WORKSHOP

Wetland Assessment Tool for Condition & Health (WATCH)

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Project and Tool Overview

- **What is WATCH?**
- **How is it different?**
- **Who are the users?**
- **Why is it important for restoration work?**

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What is WATCH?

Wetland

Assessment

Tool for

Condition &

Health

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Salt marshes are complicated

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An all encompassing evaluation is critical for an accurate diagnosis

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What are these key attributes?

What makes WATCH different?

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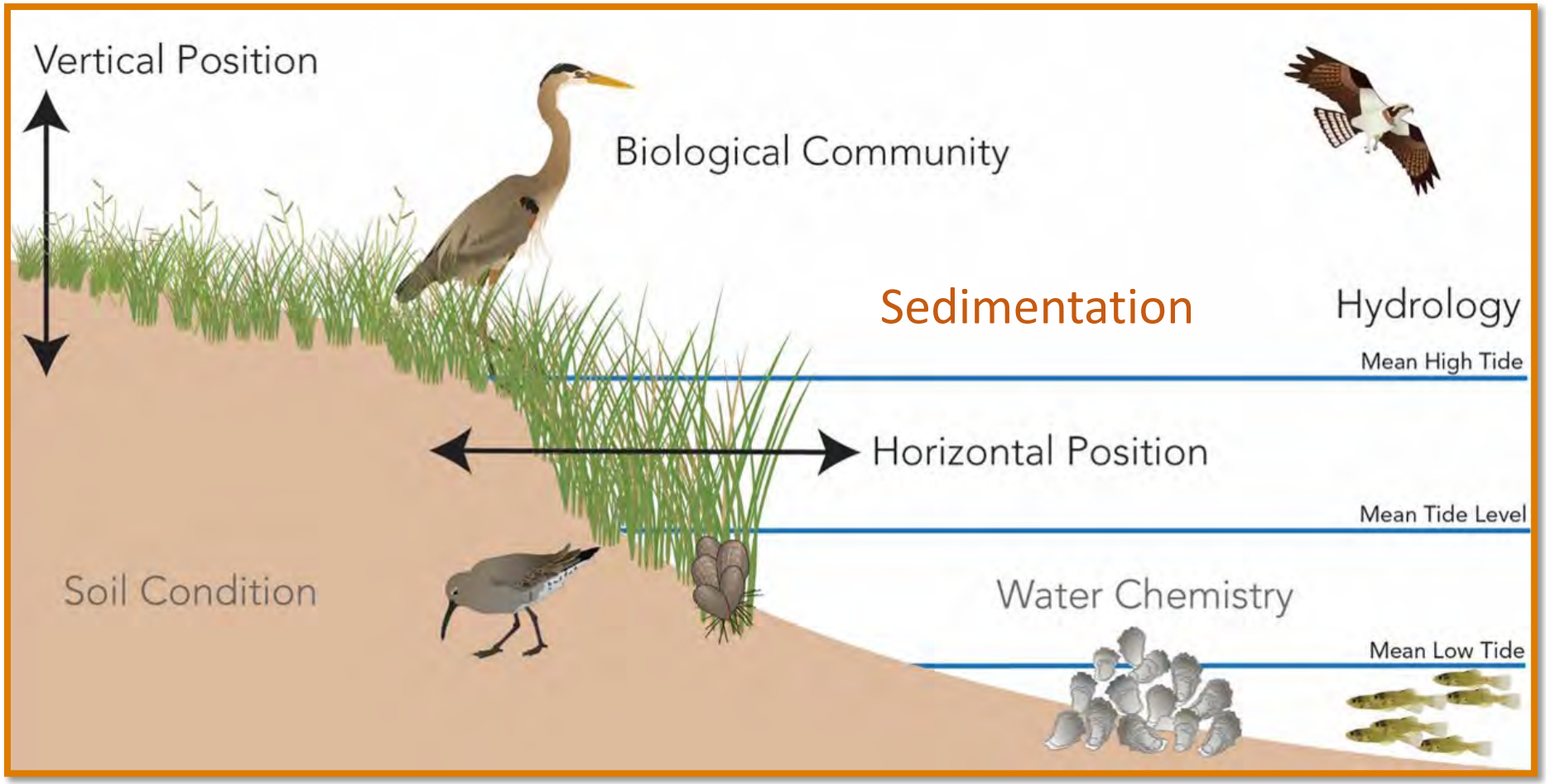

Key attributes to proper salt marsh function

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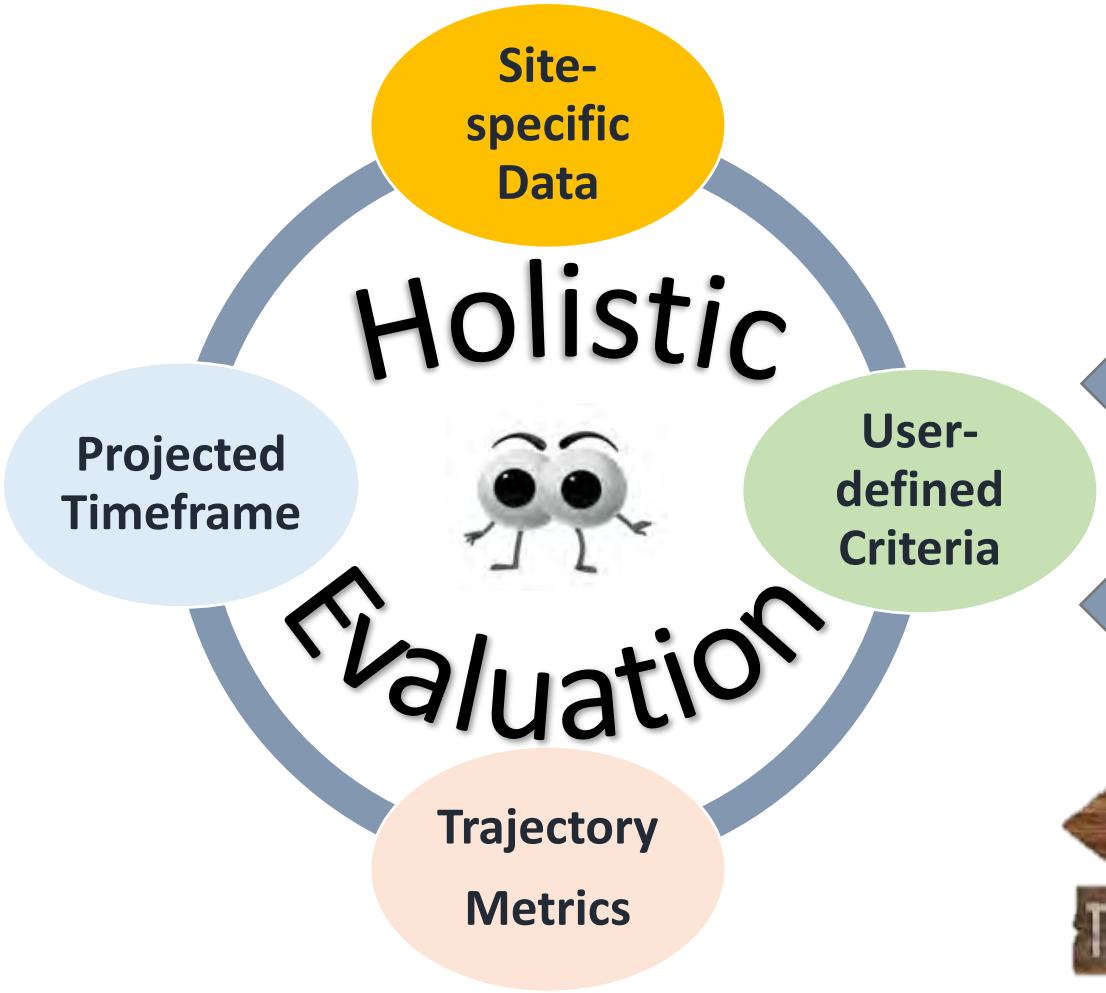
WATCH



Attribute Violations Today

+

Attribute Violations Tomorrow

=

Site-wide Deficiencies

+

Attributes of Concern

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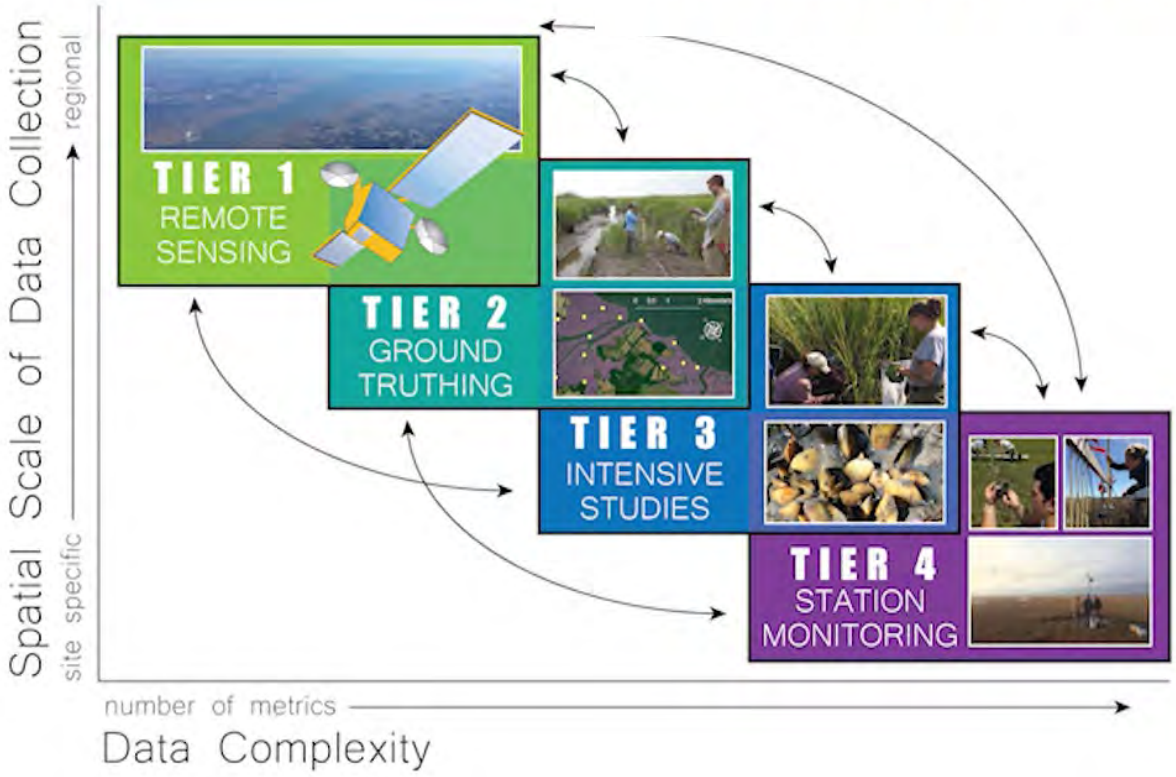
MACWA

Mid-Atlantic Coastal Wetlands Assessment



Contact lhaaf@delawareestuary.org

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Is WATCH for me?

