MONITORING DESIGN STRATEGIES

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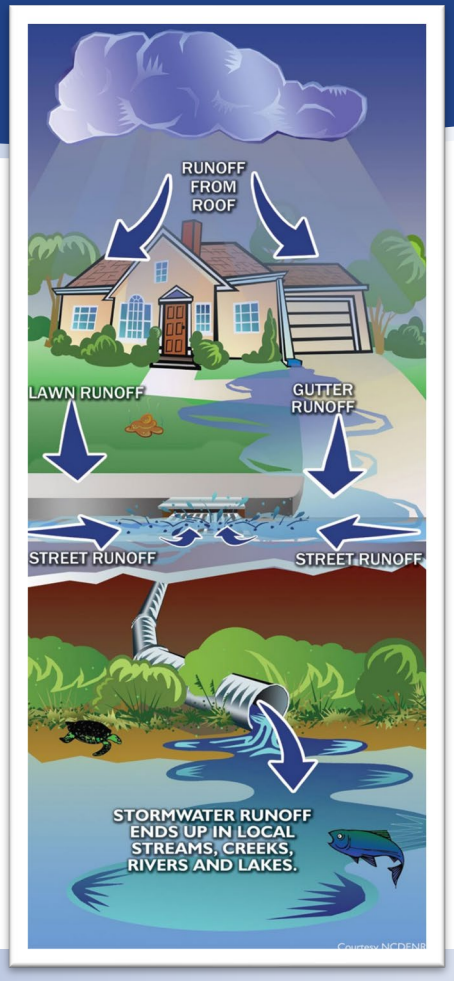
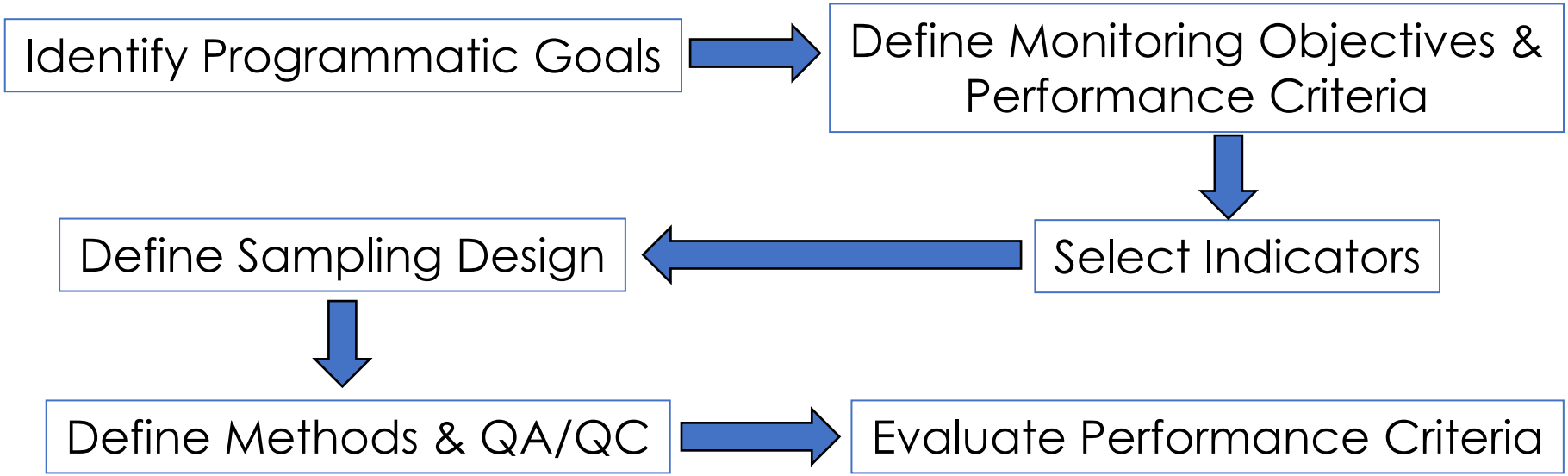
Why Do We Monitor?

- Regulatory requirements
  - NPDES
  - TMDLs and BMAPs
  - Reasonable Assurance Plans
- Watershed planning efforts
- Resource protection
- Public health

