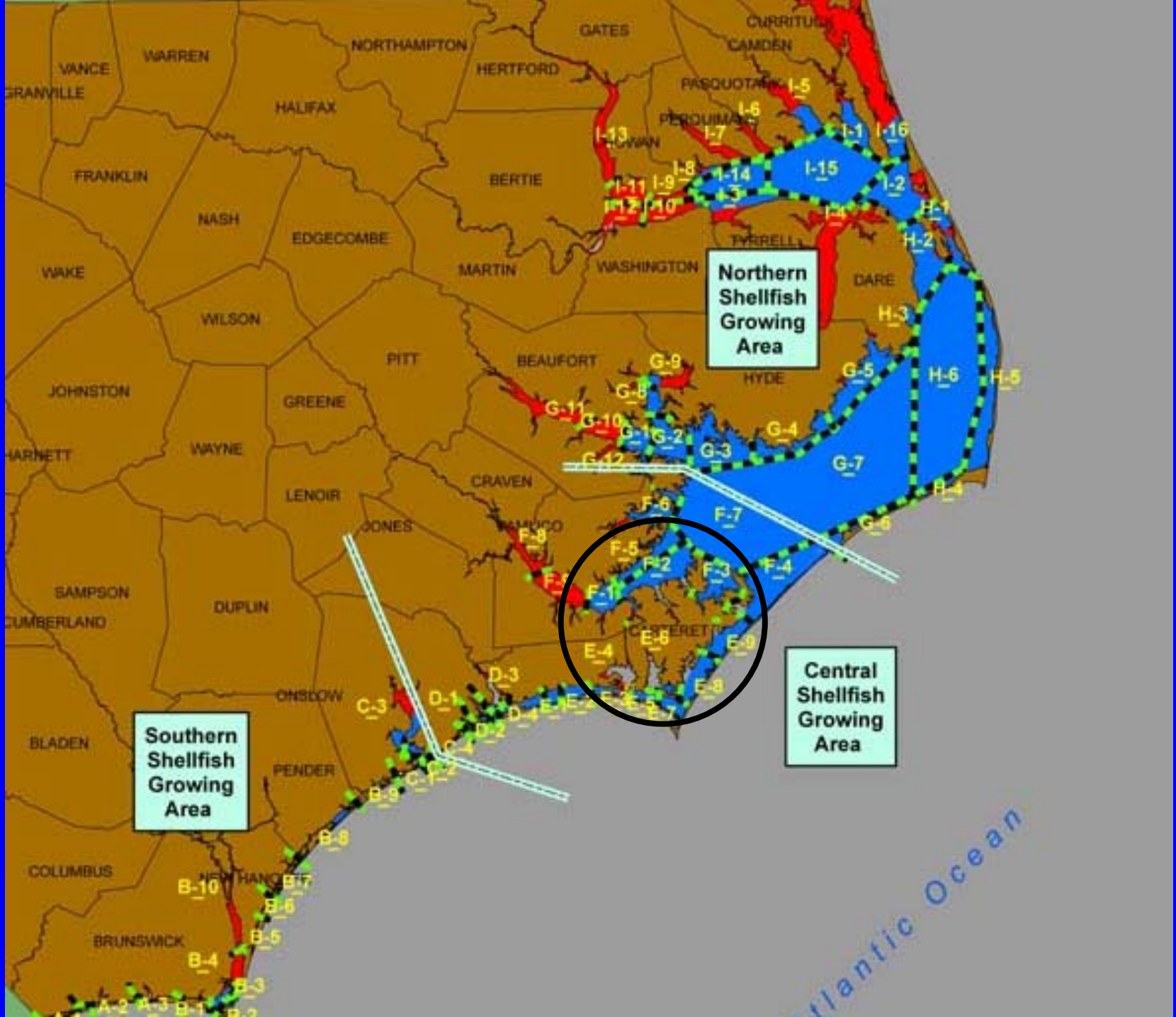
POLLUTANT EXPORT FROM 3 COASTAL NC WATERSHEDS