You betcha!

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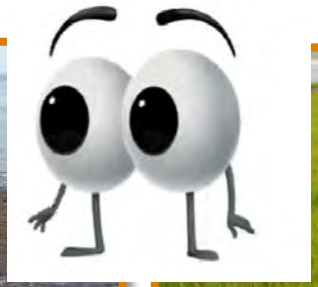

Are we looking at the same set of deficiencies at both sites or are they different?

Is one more urgent than the other?

Should we intervene? Now? Later?

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The importance of WATCH in restorations work

- Holistic assessment of concerns
- Data driven evaluations – no myopia
- Standardized and repeatable process across professions
- Aligns with other monitoring guidelines
- Provides a place to document the decision making processes and the data

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Introduction and Walk-through of WATCH

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Science Technical Analyst
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March 2021 WATCH Workshop

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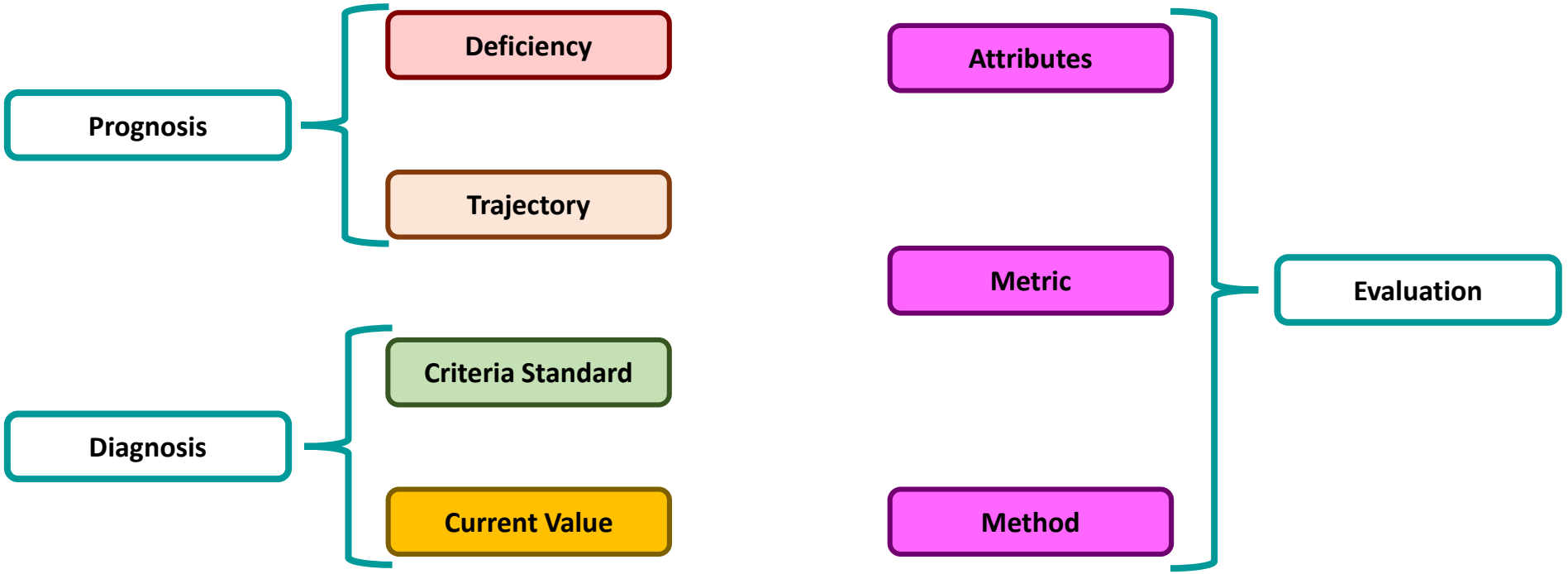
Introduction and Walk-through of WATCH

1. Definitions and connections
2. Attributes in the tool
3. Tool workflow- relationships and outcomes

1. Definitions and connections

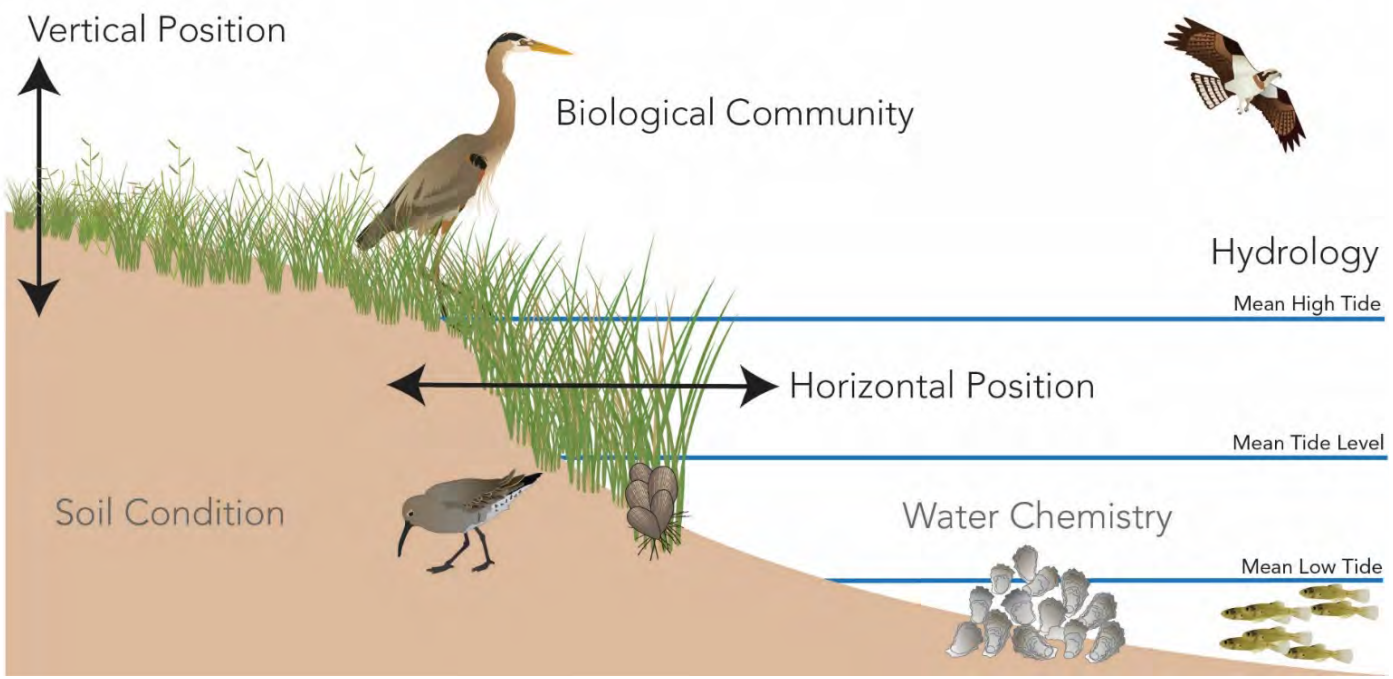
So, how *do* we assess wetland condition and health?

So, how *do* we assess wetland condition and health?



2. Attributes in the tool

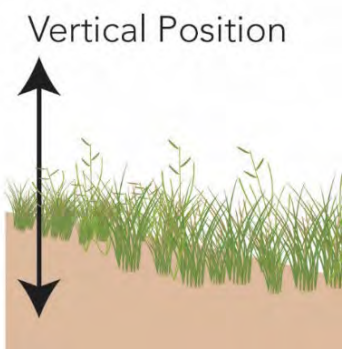
Attributes: fundamental in nature



It is key that we describe these Attributes using the best and most appropriate Metrics

These should be gathered using the established Methods

Attributes: fundamental in nature



Metric = Elevation
Units = Meters

Methods = LiDAR, RTK-GPS Survey, etc.

