP) <p>Plasticizers</p> <ul style="list-style-type: none"> Bisphenol A Tris(2-butoxyethyl) phosphate Triphenyl phosphate <p>Disinfectants</p> <ul style="list-style-type: none"> Triclosan Phenol <p>Solvents and Preservatives</p> <ul style="list-style-type: none"> Isophorone Tetrachloroethylene <i>p</i>-cresol Pentachlorophenol 	<p>Pesticides</p> <ul style="list-style-type: none"> Bromacil Carbaryl Carbazole Chlorpyrifos Diazinon d-Dichlorvos d-Limonene Indole Metalaxyl Metolachlor N,N-diethyl-meta-toluamide (DEET) Prometon <p>Plant and Animal Steroids</p> <ul style="list-style-type: none"> 3-β-coprostanol β-sitosterol β-stigmastanol Cholesterol 	<p>PAHs</p> <ul style="list-style-type: none"> Anthracene Benzo[a]pyrene Fluoranthene Naphthalene Phenanthrene Pyrene <p>Others</p> <ul style="list-style-type: none"> Anthraquinone (manufacturing) 1,4-dichlorobenzene (deodorizer) Benzophenone (fixative) Bromoform (disinfection byproduct) Caffeine (stimulant) Cotinine (nicotine metabolite) Methyl salicylate (liniment) Triethyl citrate (ethyl citrate) (cosmetics)
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Method reporting levels are 0.5 ppb (ug/L) for most compounds.



Human Health Pharmaceuticals Analyzed

(USGS National Water Quality Laboratory)

Over-the-counter pharmaceuticals



Compound	Common Name(s)	Use	Reporting level ppb ($\mu\text{g/L}$)*
<i>Acetaminophen</i>	<i>Tylenol</i>	<i>Analgesic</i>	0.12
<i>Caffeine</i>	<i>No-Doz</i>	<i>Stimulant</i>	0.06
<i>1,7-dimethyl-xanthine</i>		<i>Caffeine metabolite</i>	0.10
<i>Codeine</i>	<i>Robitussin AC</i>	<i>Opioid narcotic; cough suppressor</i>	0.046
<i>Cotinine</i>		<i>Nicotine metabolite</i>	0.038
<i>Diphenhydramine</i>	<i>Benadryl; Chlortrimeton</i>	<i>Antihistamine</i>	0.036