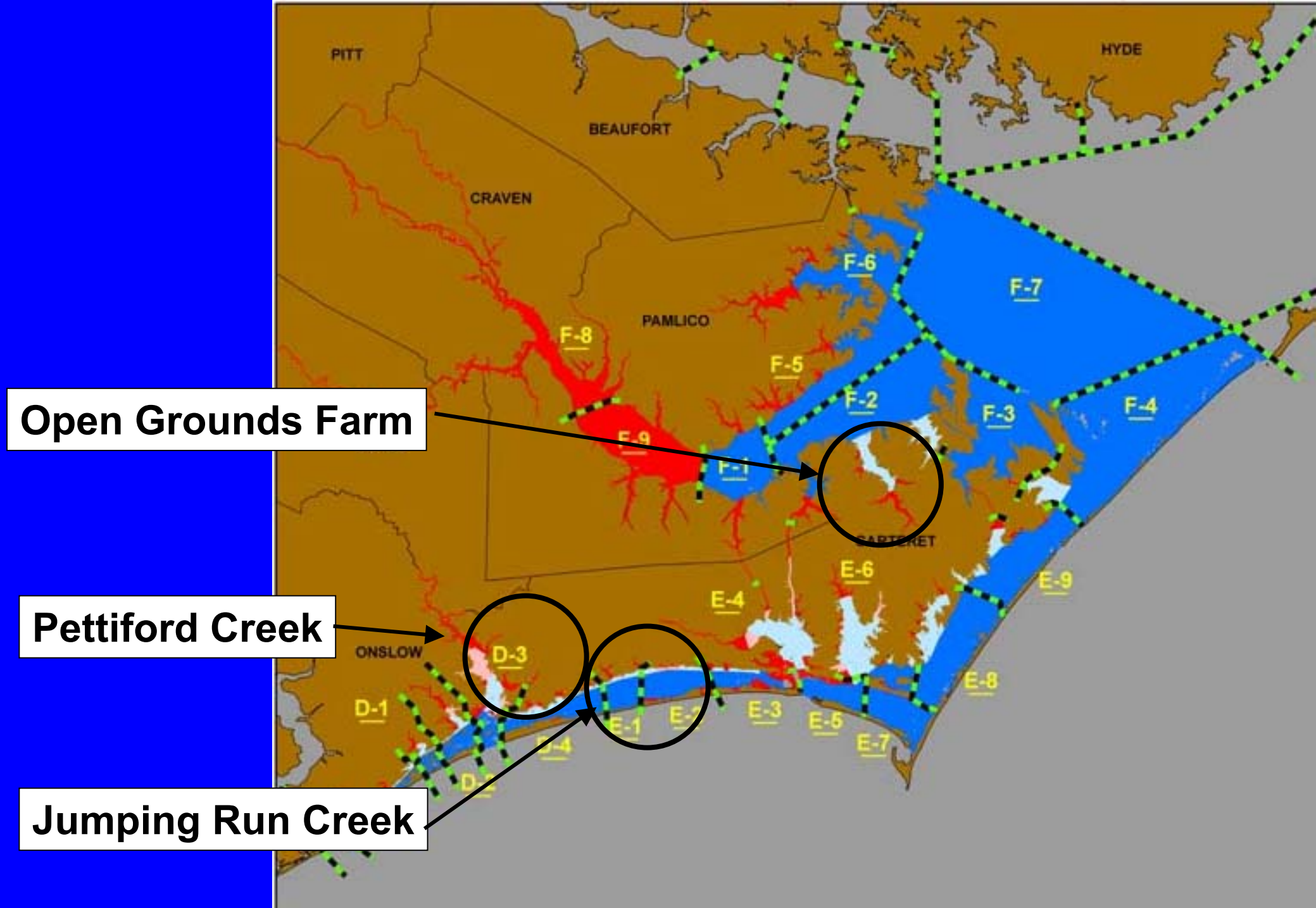
NC State University
NC DENR- Shellfish Sanitation
Duke University Marine Laboratory
Funding from
USDA-CSREES

USDA CSREES Grants

- Monitoring and TMDL Modeling Techniques to Assess Bacterial Loading in Estuarine Environments Applied to Improve Shellfish Resource Management Programs (12/06)
- Integrated Watershed-based Molecular and Hydrologic Monitoring Techniques to Assess Pathogen Loading in Estuarine Environments and Improve Shellfish Resource Management Programs (9/07)

