Modeling Agriculture in the Caloosahatchee TMDL

Nathan Bailey, PhD
Watershed Evaluation & Assessment Section

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Outline

- Brief Background on TMDLs
- Brief background on Modeling
  - Modeling Land Uses & BMPs
- Review of Caloosahatchee Impairments
- Modeling For the Caloosahatchee TMDL
  - Land Uses
  - Agriculture
  - BMPs
- Questions – Ours and Yours

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Brief Background on TMDLs.

- **1972 - EPA Clean Water Act (CWA) Passed US Congress / signed by Richard Nixon**
- **Response to pollution Waste into Surface Waters Making 2/3 USA Water Unsafe for Fishing & Swimming**

Relevant Parts

- Section 303(c) authorizes States/tribes to Develop Water Quality Standards with Designated Uses
- Section 303(d)
  - states, territories, and authorized tribes are required to develop lists of impaired waters.
  - The law requires that these jurisdictions establish priority rankings for waters on the lists and develop Total Maximum Daily Load (TMDLs) for these waters.

Brief Background on TMDLs.

TMDL (or Loading Capacity) is max. amount of pollutant loading that can be discharged to a healthy water body

TMDL = WLA + LA + MOS

WLA=Waste load Allocation (Point Sources such as waste Treatment plant, industry discharges. Also Includes NPDES Stormwater discharge)

LA=Load Allocation (Non Point Sources such as agriculture)

MOS = Margin of Safety

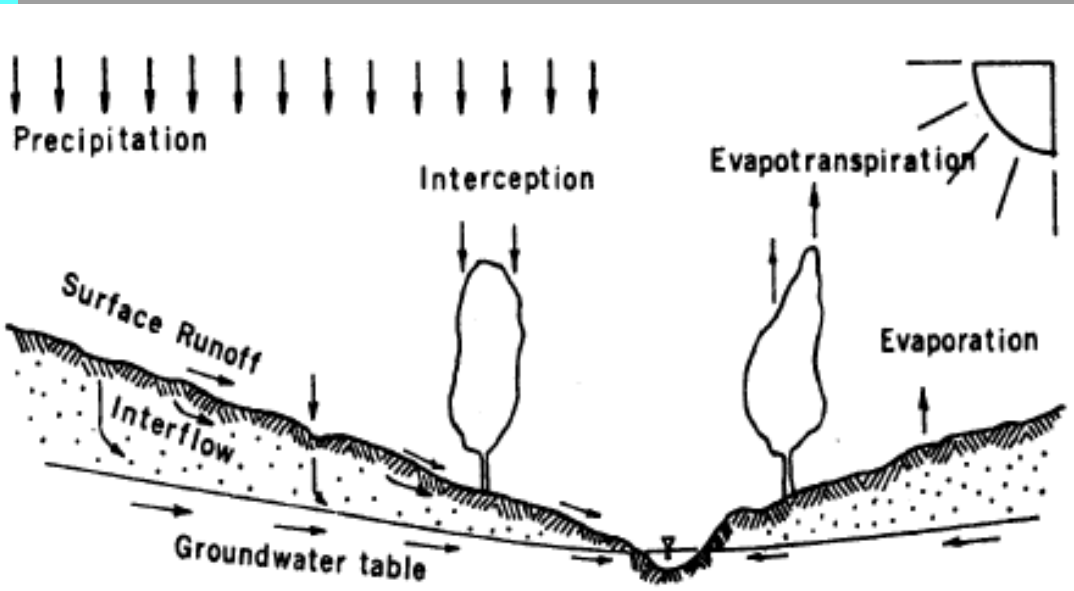
Big Push Resulted From; 48 lawsuits against EPA in 39 states

1999 Consent decree for Florida13 year schedule (2000 -2012)

FLORIDA WATERSHED RESTORATION ACT Section 403.067, F.S.

Brief Background on TMDL Computer Models

The Hydrologic Cycle



- Model Input Includes:
  - Rainfall & Climate
  - Land Features
    - Topography
    - Soils, Geology
    - Land Use and Management
  - Water Features
    - Stream Slopes, cross sections
    - Lake and Pond dimensions
    - Depth to Aquifer/Watertable

- Model Output Includes:
  - Runoff quantity and quality
  - Infiltration to groundwater
  - Surface Water Flow/Quality

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Brief Background on TMDL Computer Models

Spreadsheet Models such as WMM

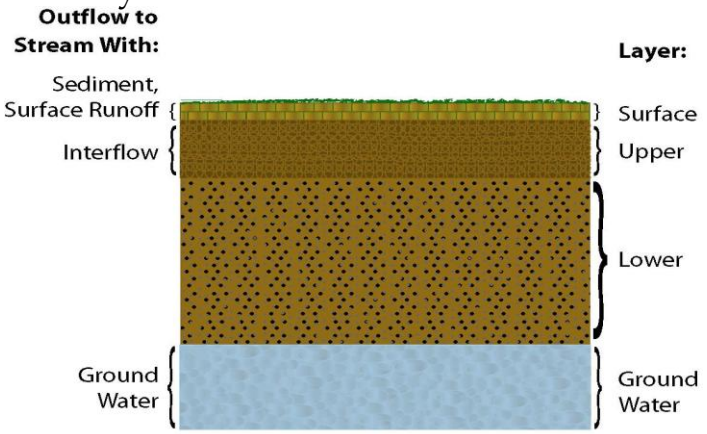
Table 4-12a. East Caloosahatchee Sub-watershed Existing BMP Coverage