All attribute metrics require *justification*

3. Tool workflow- relationships and outcomes

Horizontal Position	Vertical Position	Biology	Hydrology	Soil Condition	Water Chemistry

Data Input

Current or Most Recent Metric: What is the current state of the site?
Criteria Metric

Current Value

Criteria Standard

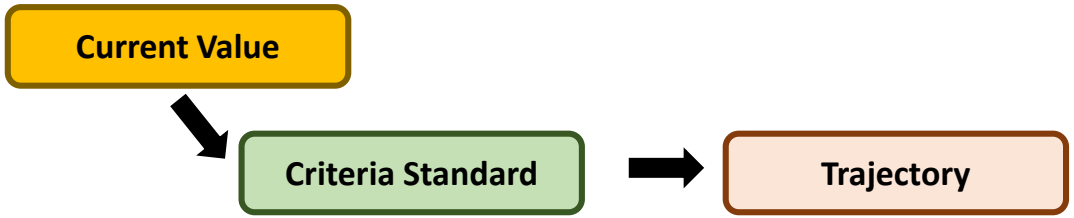
Quality *Criteria* = optimal, published standard

Reference *Criteria* = similar, representative sites

Target *Criteria* = desired specific metric value range

Horizontal Position	Vertical Position	Biology	Hydrology	Soil Condition	Water Chemistry

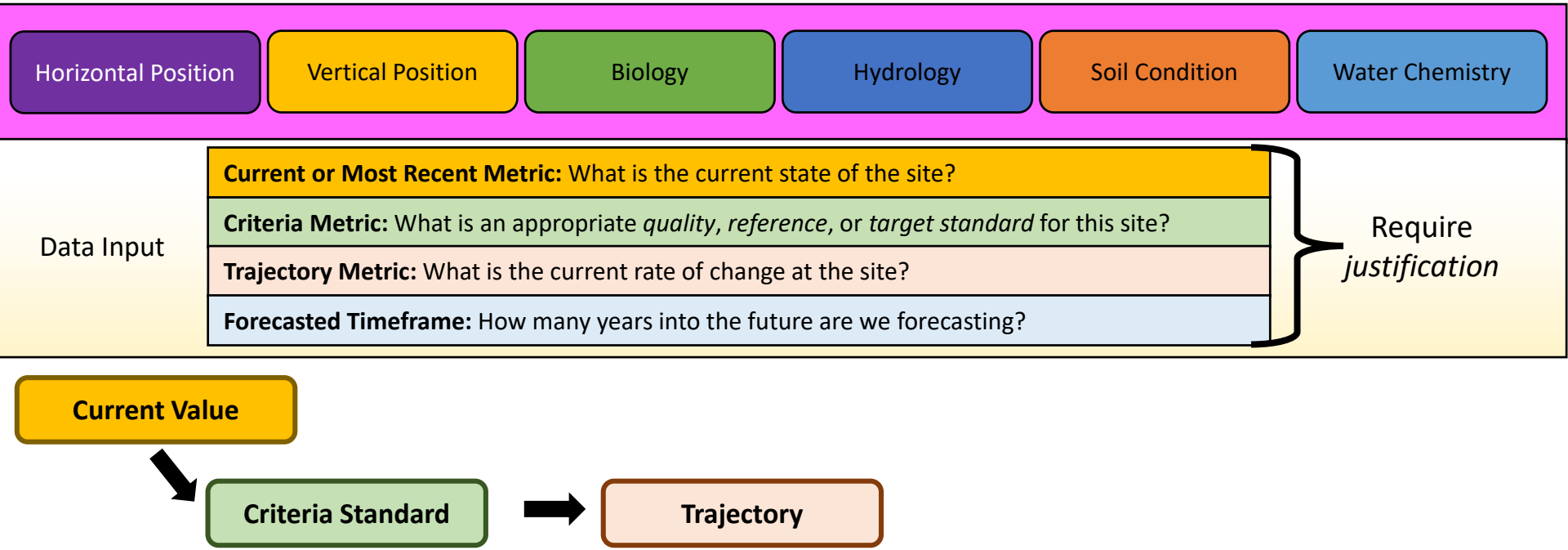
Data Input	
	Current or Most Recent Metric: What is the current state of the site?
	Criteria Metric: What is an appropriate *quality*, *reference*, or *target standard* for this site?
	Trajectory Metric
	Forecasted Timeframe



Entered as a metric trajectory range

Same units as the current value and criteria standard

User defines the number of **forecast years**


Horizontal Position
Vertical Position
Biology
Hydrology
Soil Condition
Water Chemistry
Data Input
Current or Most Recent Metric: What is the current state of the site?
Criteria Metric: What is an appropriate quality, reference, or target standard for this site?
Trajectory Metric: What is the current rate of change at the site?
Forecasted Timeframe: How many years into the future are we forecasting?
Require justification
Current Value
Criteria Standard
Trajectory

Horizontal Position | Vertical Position | Biology | Hydrology | Soil Condition | Water Chemistry

Data Input

- **Current or Most Recent Metric:** What is the current state of the site?
- **Criteria Metric:** What is an appropriate *quality*, *reference*, or *target standard* for this site?
- **Trajectory Metric:** What is the current rate of change at the site?
- **Forecasted Timeframe:** How many years into the future are we forecasting?

Require *justification*

Violations

Current or projected state of the attribute lies outside of the acceptable bound

→

Different combinations of *current* violations and *trajectory* violations lead to *attribute* violations

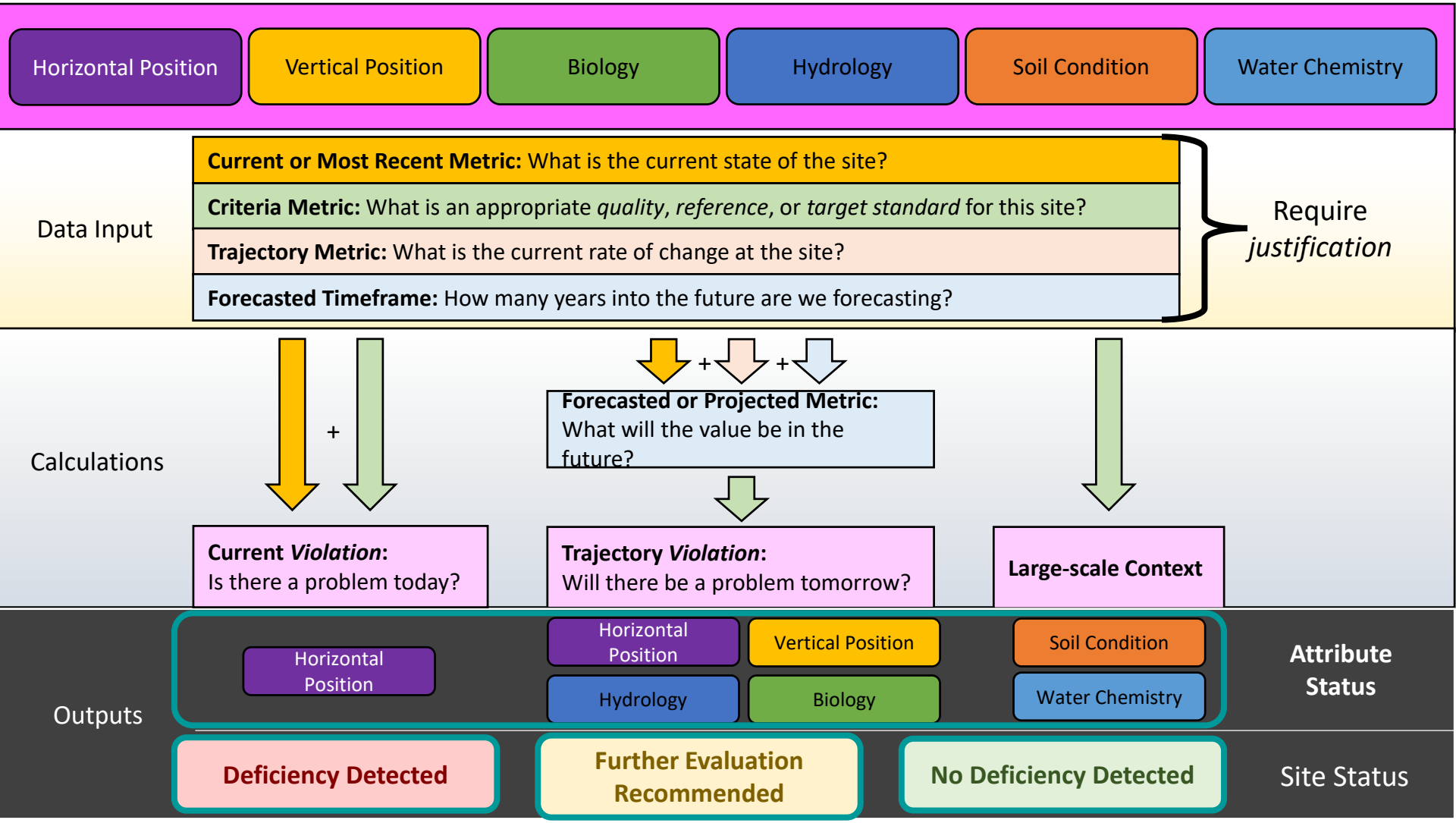
→

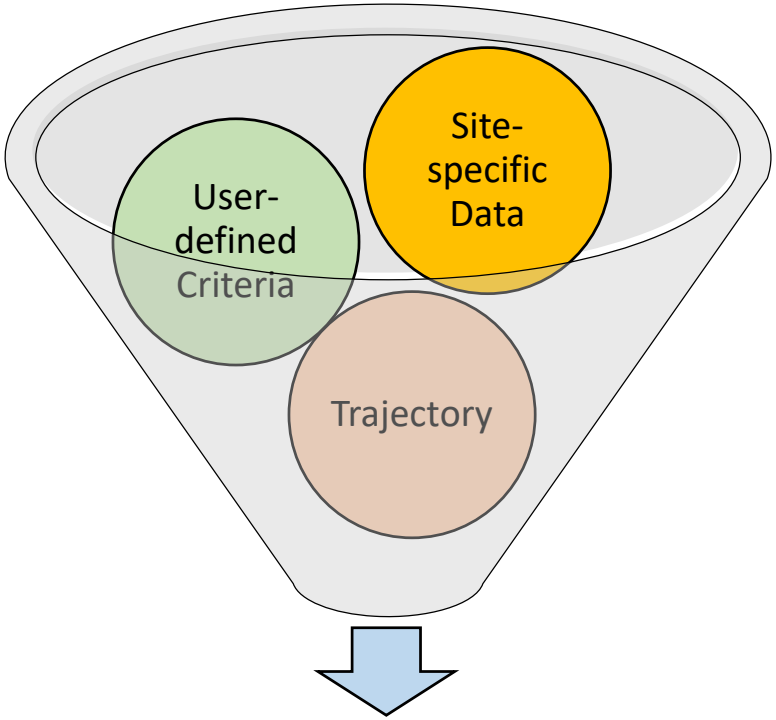
Deficiencies

Indicate the level of concern for the site

→

- **No Deficiency Detected**
- **Further Evaluation Recommended**
- **Deficiency Detected**