*1 ppb = 1 second in 32 years; or 1 penny in \$10,000,000





Human Health Pharmaceuticals Analyzed

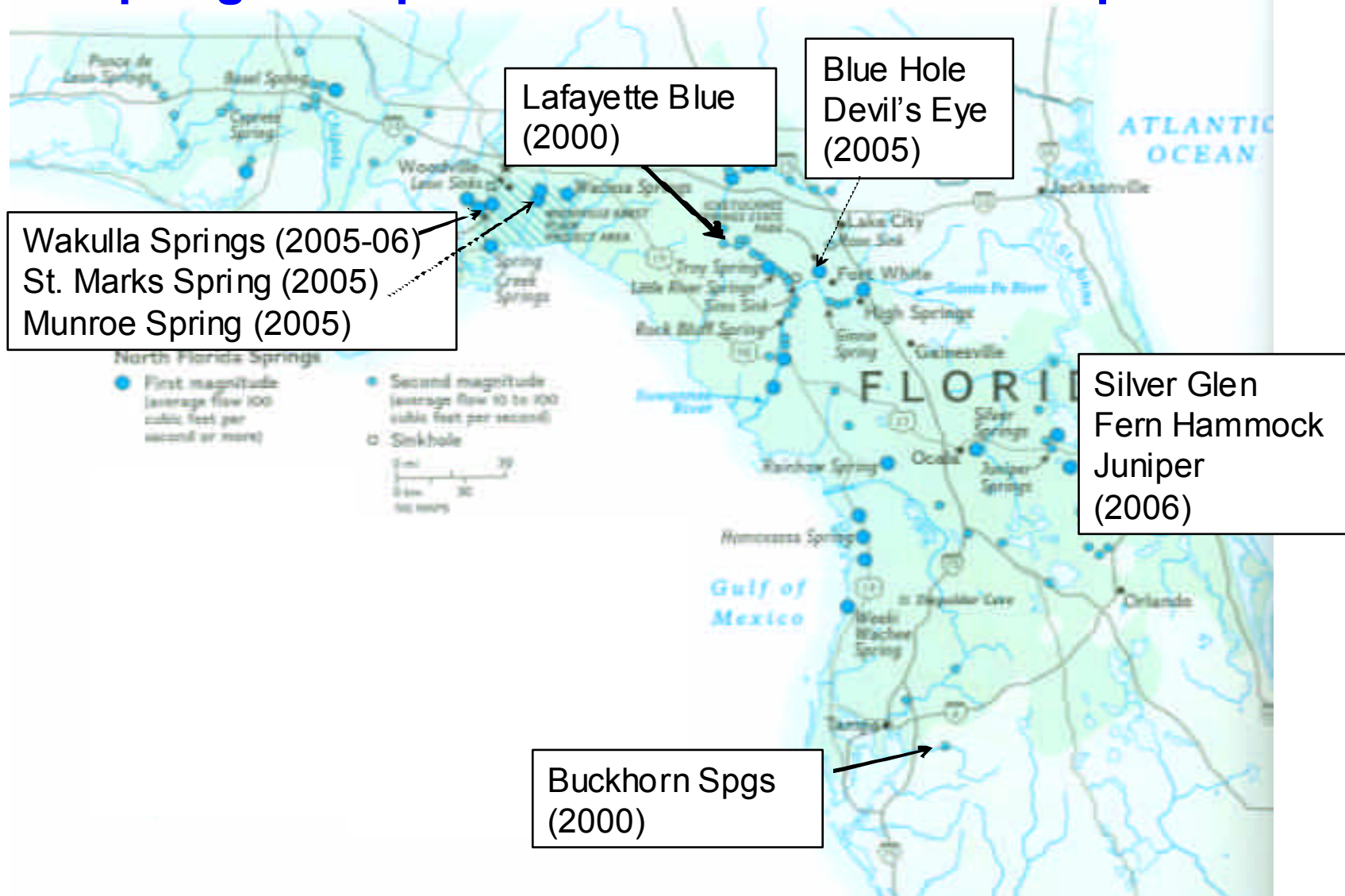
(USGS National Water Quality Laboratory)