Hydrologic Unit	EXISTING BMP COVERAGE											Total[a]
	Urban and Built-Up	Residential, low density	Residential, medium density	Residential, high density	Commercial and services	Industrial	Extractive	Institutional	Recreational	Agriculture	Transportation, communication, and utilities	
1 . 30-foot Canal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
2 . 42-foot Canal	1%	11%	7%	0%	0%	0%	0%	0%	0%	43%	1%	40%
10 . Bronson	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	55%	95%
11 . C-19	0%	0%	0%	0%	0%	0%	0%	0%	0%	78%	0%	76%
12 . C20 Canal	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
16 . Canal 3	0%	29%	0%	0%	0%	0%	0%	0%	0%	42%	1%	38%
19 . Citrus Center	0%	0%	0%	0%	0%	0%	0%	0%	0%	20%	0%	20%
21 . Clewiston	11%	2%	0%	0%	5%	1%	0%	0%	36%	90%	0%	34%
33 . Dixston Island WCD	0%	0%	0%	0%	0%	0%	0%	0%	18%	100%	0%	97%
37 . Flaghole WCD	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	95%
45 . Grassy Marsh	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	100%
52 . Hendry Hilliard WCD	0%	3%	0%	0%	0%	0%	0%	0%	0%	61%	0%	61%
54 . Hilliard	0%	68%	100%	0%	0%	100%	0%	0%	0%	51%	0%	51%
56 . Industrial Canal	0%	0%	0%	0%	0%	0%	0%	0%	0%	99%	0%	94%
58 . Jack Spratt (Myrtle Slough)	16%	4%	0%	0%	0%	4%	0%	0%	0%	19%	4%	18%
61 . L-42	0%	97%	0%	0%	0%	0%	0%	0%	0%	2%	0%	2%
65 . Lake Hicpochee	3%	2%	14%	0%	0%	0%	0%	0%	100%	94%	0%	90%
67 . Linden Pena Marsh	0%	14%	0%	0%	1%	0%	75%	0%	0%	0%	0%	4%
72 . Meander Ditch	0%	24%	0%	0%	0%	0%	0%	0%	0%	12%	1%	12%
75 . Moore Haven	30%	0%	0%	0%	0%	0%	0%	0%	4%	69%	2%	68%
77 . Nicodemus Slough	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
78 . Ninemile Canal	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	99%
102 . Sugarland WCD	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	95%
Total[b]	11%	11%	2%	0%	3%	6%	75%	0%	5%	99%	0%	51%

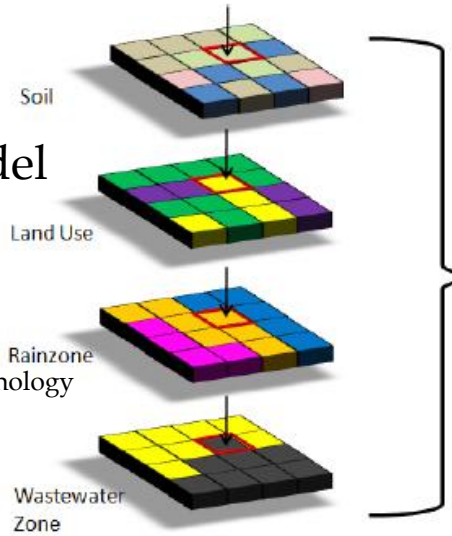
[a] Weighted BMP coverage with respect to the total area of land uses with BMPs.

Lumped Model Such as HSPF

Limited spatial definition
(i.e., lumped parameter approach)
Hydraulics limited to non-tidal freshwater systems and unidirectional flow



Distributed Model Such as WAM Model



Unique Cell Combinations

[Soil & Water Engineering Technology (SWET)]

Example of Spreadsheet Model Computations

Land Use	Area (acres)	% Impervious	Pervious Runoff Coefficient	Runoff (acre-feet)	Runoff (million gallons)
Forest/Rural Open	1,389	2.0%	0.159	1,132.3	369.0
Urban Open	22	2.0%	0.041	6.1	2.0
Agriculture/Pasture	58	4.0%	0.317	92.1	30.0
Low Density/Residential	273	14.0%	0.150	333.4	108.6
Medium Density/Residential	1,279	33.0%	0.088	2,219.9	723.4
High Density/Residential	378	33.0%	0.120	694.1	226.2
Commercial	543	72.0%	0.120	2,117.7	690.0
Industrial	396	55.0%	0.120	964.8	314.4
Highways	136	36.0%	0.542	283.0	92.2
Wetland	678	30.0%	0.230	1,409.5	459.3
Water	2	3.8%	0.000	0.3	0.1
Total	5,154			9,253	3,015