Horizontal Position
Vertical Position
Biology
Hydrology
Soil Condition
Water Chemistry
Data Input
Current or Most Recent Metric: What is the current state of the site?
Criteria Metric: What is an appropriate quality, reference, or target standard for this site?
Trajectory Metric: What is the current rate of change at the site?
Forecasted Timeframe: How many years into the future are we forecasting?
Require justification
Calculations
+
+
+
Forecasted or Projected Metric: What will the value be in the future?
Current Violation: Is there a problem today?
Trajectory Violation: Will there be a problem tomorrow?
Large-scale Context
Outputs
Horizontal Position
Horizontal Position
Vertical Position
Hydrology
Biology
Soil Condition
Water Chemistry
Attribute Status
Deficiency Detected
Further Evaluation Recommended
No Deficiency Detected
Site Status



Weight of Evidence

Orientation & Output of WATCH

Joshua Moody
Restoration Programs Manager

WATCH Workshop
March 30, 2021

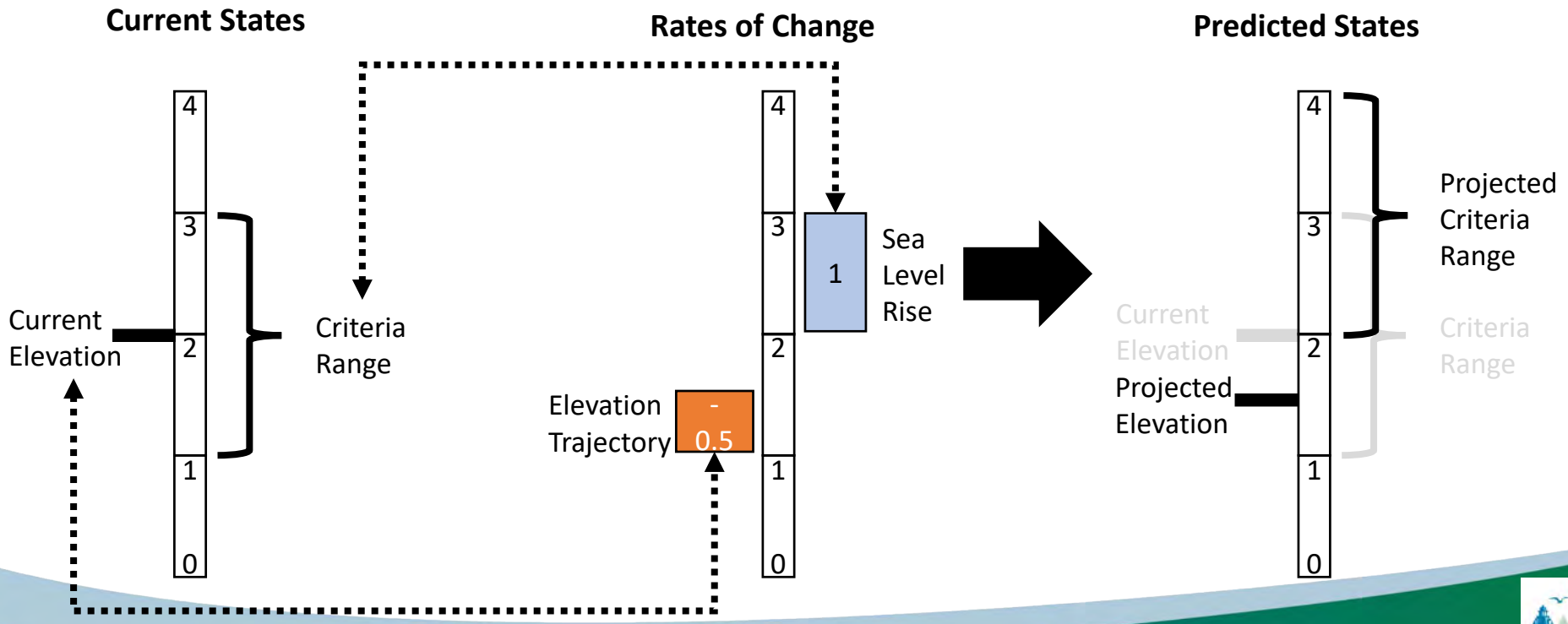
Outline

- Quick review of take-homes
- Orientation to WATCH Tabs
  - Instructions
  - Regulatory Checklist
  - Attribute Tabs
  - Sea-level Rise Component
  - Output Summary
  - Output Reflection
    - Interpretive Guidance
    - Additional Considerations

Summary: A few things to remember……

- Goal of WATCH: Facilitate
  - Holistic understanding of site
  - Project team building
  - Conversation around project implementation using common language
- Assumes no deficiency - shown by provided evidence
- Justifications need to be filled out for WATCH to calculate
- Attribute Violations
  - Horizontal: current or trajectory
  - Vertical/Biology/Hydrology
    - trajectory or
    - current if no trajectory data available
  - Soil Condition/Water Chemistry:
    - global attributes states
    - violations do not trigger deficiencies
    - Contextualize other output

Sea-level Rise: Vertical Position



Questions?

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WATCH v 2.0 – *Real world example*

LeeAnn Haaf
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March 2021 WATCH Workshop

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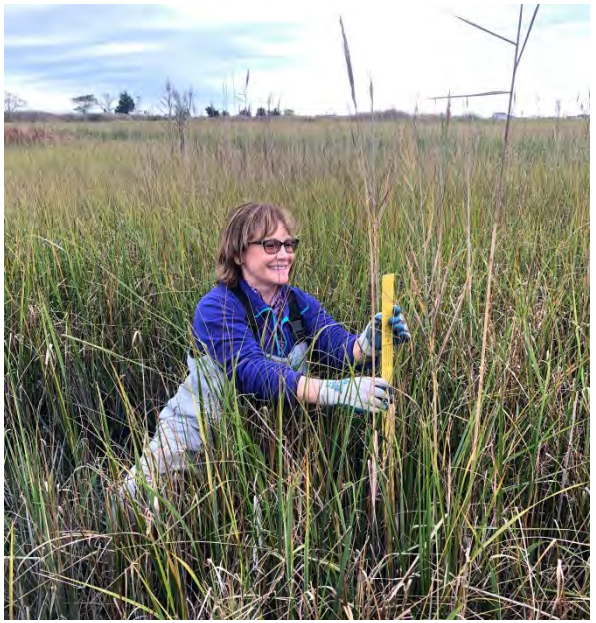
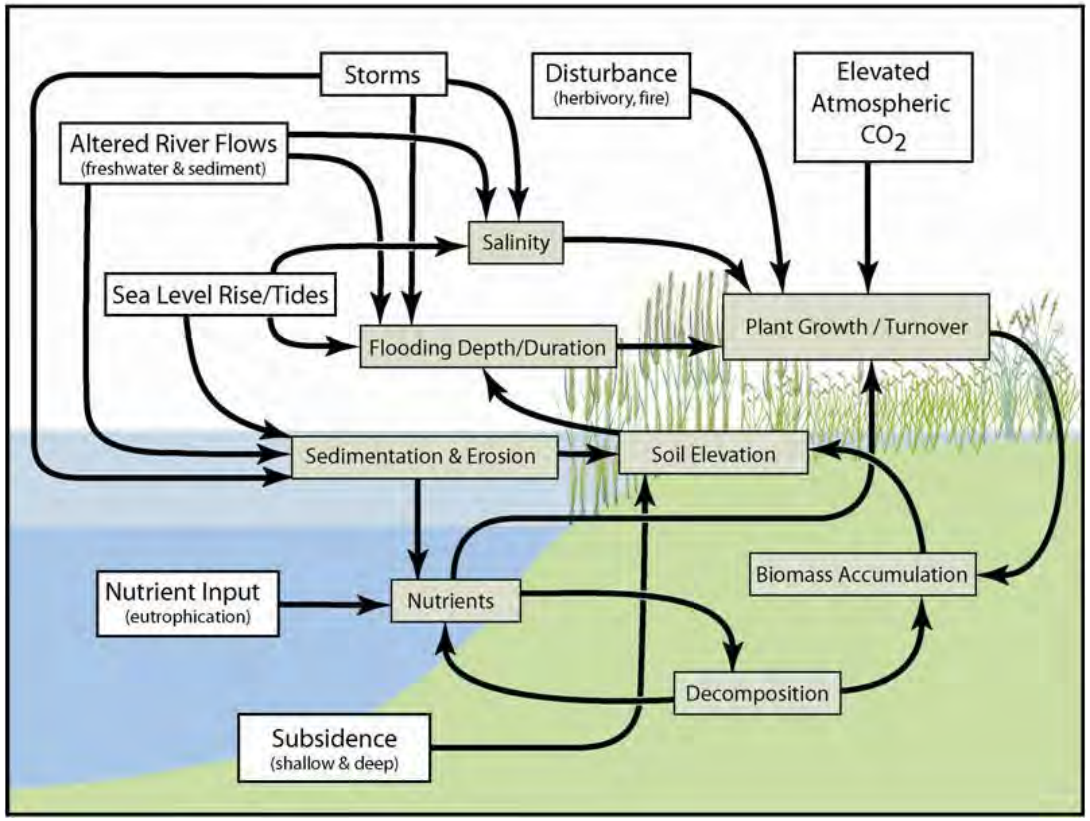
Real World Example

How do we approach using WATCH?