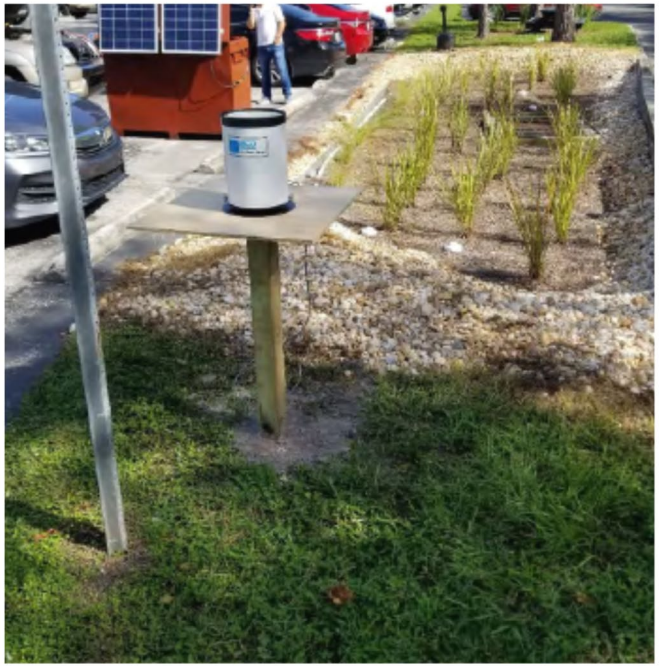


Monitoring Plan Development: Outfall and Ambient Water Quality



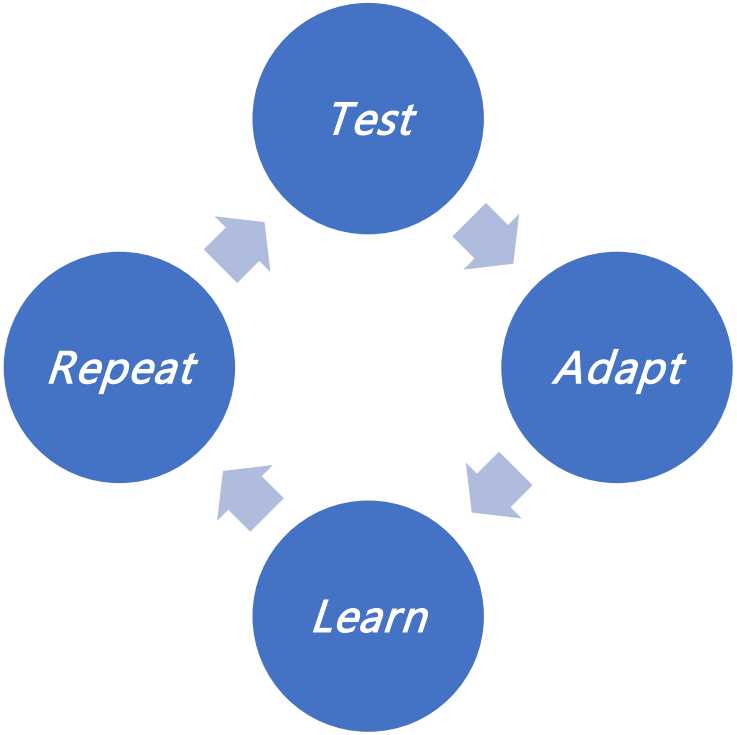
Monitoring Goals

- Identify potential water quality problem areas,
- Measure the effectiveness of stormwater pollution reduction measures,
- Document pollutant loadings,
- Water quality trends through time,
- Assess permit compliance.



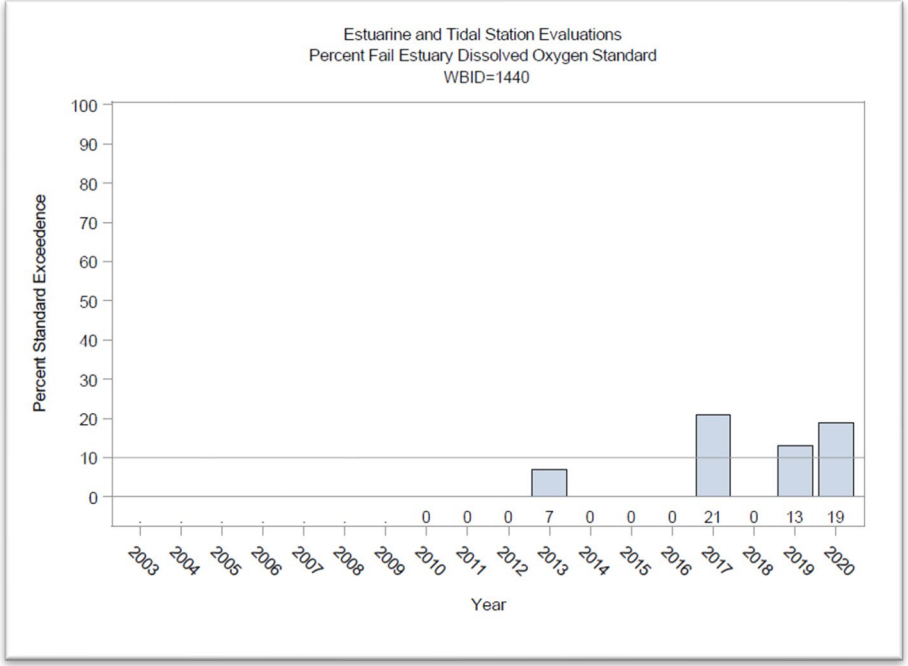
Developing Successful Monitoring Programs