Land Use	TN Concen. (mg/L)	TP Concen. (mg/L)	TN load (lbs)	TP load (lbs)
For./Rural Open	1.09	0.046	3,356.2	141.6
Urban Open	1.12	0.18	18.6	3.0
Agriculture/Pasture	2.32	0.344	581.2	86.2
Low Density/Residential	1.64	0.191	1,487.0	173.2
Medium Density/Residential	2.18	0.335	13,160.0	2,022.3
High Density/Residential	2.42	0.49	4,568.1	924.9
Commercial	2.42	0.49	13,936.0	2,821.8
Industrial	2.42	0.49	6,349.2	1,285.6
Highways	2.23	0.27	1,716.1	207.8
Wetland	1.01	0.09	3,871.2	345.0
Water	1.01	0.09	1.0	0.1
Total			**49,044**	**8,011**

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IMPAIRED WATERBODIES

CALOOSAHATCHEE BASIN

Impaired and On the Consent Decree List

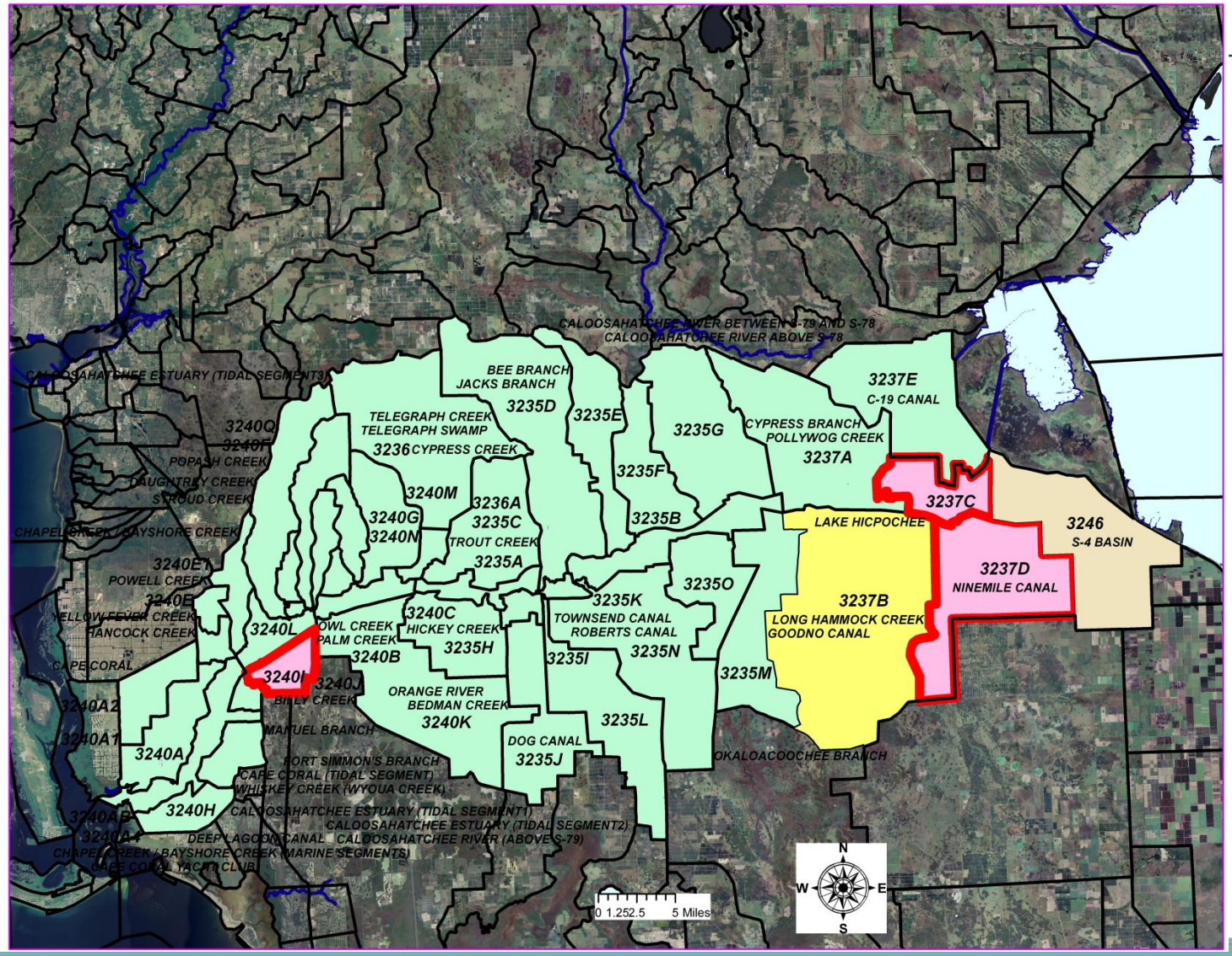
Water Segment	Impaired For	EPA TMDL	Suspected Causative Pollutant
S-4 Basin(WBID 3246)	Dissolved Oxygen	None	TN,TP, and BOD
S-4 Basin(WBID 3246)	Nutrients	None	TN and TP
Long Hammock Creek(WBID 3237B)	Nutrients	None	Indicated as Nutrients (Cycle 1) Although No Chla Cycle 2 exceeds, No "3 consec. years" data
Lake Hicpochee(WBID 3237C)	Dissolved Oxygen	EPA Finalized 2006 91% TP (LA)	TN
Ninemile Canal(WBID 3237D)	Dissolved Oxygen	EPA Finalized 2006 10% BOD, 57% TN, 59% TP (LA)	TN
Billy Creek(WBID 3240J)	Dissolved Oxygen	EPA Finalized 2006 29% BOD (LA & MS4)	TN and TP