Shellfish Resources

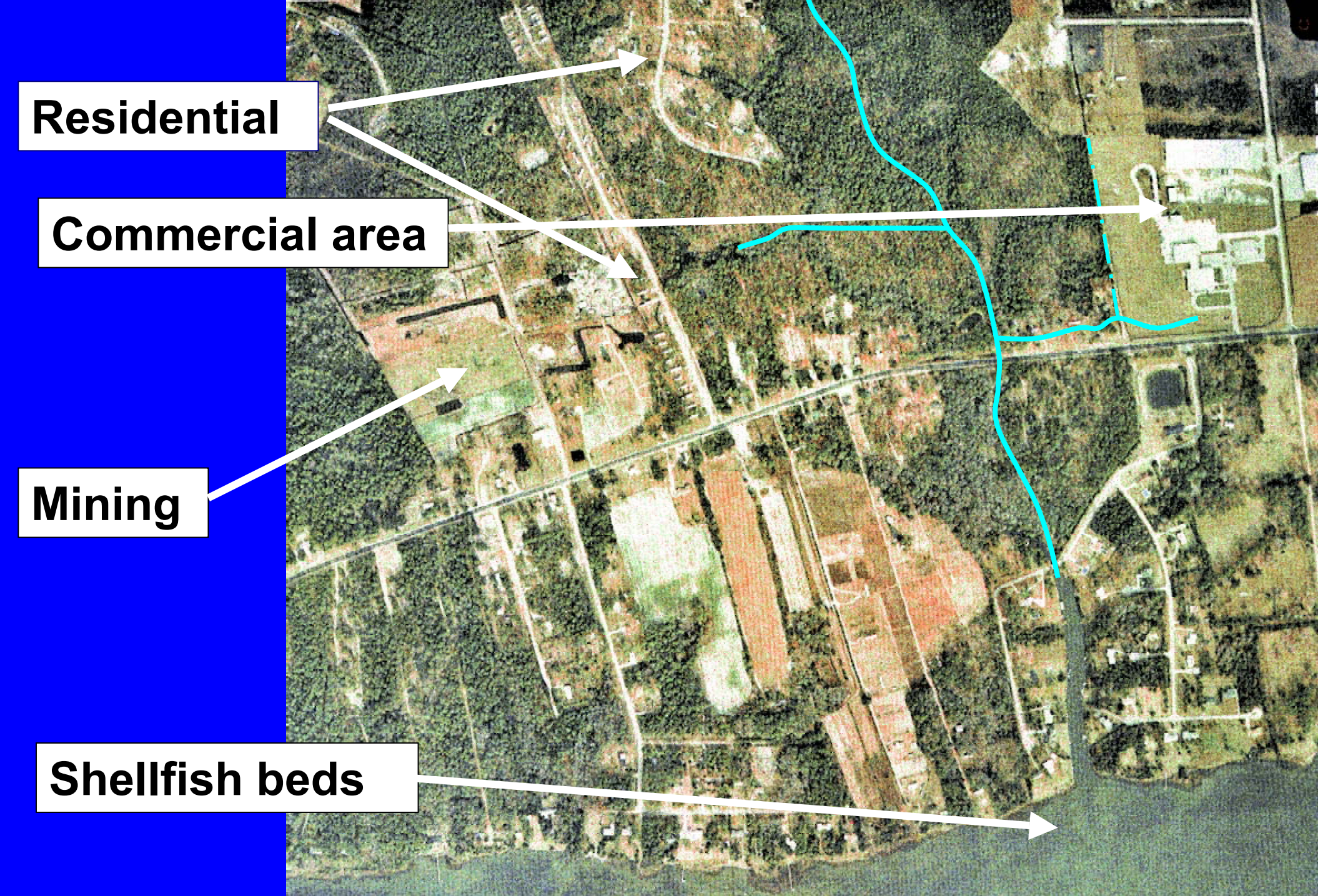

Northern Shellfish Growing Area
Central Shellfish Growing Area
Southern Shellfish Growing Area
Atlantic Ocean
VANCE
WARREN
NORTHAMPTON
GATES
CURRITUCK
CAMDEN
GRANVILLE
HALIFAX
HERTFORD
PASQUOTANK
PERQUIMANS
FRANKLIN
NASH
EDGECOMBE
BERTIE
TYRRELL
WASHINGTON
DARE
WAKE
WILSON
MARTIN
PITT
BEAUFORT
HYDE
JOHNSTON
GREENE
WAYNE
CRAVEN
LENOIR
JONES
SAMPSON
DUPLIN
ONSLOW
PENDER
BLADEN
COLUMBUS
BRUNSWICK


Open Grounds Farm
Pettiford Creek
Jumping Run Creek
PITT
BEAUFORT
HYDE
CRAVEN
PAMLICO
ONSLOW
F-6
F-7
F-8
F-5
F-2
F-3
F-4
F-9
F-1
E-6
E-9
E-4
D-3
E-8
D-1
E-1
E-3
E-5
E-7
D-4