- Get expert assistance if needed
- Develop a plan
- Determine what questions need answered
- Develop goals and objectives
- Develop and set guidelines
- Acknowledge constraints
- Test, adapt, learn, test again…



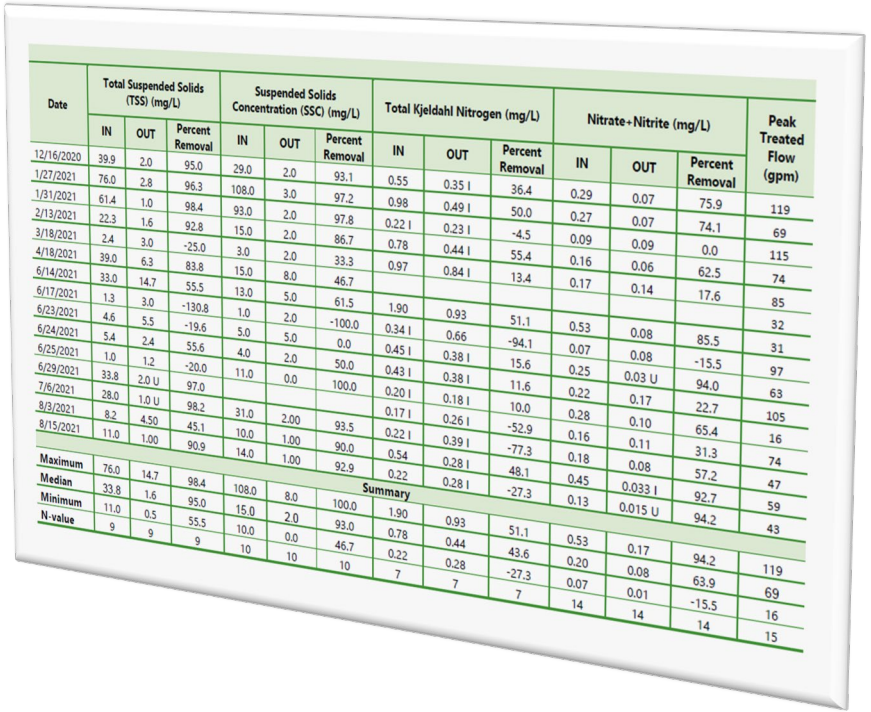
What Do We Need to Know?

- **What questions can be answered by ambient WQ monitoring?**
  - **Are waters attaining WQ standards?**
  - **Status and trends of WQ in receiving waters.**



What Do We Need to Know?

- **What questions can be answered by outfall monitoring?**
  - **Where are the problem areas?**
  - **What are the sources of pollutants and where are they coming from?**
  - **Pollutant loading estimates**
  - **How well is a BMP working?**



Date	Total Suspended Solids (TSS) (mg/L)			Suspended Solids Concentration (SSC) (mg/L)			Total Kjeldahl Nitrogen (mg/L)			Nitrate+Nitrite (mg/L)			Peak Treated Flow (gpm)
	IN	OUT	Percent Removal	IN	OUT	Percent Removal	IN	OUT	Percent Removal	IN	OUT	Percent Removal	
12/16/2020	39.9	2.0	95.0	29.0	2.0	93.1	0.55	0.35 I	36.4	0.29	0.07	75.9	119
1/27/2021	76.0	2.8	96.3	108.0	3.0	97.2	0.98	0.49 I	50.0	0.27	0.07	74.1	69
1/31/2021	61.4	1.0	98.4	93.0	2.0	97.8	0.22 I	0.23 I	-4.5	0.09	0.09	0.0	115
2/13/2021	22.3	1.6	92.8	15.0	2.0	86.7	0.78	0.44 I	55.4	0.16	0.06	62.5	74
3/18/2021	2.4	3.0	-25.0	3.0	2.0	33.3	0.97	0.84 I	13.4	0.17	0.14	17.6	85
4/18/2021	39.0	6.3	83.8	15.0	8.0	46.7							32
6/14/2021	33.0	14.7	55.5	13.0	5.0	61.5	1.90	0.93	51.1	0.53	0.08	85.5	31
6/17/2021	1.3	3.0	-130.8	1.0	2.0	-100.0	0.34 I	0.66	-94.1	0.07	0.08	-15.5	97
6/23/2021	4.6	5.5	-19.6	5.0	5.0	0.0	0.45 I	0.38 I	15.6	0.25	0.03 U	94.0	63
6/24/2021	5.4	2.4	55.6	4.0	2.0	50.0	0.43 I	0.38 I	11.6	0.22	0.17	22.7	105
6/25/2021	1.0	1.2	-20.0	11.0	0.0	100.0	0.20 I	0.18 I	10.0	0.28	0.10	65.4	16
6/29/2021	33.8	2.0 U	97.0				0.17 I	0.26 I	-52.9	0.16	0.11	31.3	74
7/6/2021	28.0	1.0 U	98.2	31.0	2.00	93.5	0.22 I	0.39 I	-77.3	0.18	0.08	57.2	47
8/3/2021	8.2	4.50	45.1	10.0	1.00	90.0	0.54	0.28 I	48.1	0.45	0.033 I	92.7	59
8/15/2021	11.0	1.00	90.9	14.0	1.00	92.9	0.22	0.28 I	-27.3	0.13	0.015 U	94.2	43
Summary													
Maximum	76.0	14.7	98.4	108.0	8.0	100.0	1.90	0.93	51.1	0.53	0.17	94.2	119
Median	33.8	1.6	95.0	15.0	2.0	93.0	0.78	0.44	43.6	0.20	0.08	63.9	69
Minimum	11.0	0.5	55.5	10.0	0.0	46.7	0.22	0.28	-27.3	0.07	0.01	-15.5	16
N-value	9	9	9	10	10	10	7	7	7	14	14	14	15