Consent Decree Nutrient TMDLs in Development by FDEP

EPA TMDLs Finalized 2006 (DO)

DO & Nutrient

Nutrient



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Impaired and Not On the Consent Decree List

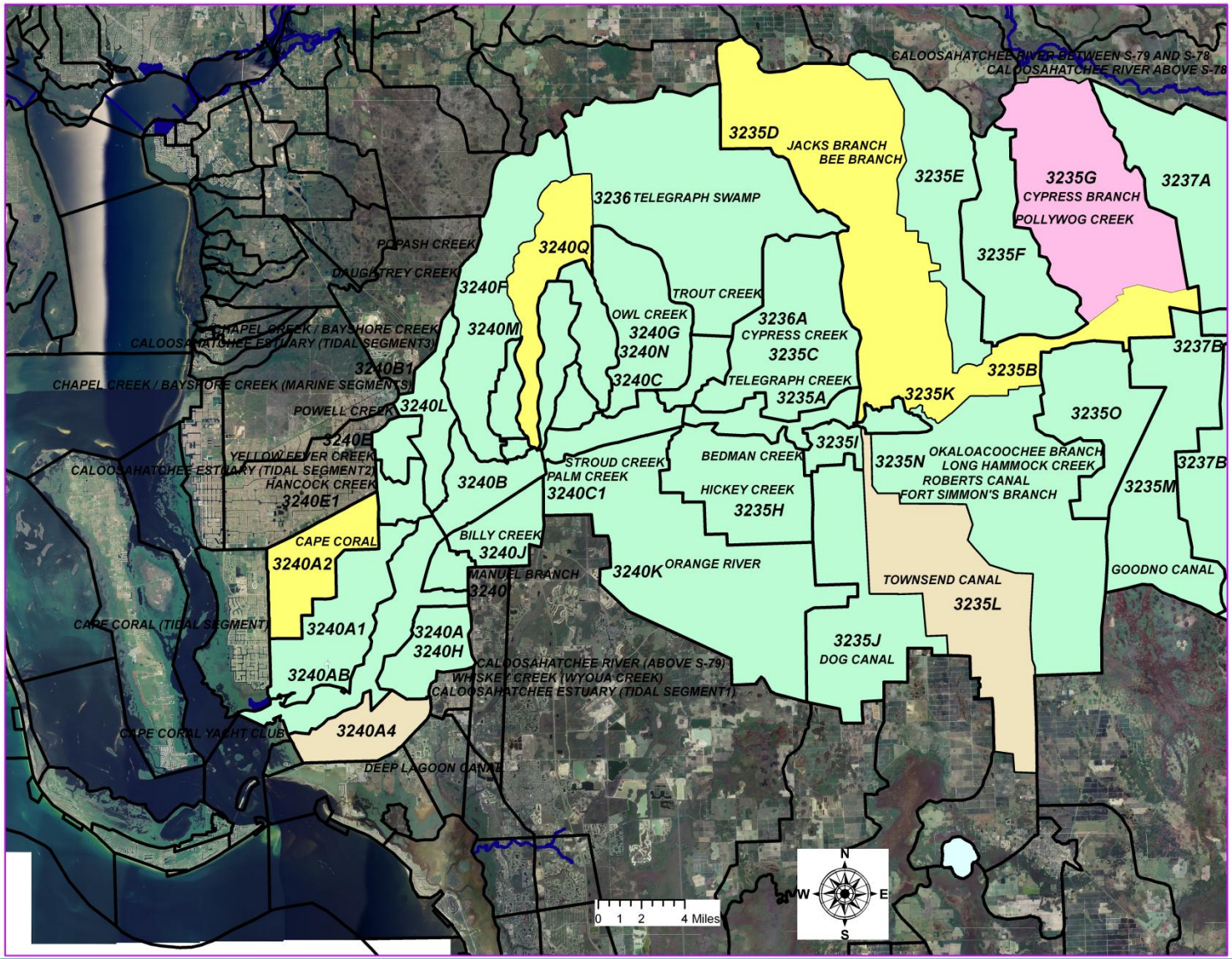
Water Segment	Impaired For	EPA TMDL?	Suspected Causative Pollutant
Cape Coral(WBID 3240A2)	Nutrients (Historic Chlorophyll)	NOT CONSENT DECREE	TP
Deep Lagoon Canal(WBID 3240A4)	Dissolved Oxygen (Nutrients)	NOT CONSENT DECREE	TN
Deep Lagoon Canal(WBID 3240A4)	Nutrients (Chlorophyll a)	NOT CONSENT DECREE	TN (and TP?) TN/TP ratio on line
Popash Creek(WBID 3240Q)	Nutrients (Chlorophyll a)	NOT CONSENT DECREE	TN and TP
Caloosahatchee River Between S-79 And S-78(WBID 3235B)	Nutrients (Chlorophyll a)	NOT CONSENT DECREE	TP
Jacks Branch(WBID 3235D)	Nutrients (Chlorophyll a)	NOT CONSENT DECREE	Not meet delisting requirements
Cypress Branch(WBID 3235G)	Dissolved Oxygen (Nutrients)	NOT CONSENT DECREE	TN and TP
Townsend Canal(WBID 3235L)	Dissolved Oxygen (Nutrients)	NOT CONSENT DECREE	TP
Townsend Canal(WBID 3235L)	Nutrients (Chlorophyll a)	NOT CONSENT DECREE	TN and TP