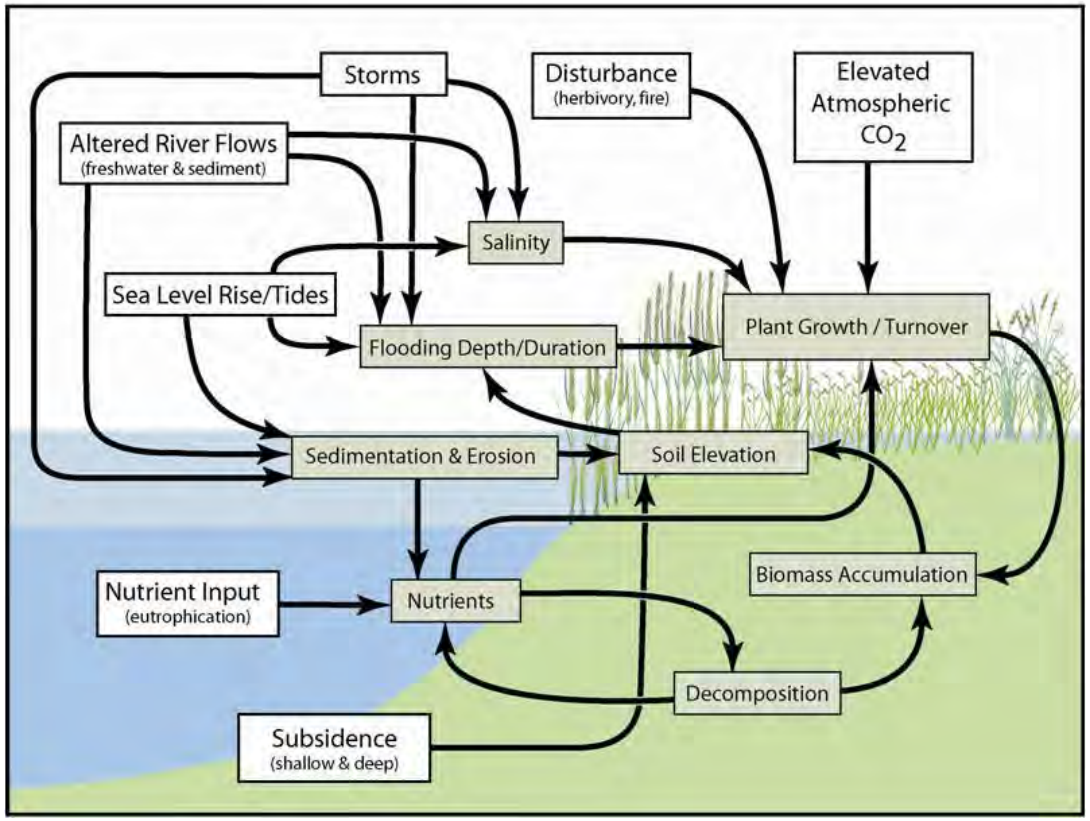
- ✓Practice with examples!
  - ✓Run it and discuss with us in break out sessions later today
- ✓Take it one step at a time



Tidal salt marshes are complex systems.



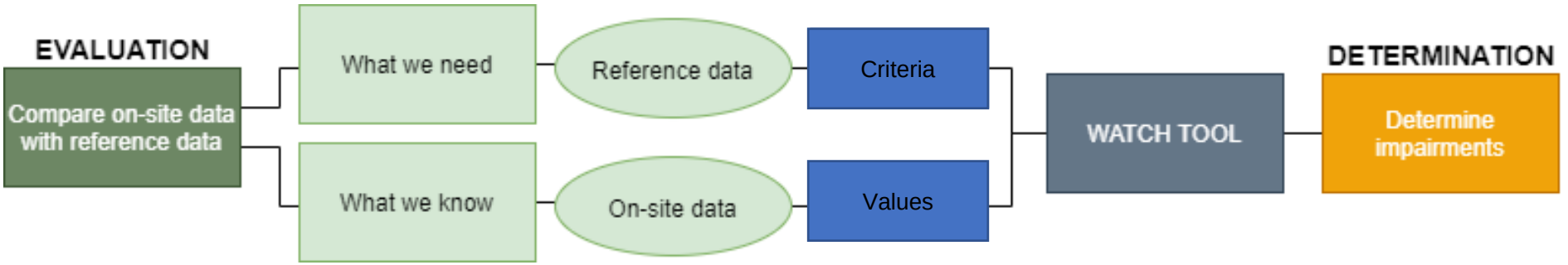
Each site will be unique.



Real World Example

How do we approach using WATCH?

1. What do we *know* about the site (**on-the-ground data**)?
2. What do we *need* (**ecological goal**)?



What we *need*

TIDES & CURRENTS

Home / Products / Datums / 8536110 Cape May, NJ ☆ Favorite Stations

Station Info | Tides/Water Levels | Meteorological Obs. | Phys. Oceanography | PORTS® | OFS

Datums for 8536110, Cape May NJ

NOTICE: All data values are relative to the MLLW.

Elevations on Mean Lower Low Water

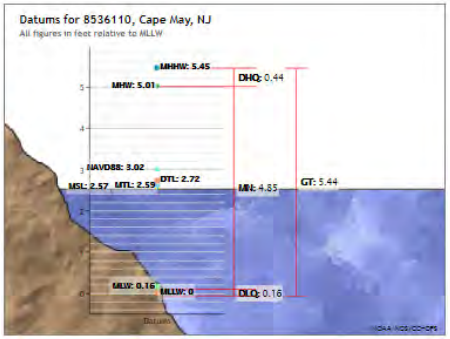
Station: 8536110, Cape May, NJ
Status: Accepted (Dec 5 2016)
Units: Feet
Control Station:

T.M.: 0
Epoch: 1983-2001
Datum: MLLW

Datum	Value	Description
MHHW	5.45	Mean Higher-High Water
MHW	5.01	Mean High Water
MTL	2.59	Mean Tide Level
MSL	2.57	Mean Sea Level
DTL	2.72	Mean Diurnal Tide Level
MLW	0.16	Mean Low Water
MLLW	0.00	Mean Lower-Low Water
NAVD88	3.02	North American Vertical Datum of 1988
STND	-2.42	Station Datum
GT	5.44	Great Diurnal Range
MN	4.85	Mean Range of Tide
DHQ	0.44	Mean Diurnal High Water Inequality
DLQ	0.16	Mean Diurnal Low Water Inequality
HWI	1.01	Greenwich High Water Interval (in hours)
LWI	7.07	Greenwich Low Water Interval (in hours)
Max Tide	8.98	Highest Observed Tide
Max Tide Date & Time	01/23/2018 13:30	Highest Observed Tide Date & Time
Min Tide	-3.02	Lowest Observed Tide
Min Tide Date & Time	01/28/1971 08:12	Lowest Observed Tide Date & Time
HAT	6.71	Highest Astronomical Tide
HAT Date & Time	11/04/1994 13:30	HAT Date and Time
LAT	-1.17	Lowest Astronomical Tide
LAT Date & Time	02/09/1997 08:18	LAT Date and Time

Tidal Datum Analysis Periods

01/01/1983 - 12/31/2001



Showing datums for
8536110 Cape May, NJ

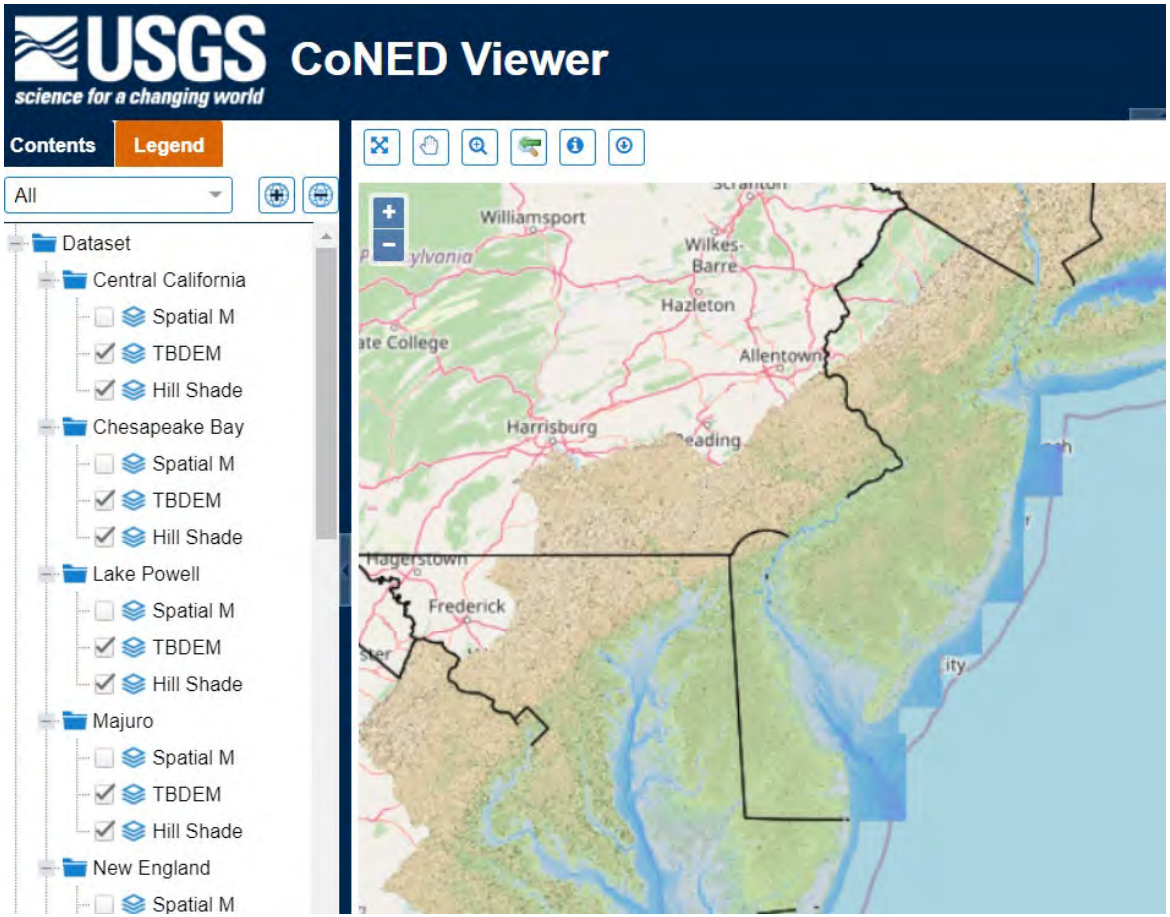
Datum
MLLW

Data Units ◉ Feet
○ Meters

Epoch ◉ Present (1983-2001)
○ Superseded (1960-1978)