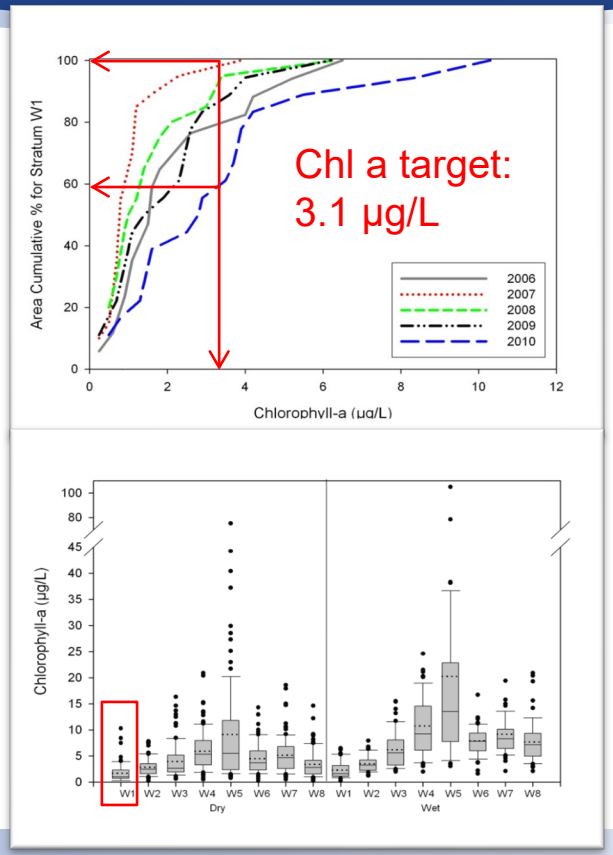
Monitoring Designs Outfall and Ambient WQ

- **Targeted**
  - **Good for answering specific questions**
  - **Bias limits use of data**
  - **Examples:**
    - Sources of water quality problems (TMDLs),
    - BMP effectiveness, or
    - Loading estimates

- **Probability-based**
  - **Good for statistically unbiased assessments**
  - **Difficult when sites are constrained**
  - **May require additional resources**
  - **Examples:**
    - Long-term assessments of water quality or
    - Site specific studies

Q1: Are Waters Attaining WQ Standards?

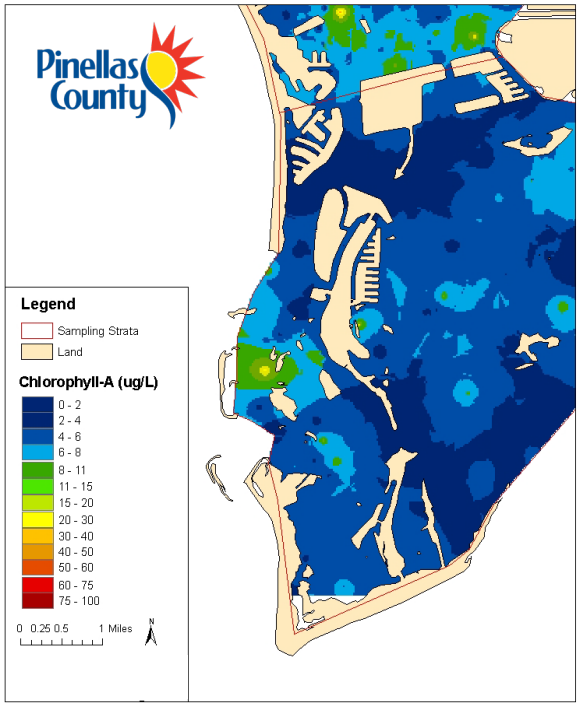
- **Probability-based design = site selection and temporal variability**
- **Targeted ONLY if complete coverage can be assessed**



Q1: Are Waters Attaining WQ Standards?