Prescription drugs

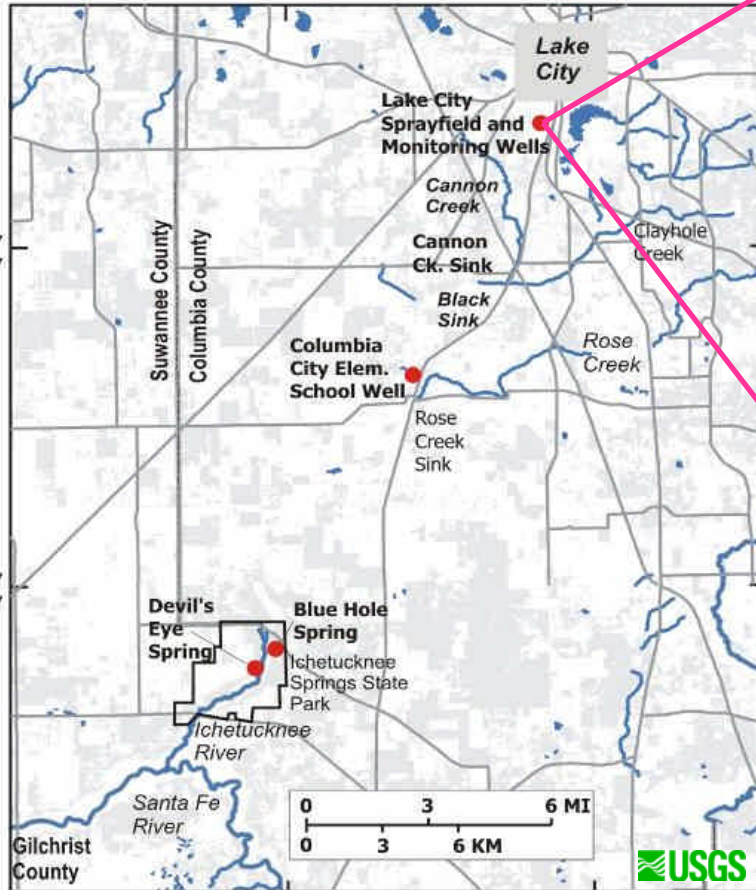


Compound	Common Name(s)	Use	Reporting level ppb
<i>Carbamazapine *</i>	<i>Tegretol, Atretol</i>	<i>Antiepileptic; anti-depressant</i>	0.06
<i>Dehydronifedipine</i>	<i>Procardia</i>	<i>Antiarrhythmic</i>	0.08
<i>Diltiazem</i>	<i>Cardizem CD</i>	<i>Antianginal, antiarrhythmic, and antihypertensive</i>	0.06
<i>Salbutamol</i>	<i>Albuterol, Aerosol</i>	<i>Bronchodilator (asthma)</i>	0.08
<i>Sulfamethoxazole *</i>	<i>Gantanol</i>	<i>Antibiotic</i>	0.16
<i>Thiabendazole</i>	<i>Mintezol</i>	<i>Anthelmintic</i>	0.06
<i>Trimethoprim</i>	<i>Proloprim; Trimplex</i>	<i>Antibiotic</i>	0.034
<i>Warfarin</i>	<i>Coumadin Tabs</i>	<i>Anticoagulant</i>	0.08

10 Springs Sampled for Pharmaceutical Compounds



Pharmaceutical compounds in water from Lake City STP reservoir, wells, and springs

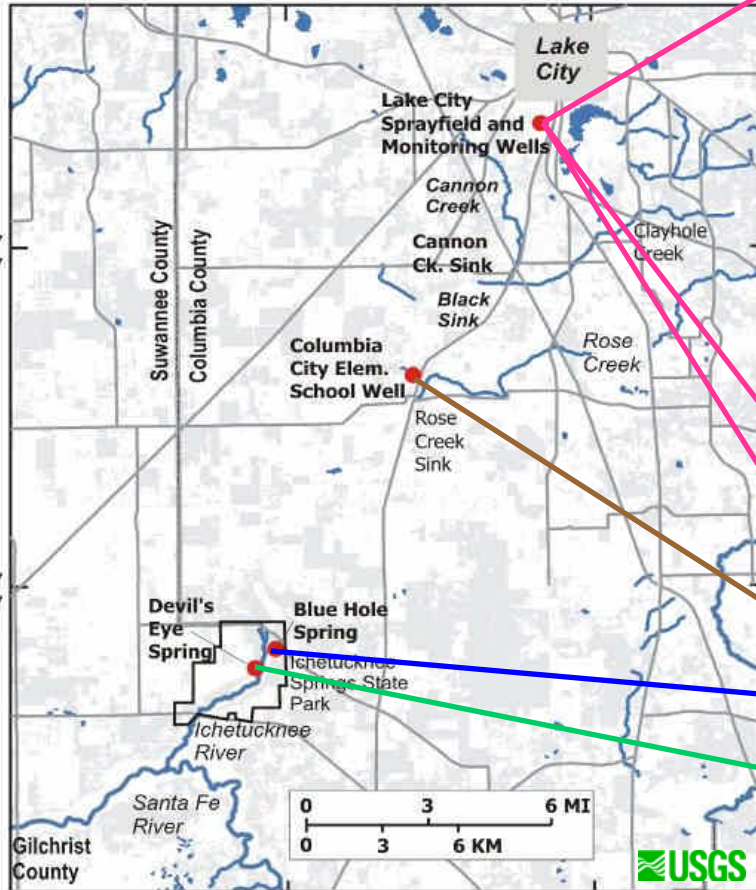


Site	Compound	E	Detected
STP Effluent Res.			
stimulant	caffeine	0.009	0.15
cough suppressant	codeine	0.02	0.034
angina metabolite	dehydronifedepine	0.01	0.015
nicotine metabolite	cotinine		0.042; 0.037
antiarrhythmic	diltiazem	0.015	
antibiotic	sulfamethoxazole		0.32; 0.53
antibiotic	trimethoprim		0.04; 0.035
caffeine metabolite	1,7 dimethylxanthine		0.11
anticonvulsant	carbamazepine		0.1; 0.1
antihistamine	diphenhydramine		0.07; 0.09
bronchodilator	salbutamol		0.02
acid reducer	cimetidine		0.05

E, estimated value

May 2005 October 2005 Both

Pharmaceutical compounds in water from Lake City STP reservoir, wells, and springs