Submit

What we *need*

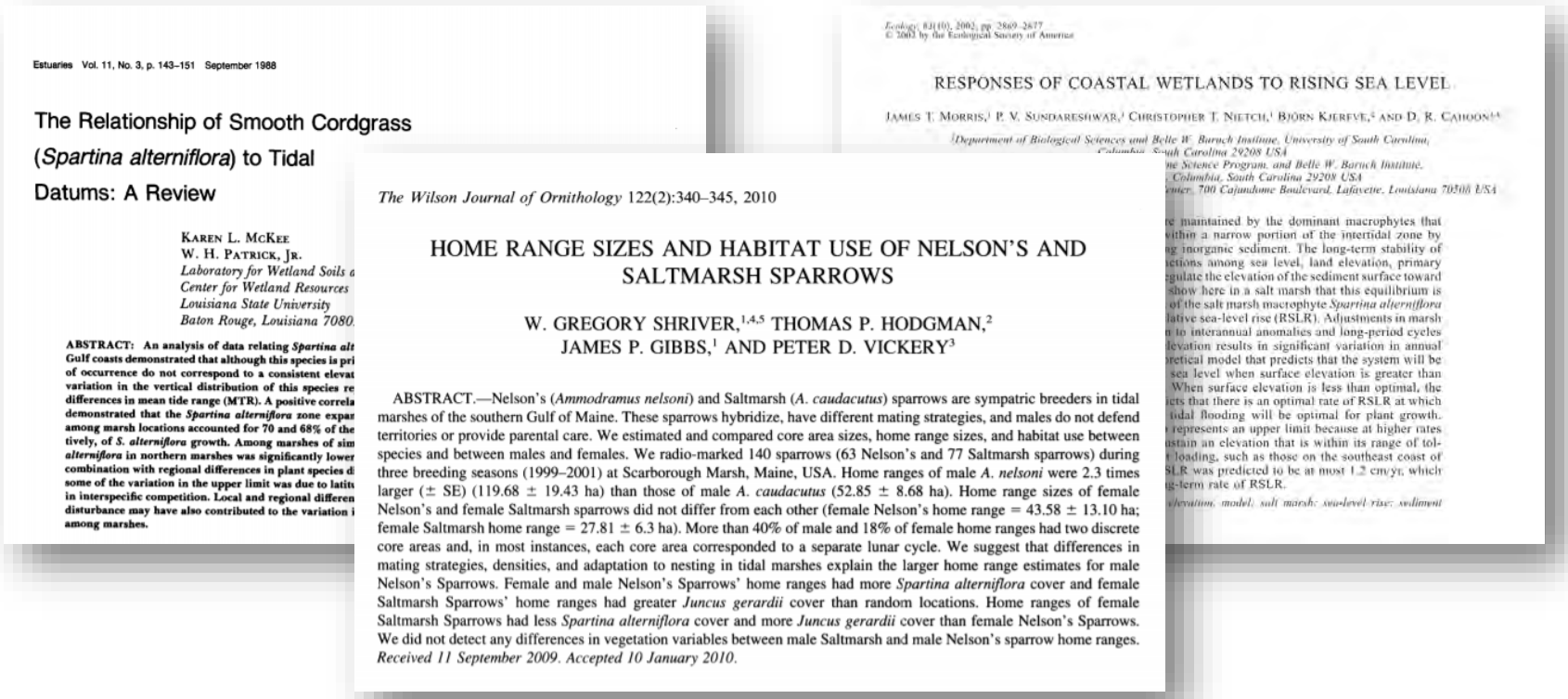

USGS
science for a changing world
CoNED Viewer
Contents
Legend
All
Dataset
Central California
Spatial M
TBDEM
Hill Shade
Chesapeake Bay
Spatial M
TBDEM
Hill Shade
Lake Powell
Spatial M
TBDEM
Hill Shade
Majuro
Spatial M
TBDEM
Hill Shade
New England
Spatial M
Williamsport
Wilkes-Barre
Hazleton
Allentown
Harrisburg
Frederick

What we *need*

MACWA

Mid-Atlantic Coastal Wetlands Assessment

What we *need*



Estuaries Vol. 11, No. 3, p. 143–151 September 1988

The Relationship of Smooth Cordgrass (*Spartina alterniflora*) to Tidal Datums: A Review

KAREN L. MCKEE
W. H. PATRICK, JR.
Laboratory for Wetland Soils a
Center for Wetland Resources
Louisiana State University
Baton Rouge, Louisiana 7080

ABSTRACT: An analysis of data relating *Spartina alt* Gulf coasts demonstrated that although this species is pri of occurrence do not correspond to a consistent elevat variation in the vertical distribution of this species re differences in mean tide range (MTR). A positive correla demonstrated that the *Spartina alterniflora* zone expar among marsh locations accounted for 70 and 68% of the tively, of *S. alterniflora* growth. Among marshes of sim *alterniflora* in northern marshes was significantly lower combination with regional differences in plant species di some of the variation in the upper limit was due to latit in interspecific competition. Local and regional differen disturbance may have also contributed to the variation i among marshes.

Ecology, 83(10), 2002, pp. 2869–2877
© 2002 by the Ecological Society of America

RESPONSES OF COASTAL WETLANDS TO RISING SEA LEVEL

JAMES T. MORRIS,[1] P. V. SUNDARESHWAR,[1] CHRISTOPHER T. NIETCH,[1] BJÖRN KJERFVE,[2] AND D. R. CAHOON[3,4]

[1]*Department of Biological Sciences and Belle W. Baruch Institute, University of South Carolina, Columbia, South Carolina 29208 USA*
ine Science Program, and Belle W. Baruch Institute, Columbia, South Carolina 29208 USA
enter, 700 Cajundome Boulevard, Lafayette, Louisiana 70506 USA

e maintained by the dominant macrophytes that within a narrow portion of the intertidal zone by *g* inorganic sediment. The long-term stability of *ctions* among sea level, land elevation, primary *gulate* the elevation of the sediment surface toward show here in a salt marsh that this equilibrium is of the salt marsh macrophyte *Spartina alterniflora* lative sea-level rise (RSLR). Adjustments in marsh n to interannual anomalies and long-period cycles levation results in significant variation in annual retical model that predicts that the system will be sea level when surface elevation is greater than When surface elevation is less than optimal, the icts that there is an optimal rate of RSLR at which tidal flooding will be optimal for plant growth. represents an upper limit because at higher rates istain an elevation that is within its range of tol- loading, such as those on the southeast coast of SLR was predicted to be at most 1.2 cm/yr, which g-term rate of RSLR.

elevation, model, salt marsh, sea-level rise, sediment

The Wilson Journal of Ornithology 122(2):340–345, 2010

HOME RANGE SIZES AND HABITAT USE OF NELSON'S AND SALTMARSH SPARROWS

W. GREGORY SHRIVER,[1,4,5] THOMAS P. HODGMAN,[2]
JAMES P. GIBBS,[1] AND PETER D. VICKERY[3]

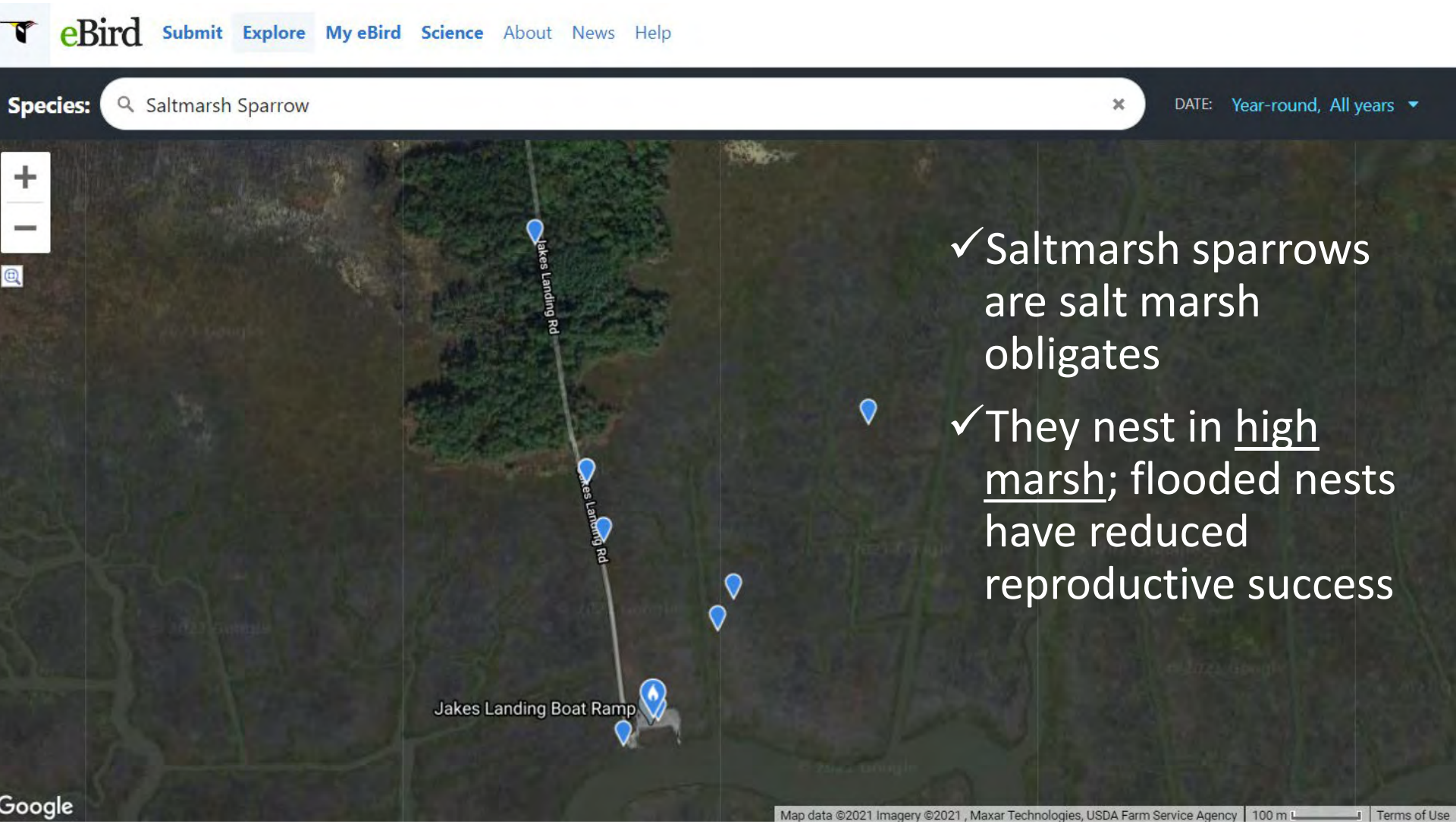
ABSTRACT.—Nelson's (*Ammodramus nelsoni*) and Saltmarsh (*A. caudacutus*) sparrows are sympatric breeders in tidal marshes of the southern Gulf of Maine. These sparrows hybridize, have different mating strategies, and males do not defend territories or provide parental care. We estimated and compared core area sizes, home range sizes, and habitat use between species and between males and females. We radio-marked 140 sparrows (63 Nelson's and 77 Saltmarsh sparrows) during three breeding seasons (1999–2001) at Scarborough Marsh, Maine, USA. Home ranges of male *A. nelsoni* were 2.3 times larger (± SE) (119.68 ± 19.43 ha) than those of male *A. caudacutus* (52.85 ± 8.68 ha). Home range sizes of female Nelson's and female Saltmarsh sparrows did not differ from each other (female Nelson's home range = 43.58 ± 13.10 ha; female Saltmarsh home range = 27.81 ± 6.3 ha). More than 40% of male and 18% of female home ranges had two discrete core areas and, in most instances, each core area corresponded to a separate lunar cycle. We suggest that differences in mating strategies, densities, and adaptation to nesting in tidal marshes explain the larger home range estimates for male Nelson's Sparrows. Female and male Nelson's Sparrows' home ranges had more *Spartina alterniflora* cover and female Saltmarsh Sparrows' home ranges had greater *Juncus gerardii* cover than random locations. Home ranges of female Saltmarsh Sparrows had less *Spartina alterniflora* cover and more *Juncus gerardii* cover than female Nelson's Sparrows. We did not detect any differences in vegetation variables between male Saltmarsh and male Nelson's sparrow home ranges.
Received 11 September 2009. Accepted 10 January 2010.