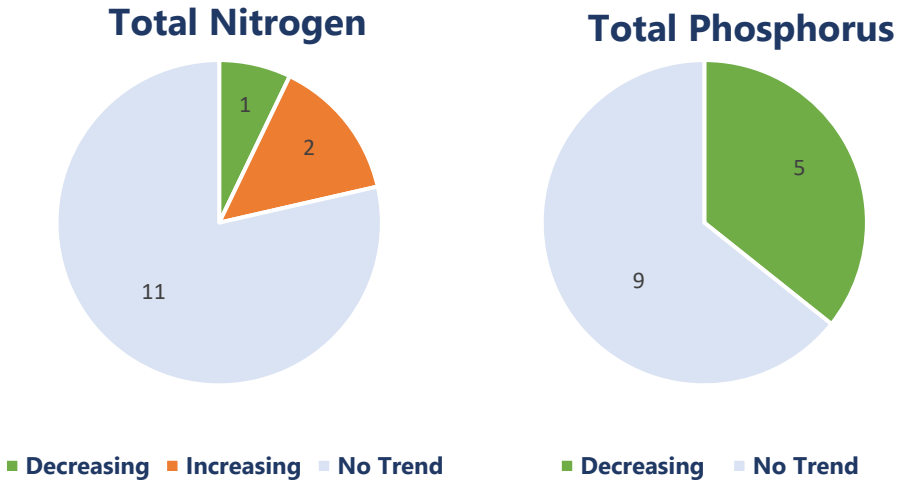
- Boca Ciega Bay North
  - Seagrass target = 1,140 acres
  - Depth target = 1.7 m
  - Chlorophyll *a* threshold = 8.3 µg/L
  - Based on a reference period approach,
    - TN load target = 94 tons/year
    - TN load threshold = 1.54 tons/million m^3
    - TN concentration criterion = 0.57 mg/L

- Boca Ciega Bay South
  - Seagrass target = 7,220 acres
  - Depth target = 2.8 m
  - Chlorophyll *a* threshold = 6.3 µg/L
  - Based on a reference period approach,
    - TN load target = 82 tons/year
    - TN load threshold = 0.97 tons/million m^3
    - TN concentration criterion = 0.54 mg/L



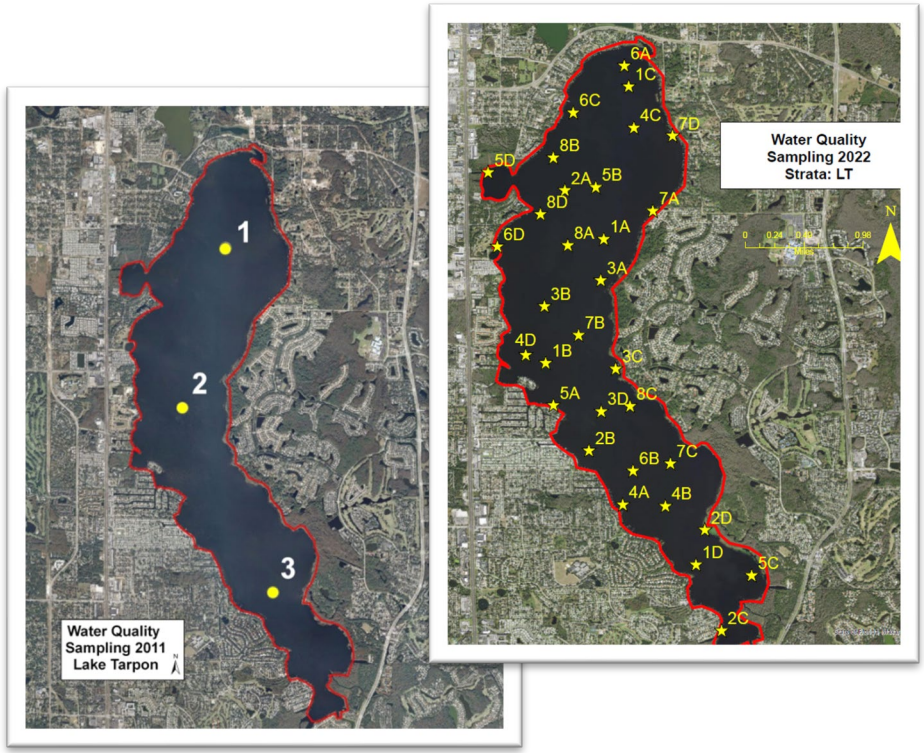
Q2: Water Quality Status and Trends

- **Traditional ambient WQ monitoring program**
- **Design can be targeted or probability-based**