Watersheds

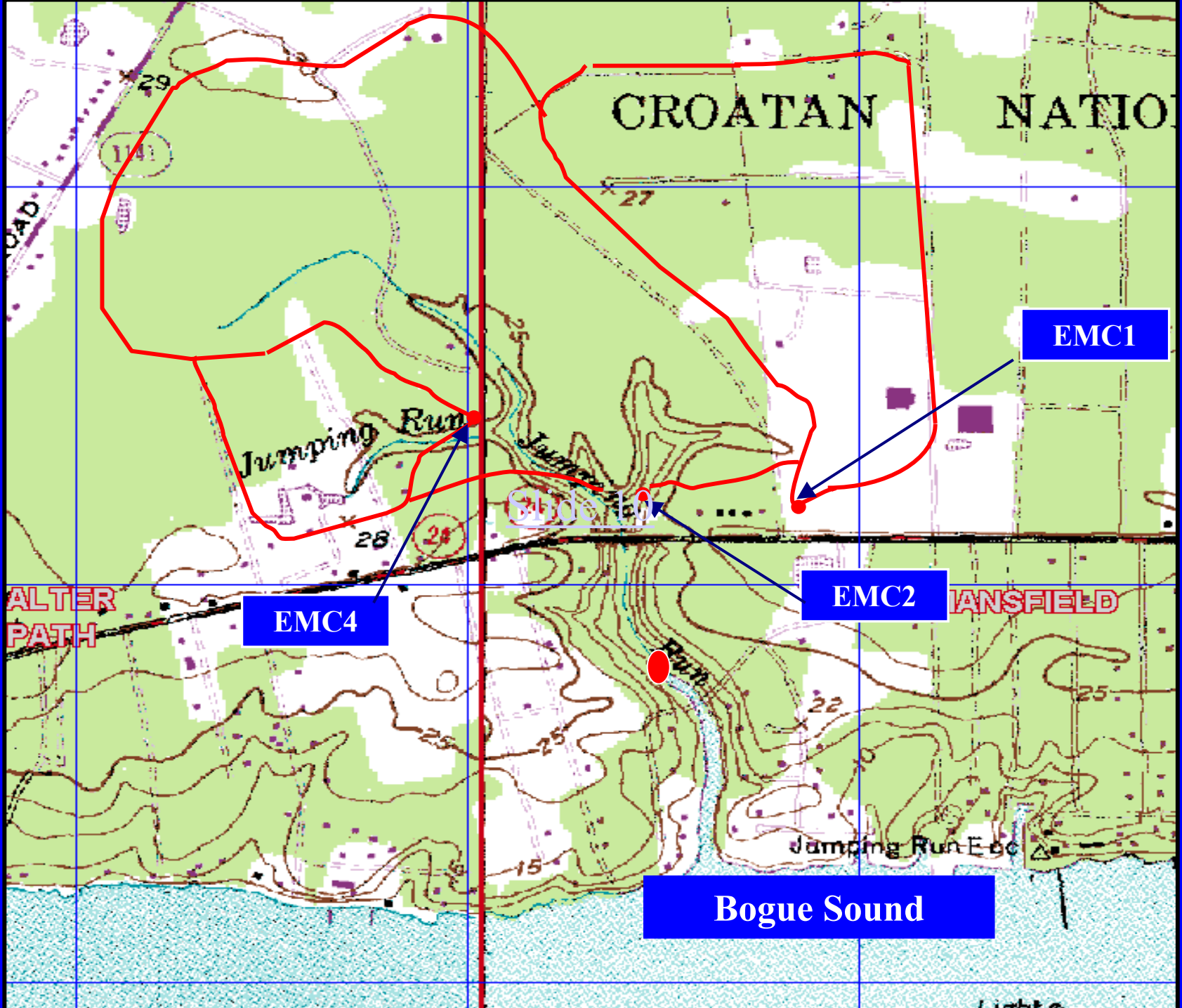
- **Jumping Run Creek**
  - Area: ~800 ac
  - Land Use: Commercial, residential, mining
  - Soil: Leon and Kureb sand & Murville mucky sand
- **Pettiford Creek**
  - Area: ~2800 ac
  - Land use: National forest
  - Soils: Leon sand and Murville mucky sand
- **Open Grounds Ditch**
  - Area: ~630 ac
  - Land use: Cropland
  - Soils: Ponzer muck and Arapahoe loamy sand

Jumping Run Creek


Residential
Commercial area
Mining
Shellfish beds

PHYSICAL CHARACTERISTICS

- **Hydrology**
  - Permeable soils, relatively little surface runoff
  - High water table
- **Drainage**
  - Ditched extensively
- **Topography**
  - Flat (slopes <1%) except near Jumping Run


CROATAN
NATIO
EMC1
EMC2
EMC4
Bogue Sound
Jumping Run
Jumping Run
Jumping Run Esc
ALTER
PATH
ANSFIELD
Run
25
22
15
28
27
29