Real World Example

We can look through specific lenses…

????

Are there any observable impairments to salt marsh sparrow breeding habitat at Dennis Creek?



- ✓Saltmarsh sparrows are salt marsh obligates
- ✓They nest in high marsh; flooded nests have reduced reproductive success

What is our concern?

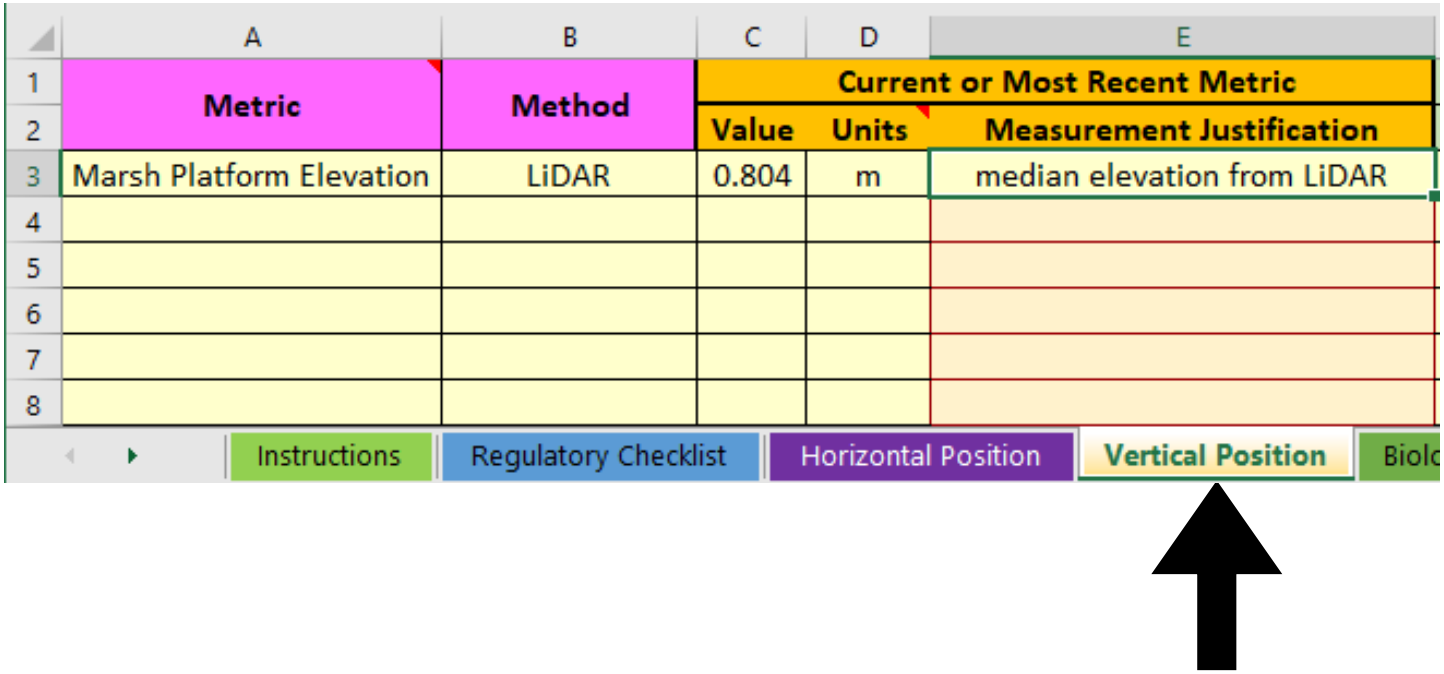
- Decreasing breeding habitat suitability

Data: what do we *know*?

VERTICAL POSITION

- Median elevation is 0.804 m NAVD88
  - Source: LiDAR
- Elevation change is 1-2 mm/yr
  - Source: SET data from MACWA SSIM (7 years)

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



	A	B	C	D	E
1	Metric	Method	Current or Most Recent Metric		
2			Value	Units	Measurement Justification
3	Marsh Platform Elevation	LiDAR	0.804	m	median elevation from LiDAR
4					
5					
6					
7					
8					

Instructions | Regulatory Checklist | Horizontal Position | Vertical Position | Biolo

Data: what do we *know*?