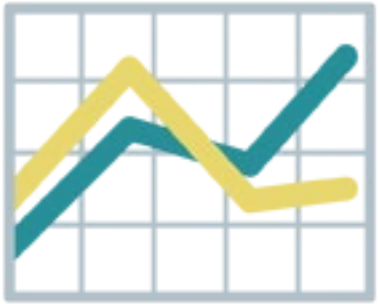
Q2: Water Quality Status and Trends

- **Frequency is dependent on assessment needs**
- **Limitations on data**
- **Planning and design is critical!**



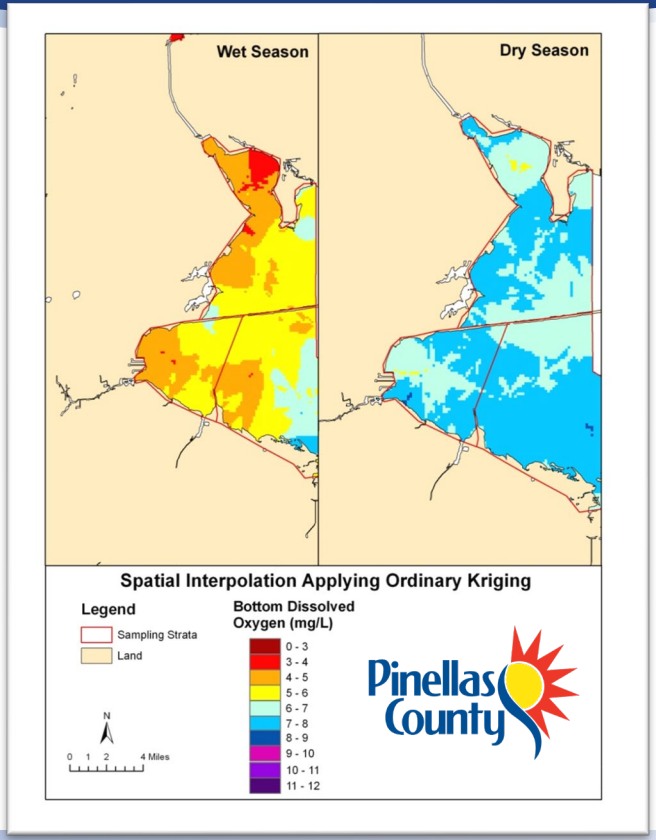
Q2: Water Quality Status and Trends

- **Fulfill NPDES/TMDL obligations**
- **Provide an early warning program***
- **Measure long-term WQ response to management efforts**
- **Estimate the magnitude and direction of change over a specific time frame**
- **Estimates for given parameters – annual, once every five years, etc.**



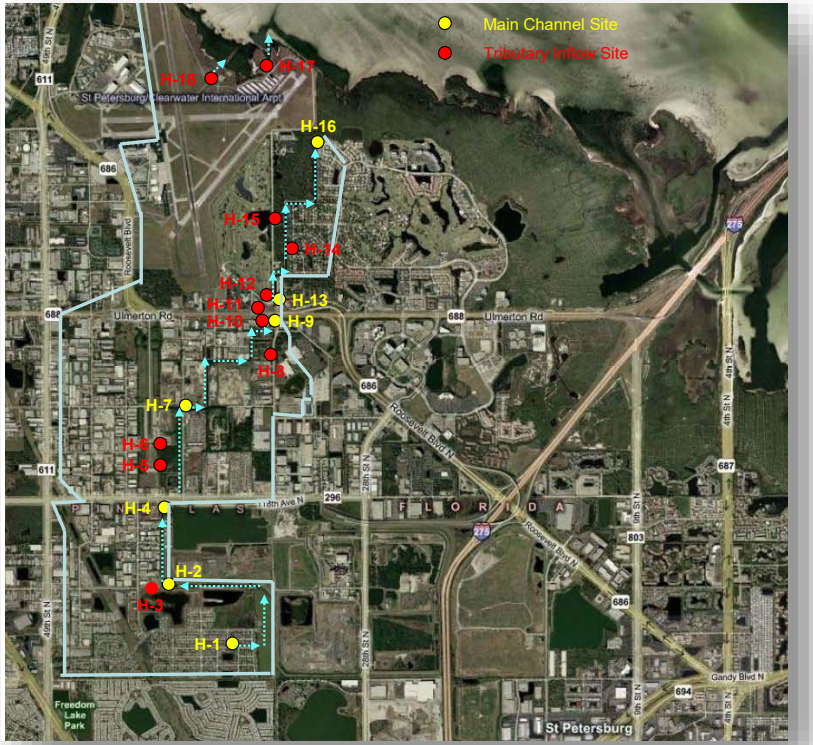
Q3: Where are the problems?