Site	Compound	Concentration, ug/L (ppb)	
		E	Detected
STP Effluent Res.			
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bronchodilator	salbutamol		0.02
acid reducer	cimetidine		0.05
LCS-MBW			
anticonvulsant	carbamazepine		0.023; 0.033
MW-7			
antibiotic	sulfamethoxazole	0.013	
CCESW			
	NONE		
Blue Hole Spring			
	NONE		
Devil's Eye Spring			
anticonvulsant	carbamazepine	0.0026	
antihistamine	diphenhydramine	0.004	

May 2005

October 2005

Both

E, estimated value

**Map showing connections
Between residence and
Several locations in
Ichetucknee Springs
State Park**

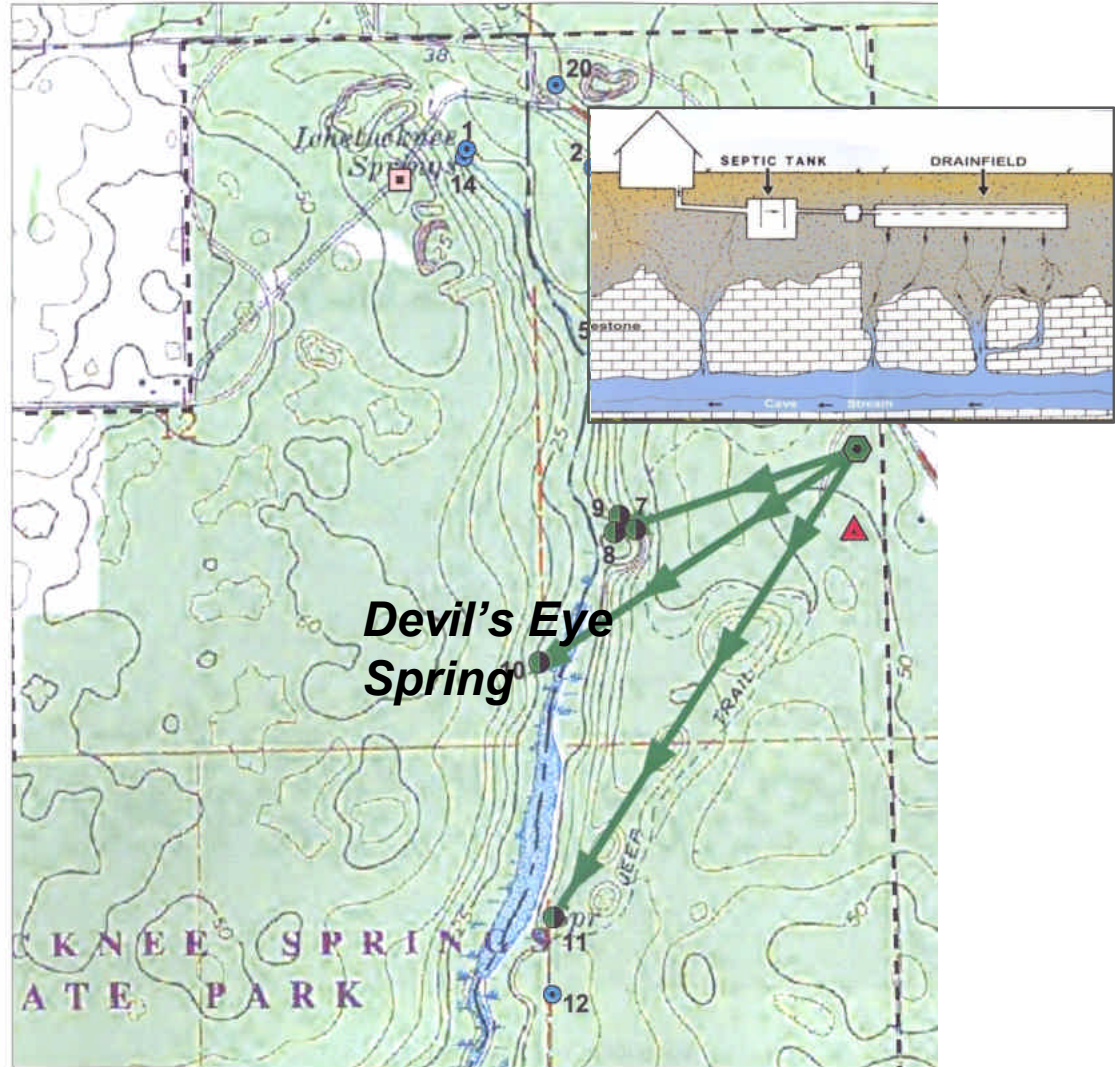
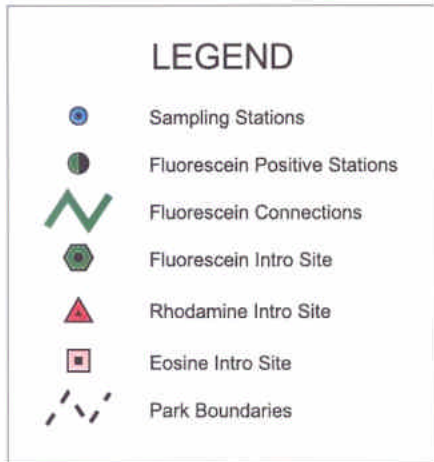