Non Consent Decree TMDLs Being Developed

Nutrients Impairment

Nutrients and Low DO Impairment

Low DO Impairment



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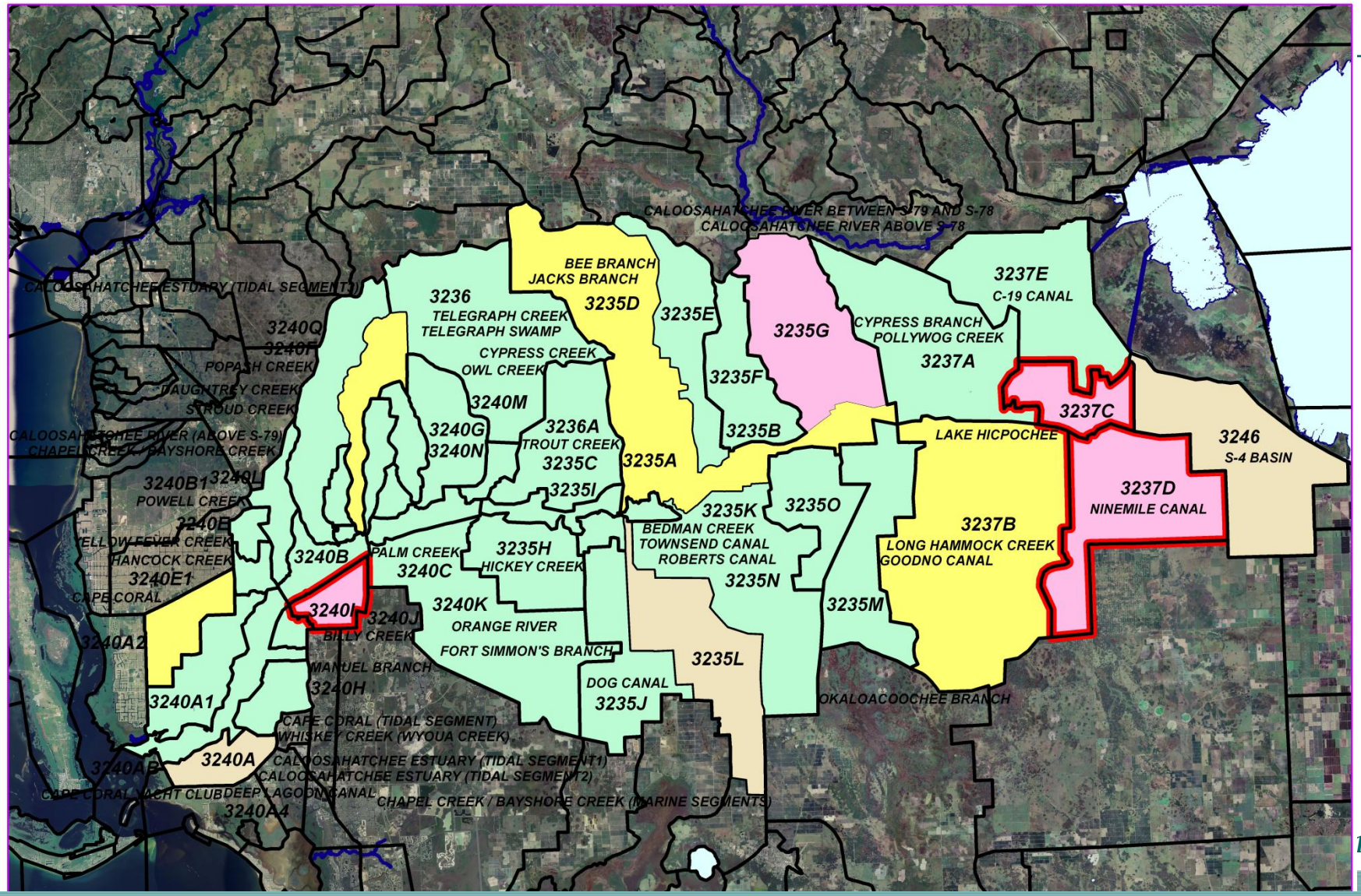
All TMDLs Being Developed