Drainage Areas

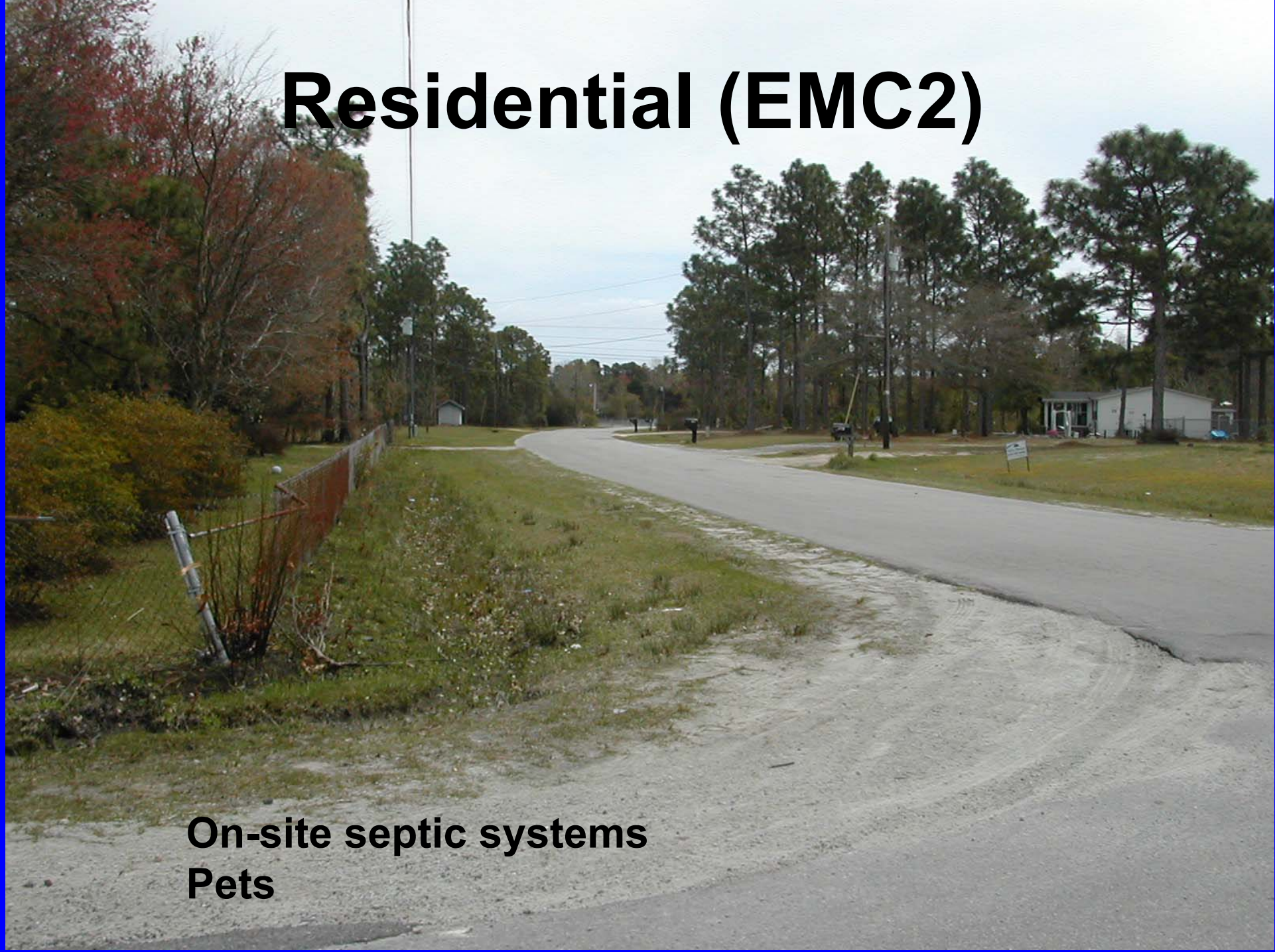
- EMC1– 63 ha, commercial/industrial , few houses, open space
- EMC2- 112 ha, residential, open space, woods
- EMC4- 44 ha, residential, open space, soil mining, woods

Mobile Home Park (EMC4)

Soil Mining (EMC4)

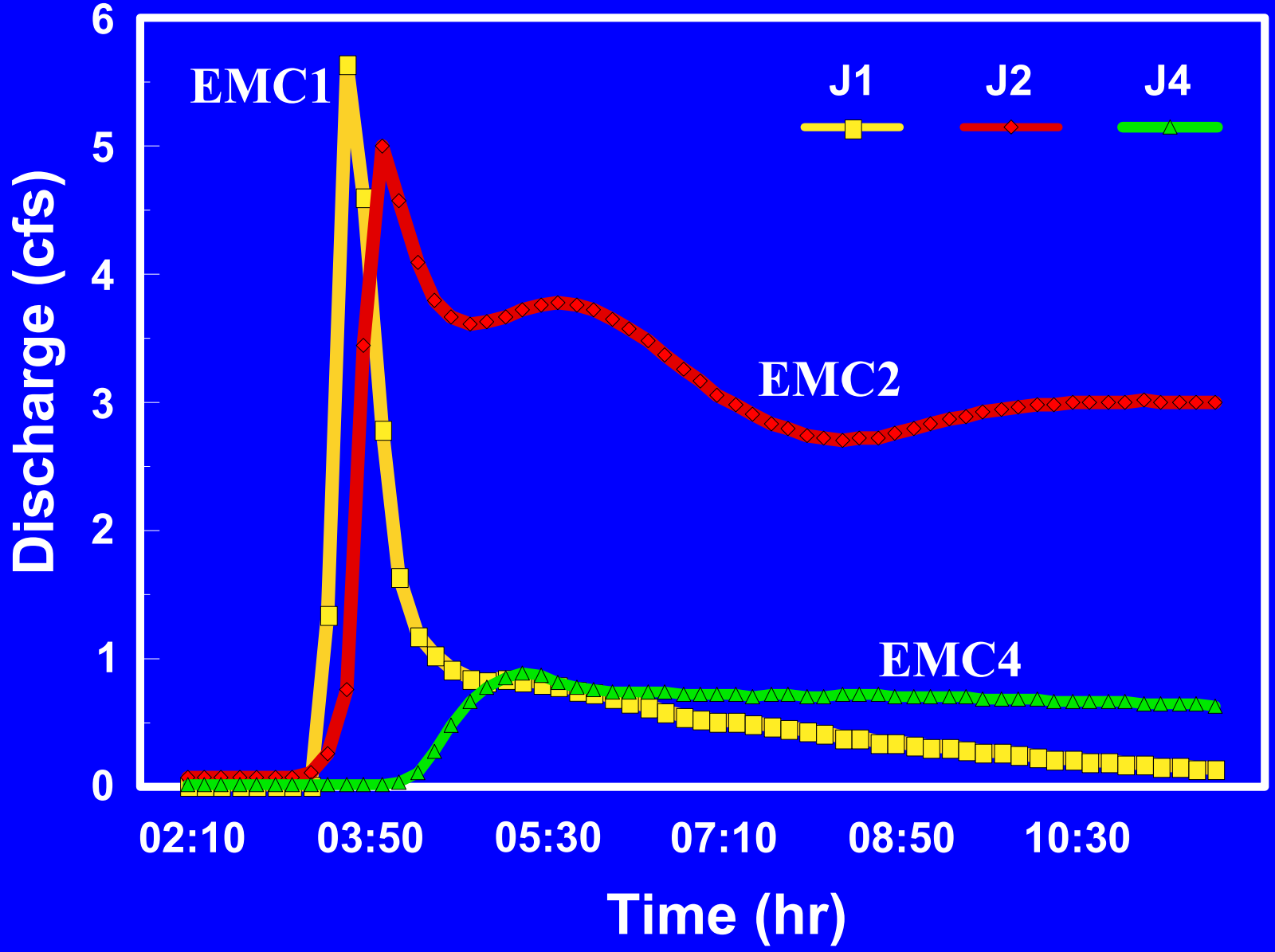
Commercial (EMC1)