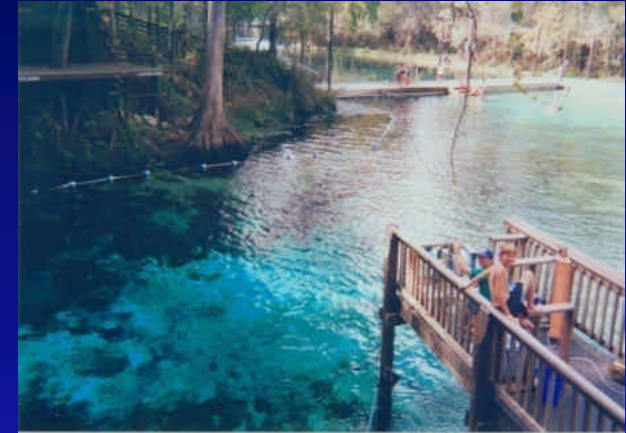
Figure 6.
Sampling Stations Results Map.

P. L. Butt, 2005



Ensuring a representative measurement

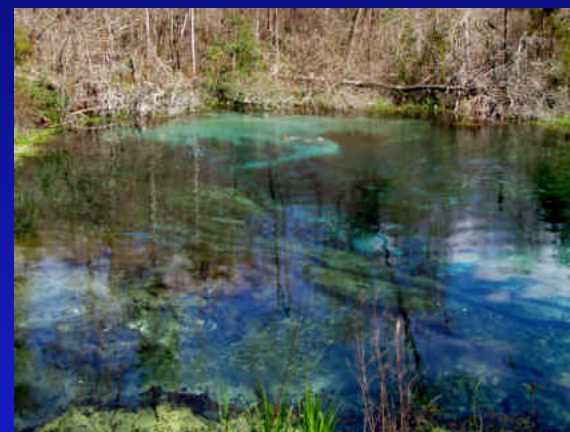
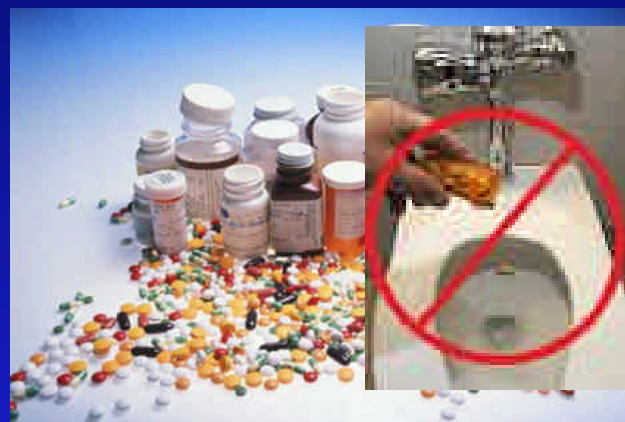
- * Consistent field protocols
- * Field Quality Assurance
- * Laboratory QA
- * Multiple-lab QA datasets
- * Interlab comparison & coordination



Ongoing USGS national studies— more emphasis on Linking Environmental Contamination and Ecosystem Effects



Questions ??



Brian G. Katz
USGS
2639 N. Monroe St.
Tallahassee, FL
bkatz@usgs.gov