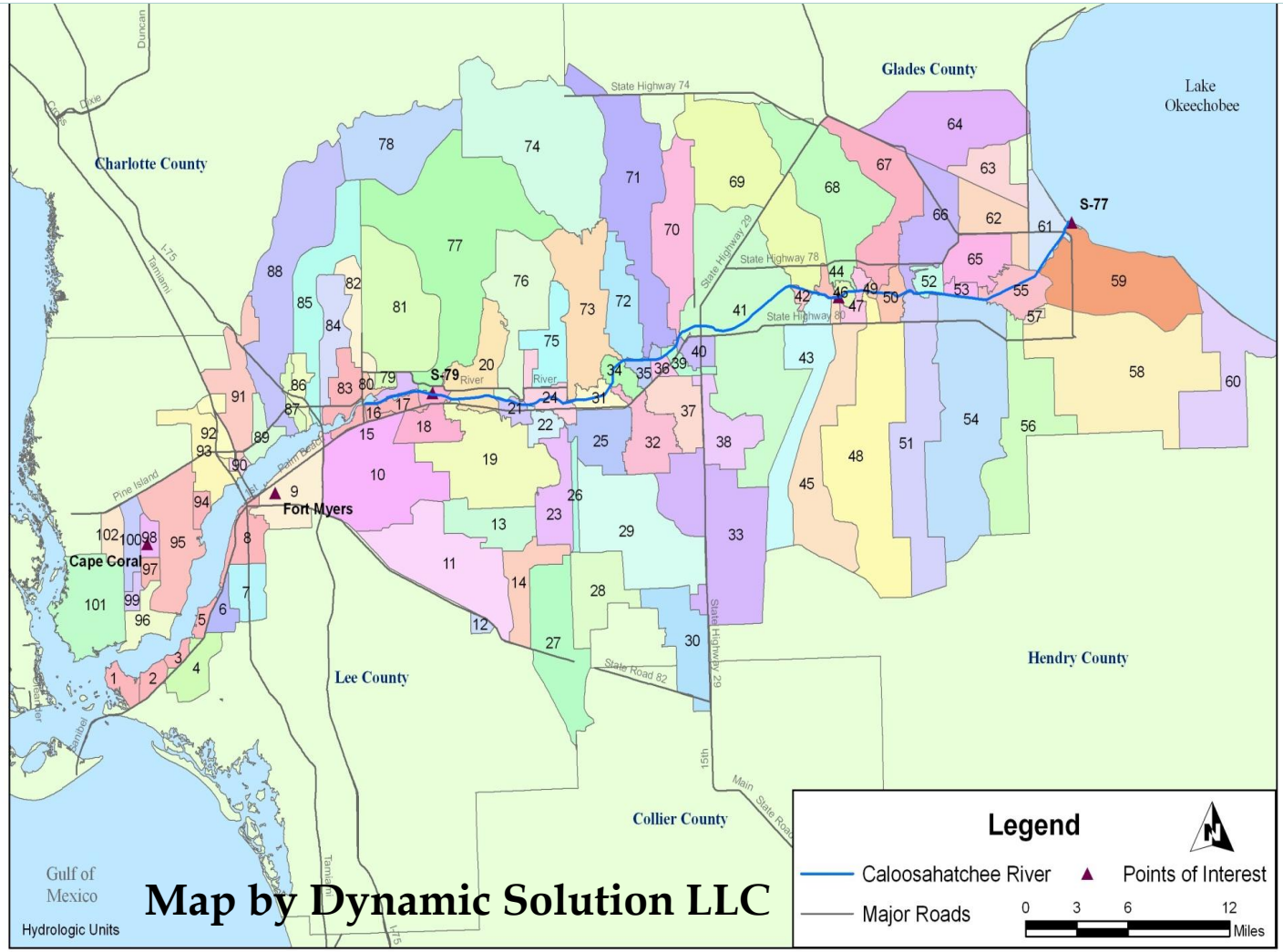


Nutrients Levels in Impaired WBIDs

WBID	Total Nitrogen		Total Phosphorus		BOD		DO	
	Median	Maximum	Median	Maximum	Median	Maximum	Median	Minimum
3237D	1.62	5.58	0.070	0.483	2	3.8	3.935	0.57
3246	1.82	17.20	0.107	0.535	2.5	3.8	5.87	0.4
3240Q	0.98	3.81	0.092	0.540	1.9	8	4.3	0.6
3240J	1.06	3.10	0.220	1.120	1.8	8	4.2	0.3
3240A4	1.21	4.56	0.120	1.370	2.5	8.7	2.1	0.1
3240A2	0.60	20.65	0.016	3.586	2.4	9.5	7.27	0.15
3237C	1.76	4.30	0.030	0.250	2.5	6.7	5.51	0.86
3237B	1.31	2.89	0.066	0.586	2	6.8	7.57	1.86
3235L	1.51	7.40	0.130	1.800	2.3	26	4.87	0.26
3235G	1.72	6.21	0.120	1.800	2.1	13	4.88	0.4
3235D	1.13	5.78	0.046	0.615	2	5.4	4.83	0.19
3235B	1.50	5.10	0.084	0.960	2	3.8	8.22	2.4