Residential (EMC2)



On-site septic systems
Pets


Jumping Run Creek (EMC2)


EMC1
J1
J2
J4
EMC2
EMC4
Discharge (cfs)
0
1
2
3
4
5
6
02:10
03:50
05:30
07:10
08:50
10:30
Time (hr)

MONITORING SCHEME

- Discharge and rainfall
- Nonstorm grab (NO3, NH3, PO4, TSS, FC)
- Flow-proportional storm composite (NO3, NH3, PO4, TSS, FC)

QA/QC

- Sampler Blank- 23 & <2 mpn/100 ml
- Duplicate Sample- both 330 mpn/100 ml

STORM SAMPLES

	Turb	TSS	NH4	NO3	PO4	FC[a]
	ntu	mg/L	mg/L	mg/L	mg/L	mpn/100 ml
EMC1	8	21	0.04	0.05	0.05	1271
EMC2	7	77	0.05	0.05	0.02	1152
EMC4	11	58	0.12	0.07	0.02	593

[a] Geometric mean

Note: 71-96 storms between 9/99 and 2/04

EXPORT (9/99-2/04)

	Q	TSS	NH4	NO3	PO4	FC
	mm/yr	-------- kg/ha-yr -------				Mill mpn/ha-yr
EMC1	531	70	0.29	0.42	0.25	76,900
EMC2	836	259	0.39	0.57	0.19	193,300
EMC4	1165	235	1.42	0.67	0.25	118,900