- Probability-based
- Targeted if complete coverage is known or monitoring a point-source
- Short or long-term assessments
- Outfall selection could be based on watershed modeling



Q4: What are the Sources of Pollutants and Where are they Coming From?

- Pollution source tracking, TMDLs
- Targeted monitoring
- Surface water, groundwater, and sediments

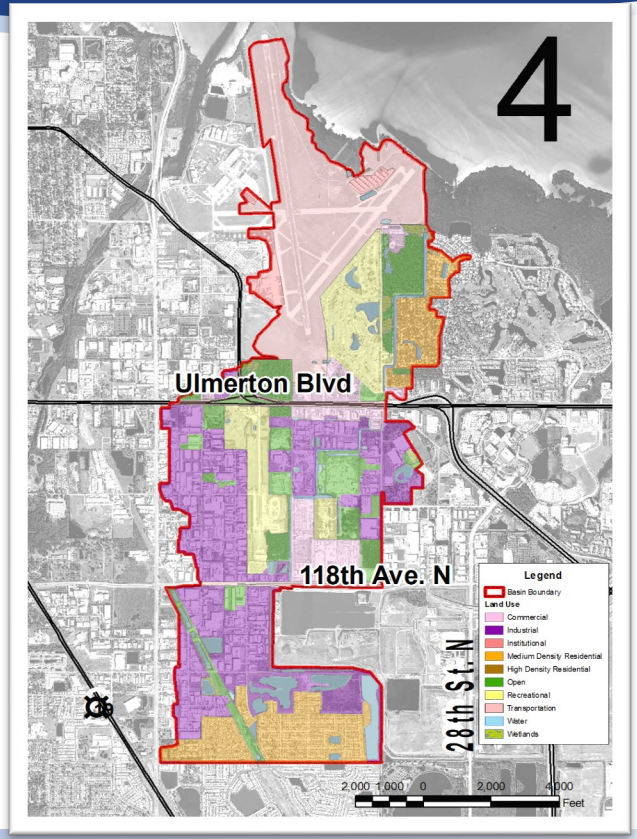


Q4: What are the Sources of Pollutants and Where are they Coming From?

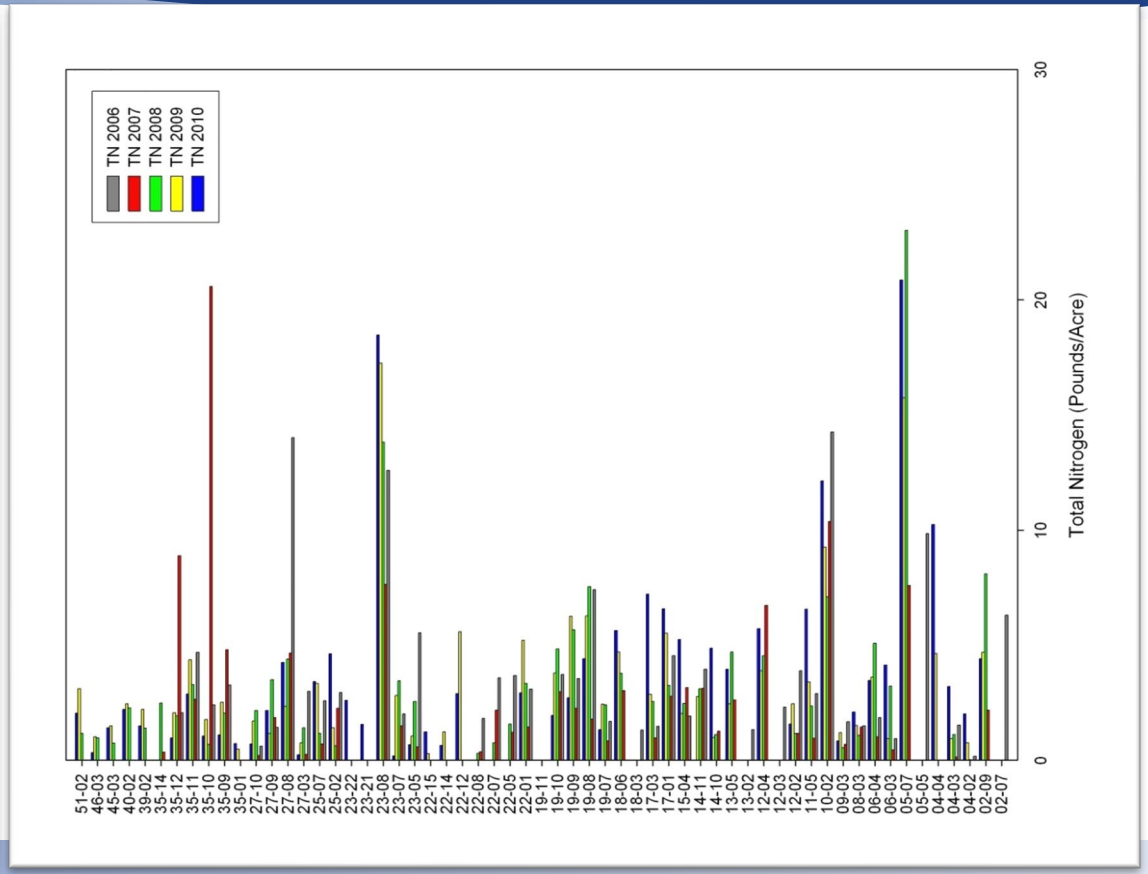
PARAMETER	UNITS	INFLOW SITES									
		H-1	H-3	H-5	H-6	H-8	H-10	H-11	H-12	H-14	H-15
Alkalinity	mg/l	122	140	245	263	269	186	176	192	144	137
NH_3	mg/l	213	105	255	55	**2974**	46	221	56	72	142
NO_x	mg/l	15	20	627	18	103	67	131	56	10	10
Diss. Org. N	mg/l	452	428	368	555	**1274**	684	597	528	589	750
Particulate N	mg/l	659	162	108	149	50	87	704	146	572	390
Total N	mg/l	1339	715	1359	777	**4401**	884	1653	786	1242	1291
SRP	mg/l	9	10	10	17	17	264	4	360	2	216
Diss. Org. P	mg/l	8	6	4	10	9	17	5	124	6	8
Particulate P	mg/l	86	21	12	45	31	65	92	75	58	74
Total P	mg/l	102	37	27	71	57	345	101	559	66	298
Turbidity	NTU	4.2	1.0	2.5	3.6	2.1	1.7	6.8	2.9	2.5	4.2
Color	Pt-Co	32	32	43	44	141	69	47	95	36	100
TSS	mg/l	11.9	1.4	2.9	4.3	3.3	2.2	11.8	6.2	4.1	6.2