Modeling the Watersheds in the Caloosahatchee

TMDL Model Representation of the Caloosahatchee Watershed



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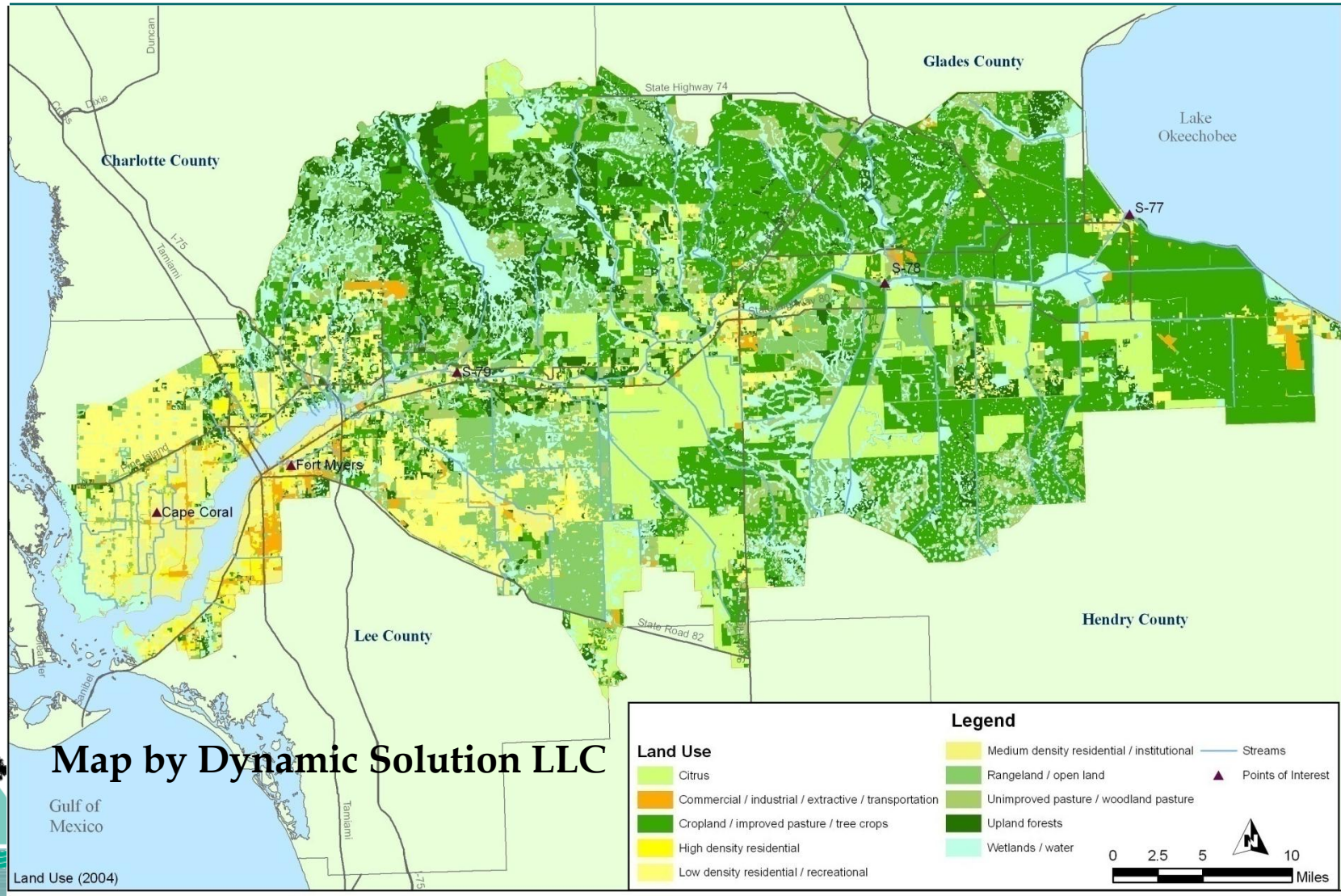
Caloosahatchee Land Uses



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Loads (Relative to Landuse)

Although HSPF is not a model that uses EMCs, the Below Table Provides a Good Look at the Loads Related to different Land uses. These are also the HSPF Landuse divisions in the Caloosahatchee HSPF Model.

Land Use	Total N EMC mg/L	Flow Factor C	DCIA
A. Forest/Rural Open	*1.16*	*0.30*	*1*
B. Urban Open	*1.16*	*0.30*	*1*
C. Agriculture/Pasture	*3.18*	*0.32*	*5*
D. Low Density/Residential	*2.02*	*0.33*	*10*
E. Medium Density/Residential	*2.34*	*0.38*	*26*
F. High Density/Residential	*2.45*	*0.45*	*49*
G. Commercial	*1.87*	*0.50*	*66*
H. Industrial	*1.87*	*0.50*	*66*
I. Highways	*1.87*	*0.50*	*66*
J. Water/Wetland	*0.96*	*0.32*	*5*
NOTES			
1. EMC reflects typical surface runoff concentration			
2. Flow factor C based on following:			
a. Pervious runoff coefficient = 0.15 based on Caloosahatchee WMM calibration			
b. Impervious runoff coefficient = 0.75 based on Caloosahatchee HSPF calibration			
c. Adjustment to account for expected baseflow quantity and quality			

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Caloosahatchee Load Reductions Per BMPs

Caloosahatchee HSPF (& WMM) Model
Urban and Agricultural BMP Removal Efficiencies by Constituent and BMP Type