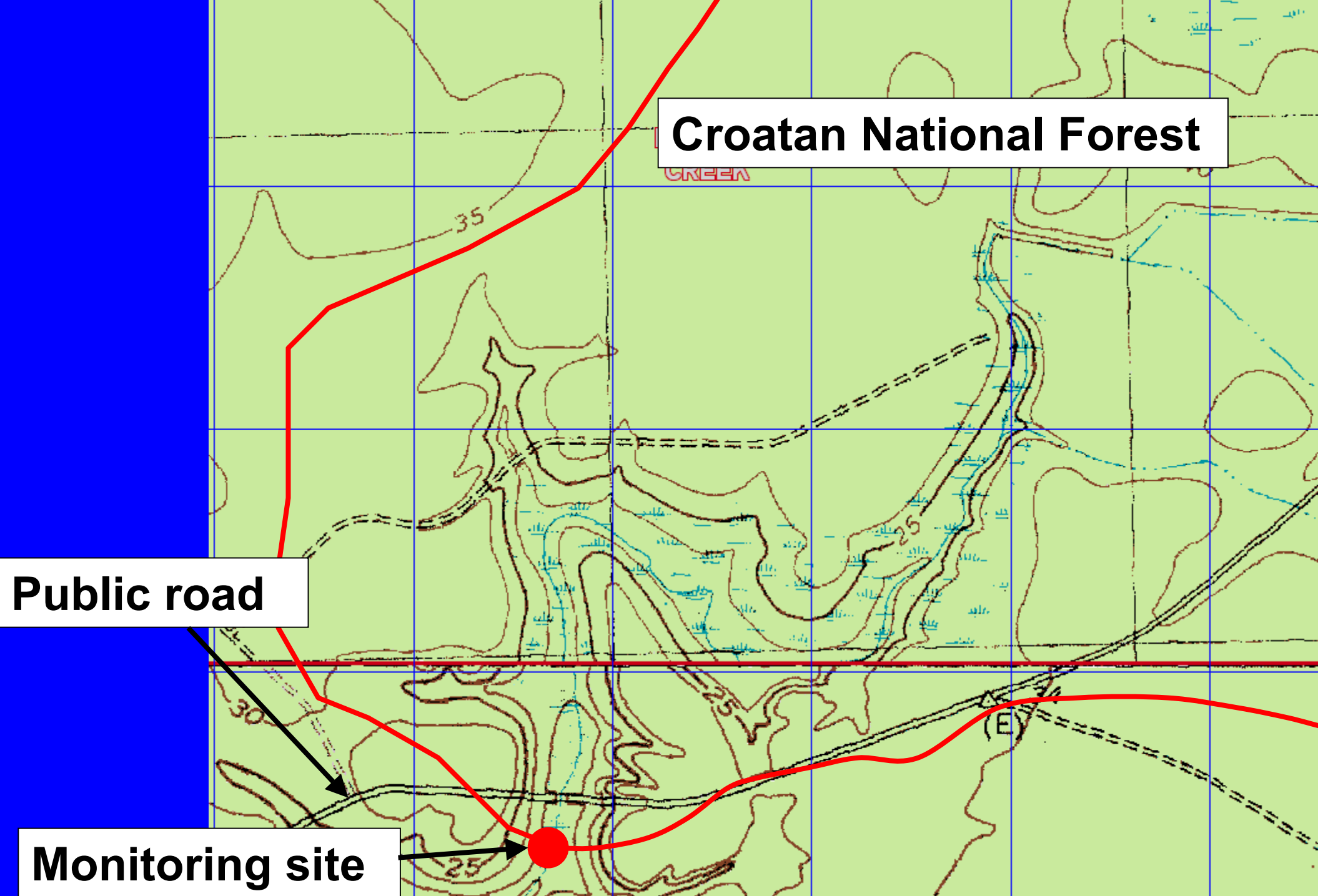
STORM LOAD'S % of TOTAL

	Q	TSS	NH4	NO3	PO4	FC
	%	%	%	%	%	%
EMC1	63	84	43	27	72	90
EMC2	45	58	38	29	51	73
EMC4	38	82	52	35	45	38

SEASONAL LOAD

	Q	TSS	NH4	NO3	PO4	FC
	m^3/wk	kg/wk	------ g/week -----			Mill mpn/ha-wk
EMC1	4,450	131	263	251	108	15,340
Mar-Nov	8,380	78	435	710	425	139,460
EMC2	14,790	382	843	641	279	53,600
Mar-Nov	30,470	942	1350	2,243	706	896,670
EMC4	5,770	70	1125	337	91	11,610
Mar-Nov	18,140	635	3600	1803	694	374,600

Pettiford Creek


Croatan National Forest
Public road
Monitoring site
35
25
30
25
25
(E)

PHYSICAL CHARACTERISTICS

- **Hydrology**
  - Relatively little surface runoff
  - High water table, swampy
- **Drainage**
  - Ditched, not extensively (forest operations)
- **Topography**
  - Flat (slopes <1%)

STORM SAMPLES

	Turb	TSS	NH4	NO3	PO4	FC
	ntu	mg/L	mg/L	mg/L	mg/L	mpn/100 ml
PC	1.5	4	0.05	0.01	0.04	191[a]
EMC2	7	77	0.05	0.05	0.02	1152[a]