Q5: Estimates of Pollutant Loading

- **Targeted monitoring**
- **Outfall/EMC based**
  - Resource intensive
  - Problematic in urban areas, coastal areas
  - Numerous contributing factors
- **Gauged/WQ based**
  - More accurate discharge estimates
  - Reflective of existing conditions

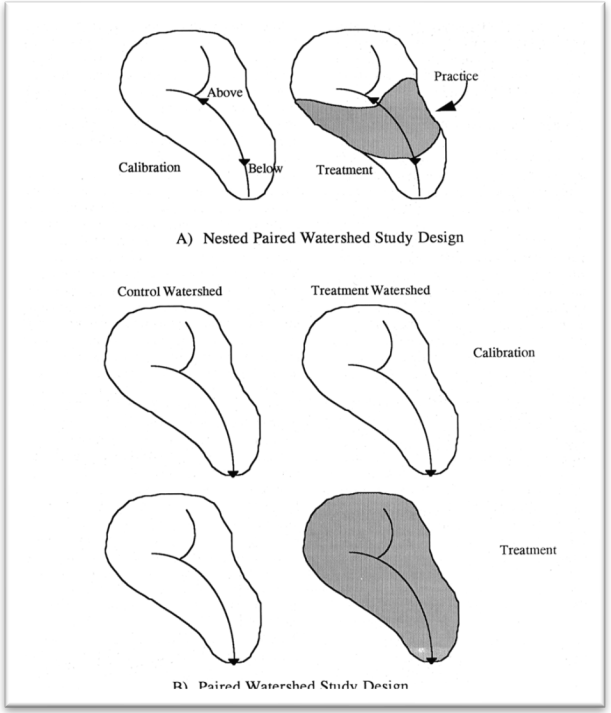


Q5: Estimates of Pollutant Loading



Q6: How Well is a BMP Working?

- **Targeted = Individual BMP**
  - **Inflow/outflow; upstream/downstream**
  - **~Short term**
- **Targeted or probability-based = set of BMPs**
  - **~Long term (>5 years)**



Source: EPA

Summary

- **The monitoring design approach must:**
  - ✓ **Answer the questions**
  - ✓ **Provide a path to accomplishing the goals**
  - ✓ **Meet the specific objectives**
  - ✓ **Adhere to the guidelines and constraints**
  - ✓ **Be adaptive over time***

Adaptive Management

Applying adaptive management involves the integration of project/program design, management, and monitoring to systematically test assumptions in order to adapt and learn.

Questions

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