Urban and Agricultural BMP Removal Efficiencies	Urban BMP	Agricultural BMP 1	Agricultural BMP 2	Agricultural BMP 3	Agricultural BMP 4
Total Suspended Solids	0.85	0.80	0.30	0.50	0.10
BOD5	0.30	0.40	0.13	0.23	0.07
Nitrate+Nitrite	0.35	0.30	0.10	0.18	0.05
Total Kjeldahl Nitrogen (TKN)	0.25	0.30	0.10	0.18	0.05
Dissolved Phosphorus	0.65	0.60	0.20	0.35	0.10
Total Phosphorus	0.50	0.60	0.20	0.35	0.10

Agricultural BMP 1 Water Management Activities
Agricultural BMP 2 Water Control Structures Maintenance
Agricultural BMP 3 Pest Management Activities
Agricultural BMP 4 Nutrient Management Activities

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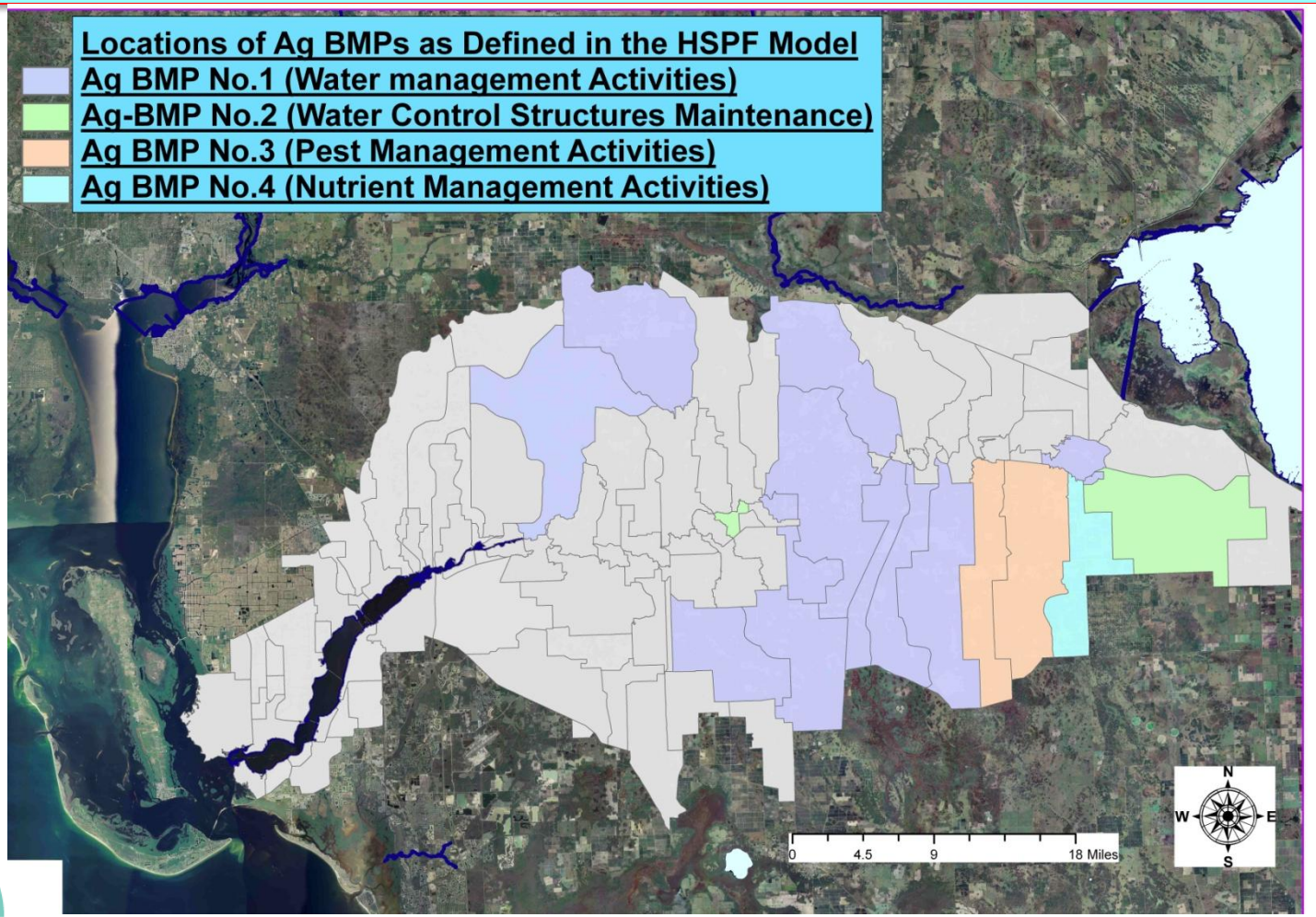
For the Caloosahatchee TMDL Model– Why, Where and how are BMPs Included?

- Because a computer model attempts to simulate existing conditions, it must simulate BMPs and their Effect on the Load. Thus for Model to Best Work, we need to input the existing level of BMP implementation. (How many acres, where, and what BMPs)
- If we don't have the actual acres, we make educated guesses (i.e. a percentage of NOI sign-ups, or input from Stakeholders)

Where Are the Ag BMPs (2003 – 2005) in Caloosahatchee Basin (As input into Model)?



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The goal is to stay up-to-date on any changes and correct any assumptions To Provide the Best Model & Improved Chances For Basin Improvements

We need Your (Stakeholder) Input.

Let us know if we have got it wrong.

Questions?

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