[a] Geometric mean of 38 and 73 samples

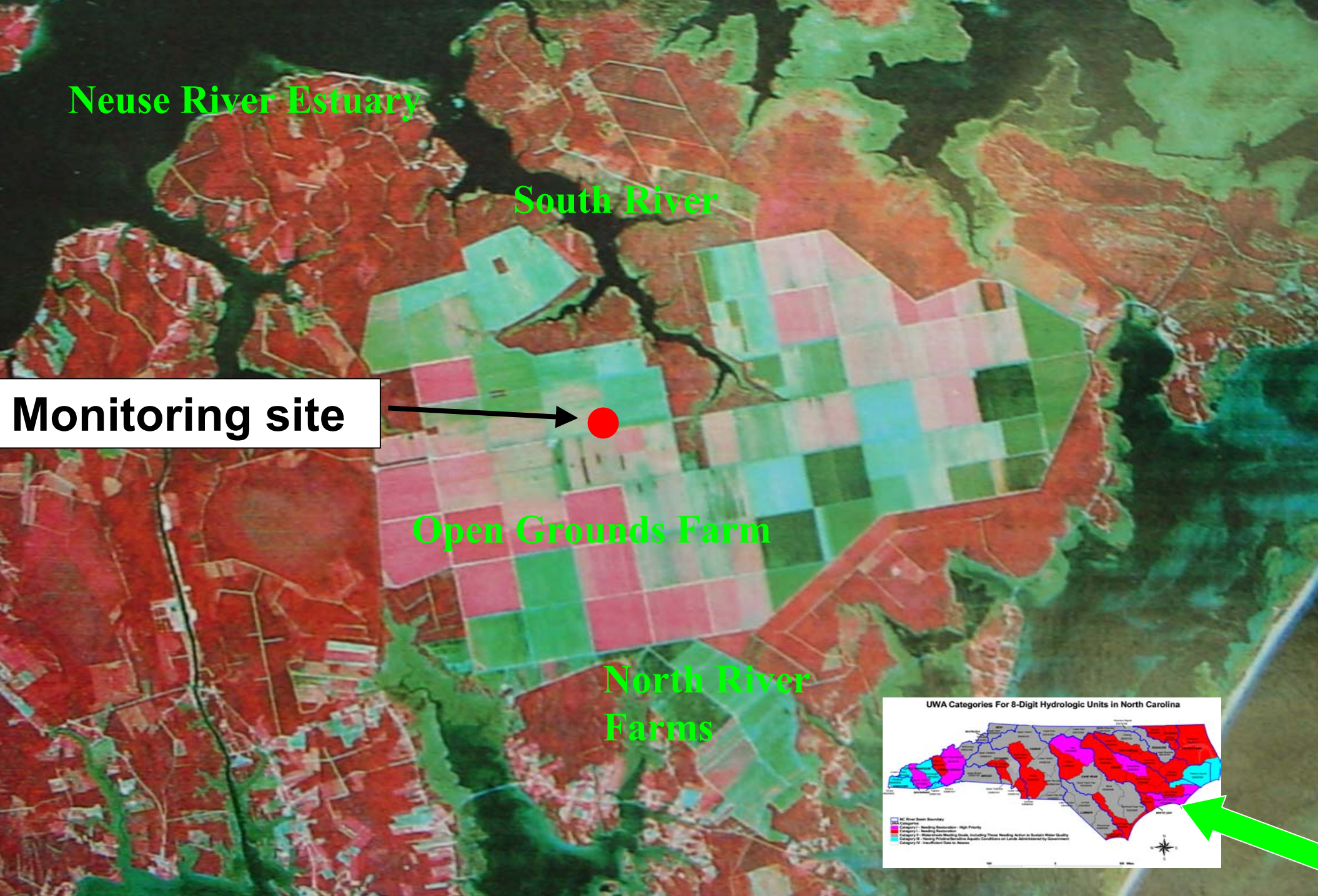
PC EXPORT (10/02-2/04)

	Q	TSS	NH4	NO3	PO4	FC
	mm/yr	------ kg/ha-yr -----				Mill mpn/ha-yr
PC	653	9	0.17	0.03	0.26	18,100
EMC2	836	259	0.39	0.57	0.19	193,300

Seasonal Loads at PC

	Q	TSS	NH4	NO3	PO4	FC
	m^3/wk	kg/wk	-------- g/wk -------			mill mpn/wk
PC	127900	58	2743	297	5330	81,070
Mar-Nov	149100	262	4253	856	5720	575,700
EMC2	14,790	382	843	641	279	53,600
Mar-Nov	30,470	942	1350	2,243	706	896,670

Open Grounds Farm Ditch


Neuse River Estuary
South River
Monitoring site
Open Grounds Farm
North River
Farms
UWA Categories For 8-Digit Hydrologic Units in North Carolina

PHYSICAL CHARACTERISTICS

- **Hydrology**
  - Permeable soils relatively little surface runoff
  - Soil/Crop effects
- **Drainage**
  - Ditched extensively, controlled drainage
- **Topography**
  - Flat (slopes <1%)

STORM SAMPLES

	Turb	TSS	NH4	NO3	PO4	FC[a]
	ntu	mg/L	mg/L	mg/L	mg/L	mpn/100 ml
OPG	12	44	0.09	0.29	0.28	784
PC	1.5	4	0.05	0.01	0.04	191
EMC2	7	77	0.05	0.05	0.02	1152

[a] Geometric mean

EXPORT

	Q	TSS	NH4	NO3	PO4	FC
	mm/yr	-------- kg/ha-yr --------				Mill mpn/ha-yr
OPG	536	231	0.24	1.41	1.09	33,314
PC	653	9	0.17	0.03	0.26	18,100
EMC2	836	259	0.39	0.57	0.19	193,300

STORM %

Site	Q	TSS	NH4	NO3	PO4	FC
	%	%	%	%	%	%
OPG	80	84	95	72	81	79
PC	25	49	45	32	22	66
EMC2	45	58	38	29	51	73

Seasonal Loads

	Q	TSS		NO3	PO4	FC
	m3/wk	---------- g/week ----------				Mill mpn/wk
OPG	28,300	1400		7959	5780	187,500
Mar-Nov	26,000	1070		6714	5270	158,700
PC	127,900	58		297	5330	81,070
Mar-Nov	149,100	262		856	5720	575,700
EMC2	14,790	382		641	279	53,600
Mar-Nov	30,470	942		2,243	706	896,670

SUMMARY

Bacteria Sources

- Low Dens Residential > Cropland > Forest

Storm vs Nonstorm

- Most (>66%) FC moves during storm events

Seasonal Effect

- Export greater during Mar-Nov for PC & EMC2, but not OPG

Future Work

- Swine Waste Application on Cattle Pasture
- Bacteria Source Tracking testing at all sites