VERTICAL POSITION

- Median elevation is 0.804 m NAVD88
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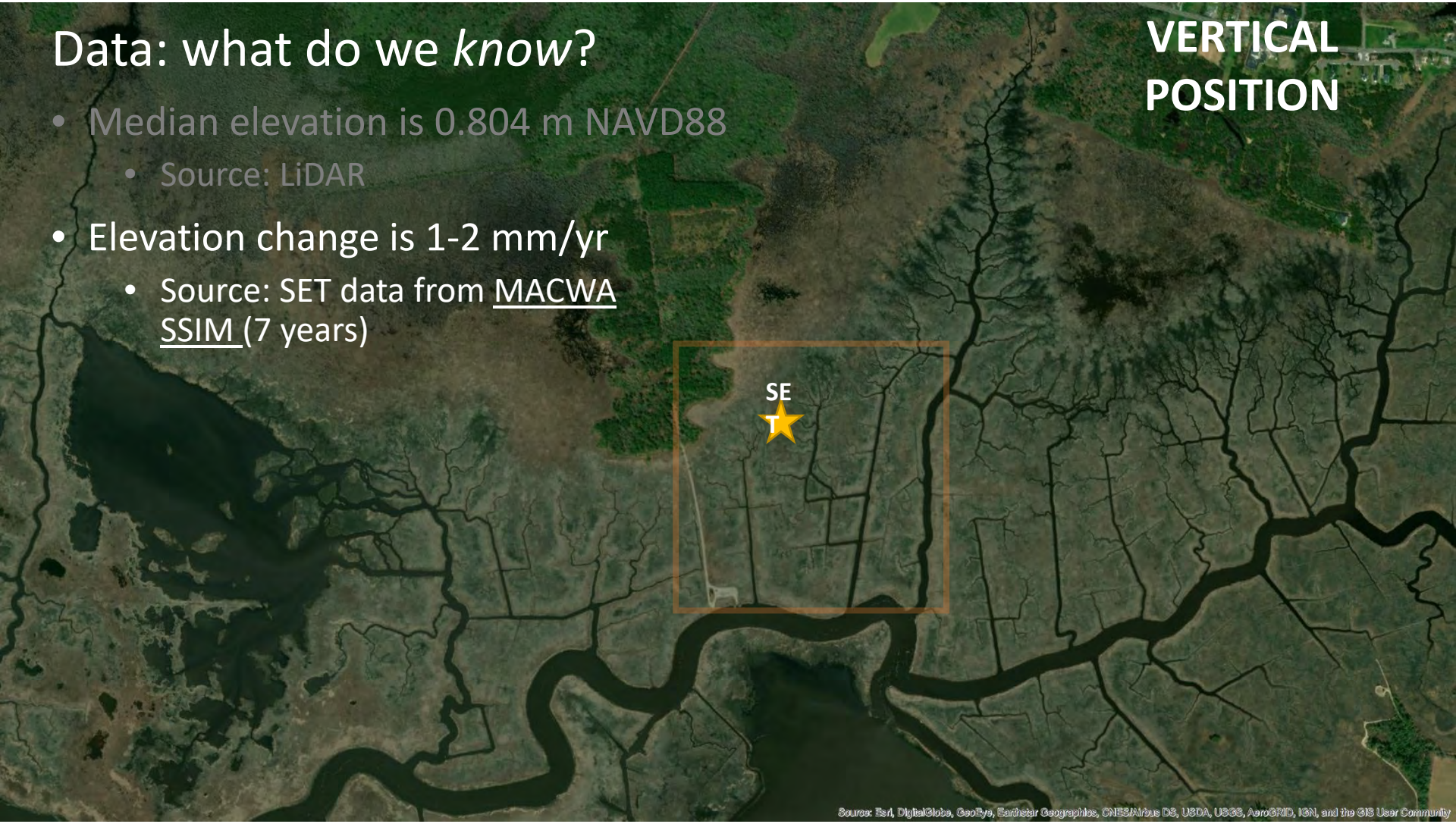
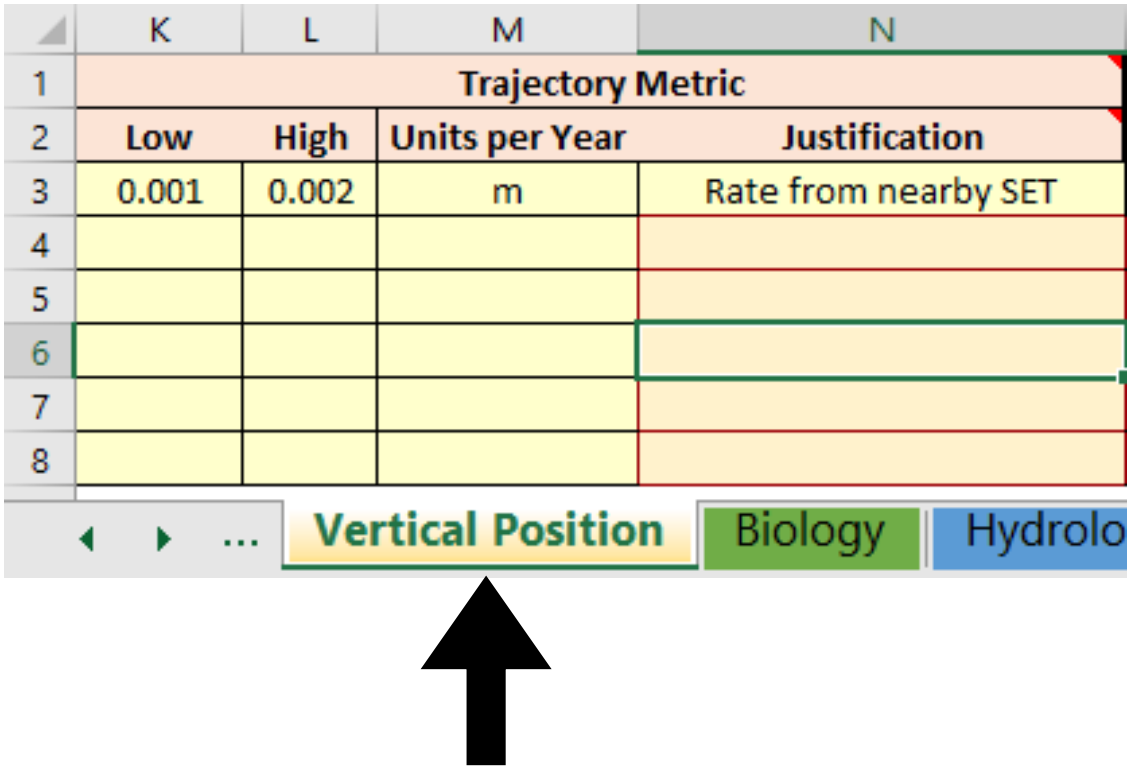




	K	L	M	N
1	Trajectory Metric			
2	Low	High	Units per Year	Justification
3	0.001	0.002	m	Rate from nearby SET
4				
5				
6				
7				
8				

... Vertical Position Biology Hydrolo

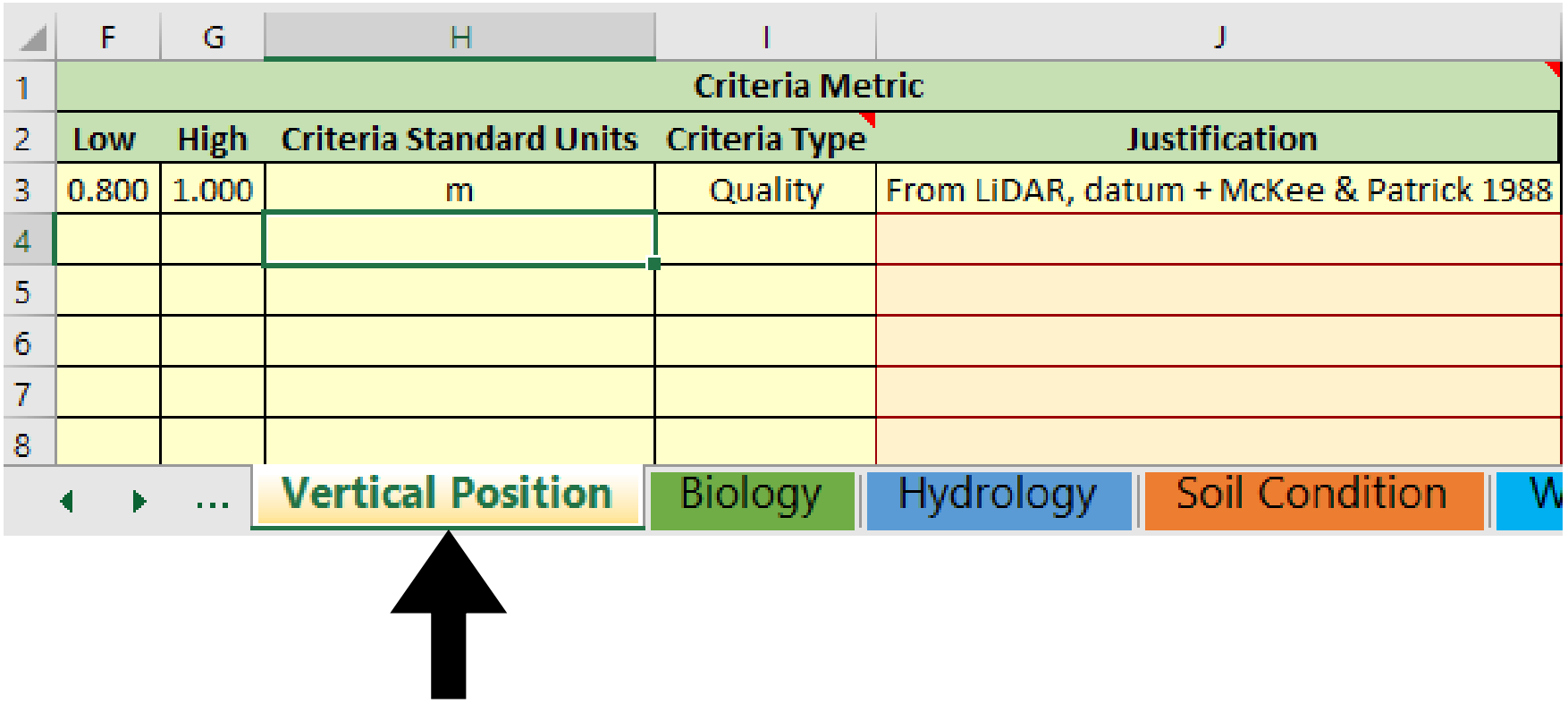
Data: what might we *need*?

VERTICAL POSITION

- Elevation: 0.8 – 1 m NAVD88 → ***Quality criteria****
  - Possible range of high marsh
  - Mean higher high water at Cape May is 0.74 m NAVD88
  - Std Err buffer for lower
  - Upland for upper
- Habitat composition: 40-60% high marsh → *Target criteria*
  - About half marsh tract viable habitat

***Quality criteria developed by using site specific information relative to patterns of *S. alterniflora* distribution in McKee and Patrick 1988.**

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

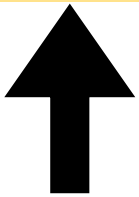


	F	G	H	I	J
1	Criteria Metric				
2	Low	High	Criteria Standard Units	Criteria Type	Justification
3	0.800	1.000	m	Quality	From LiDAR, datum + McKee & Patrick 1988
4					
5					
6					
7					
8					

... Vertical Position Biology Hydrology Soil Condition W

	K	L	M	N	O	P	Q	R	S
1	Trajectory Metric				Forecasted or Projected Metric				
2	Low	High	Units per Year	Justification	Years in Future	Justification	Low	High	Units
3	0.001	0.002	m	Rate from nearby SET	10	SET dataset only 7 yrs	0.814	0.824	m
4							-	-	-
5							-	-	-
6							-	-	-
7							-	-	-
8							-	-	-

... Vertical Position | Biology | Hydrology | Soil Condition | Water Chemistry | Ou

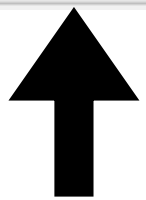


O	P	Q	R	S
Forecasted or Projected Metric				
Years in Future	Justification	Low	High	Units
10	SET dataset only 7 yrs	0.814	0.824	m
		-	-	-
		-	-	-
		-	-	-
		-	-	-
		-	-	-

gy | Soil Condition | Water Chemistry | Ou

	T	U	V	W
1	Sea-Level Rise	Sea level rise	Forecasted Criteria (Relative to SLR)	
2	Rate	rate units	From	To
3	0.005	m	0.850	1.050
4			-	-
5			-	-
6			-	-
7			-	-
8			-	-

... | Vertical Position | Biology | Hydrology



Data: what do we *know*?

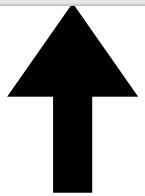
BIOLOGY

- 57% of the area is high marsh using 0.75 m NAVD88 as a cut off value between low and high marsh
  - Sources: Cape May tidal station & LiDAR

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

	A	B	C	D	E
1	Metric	Method	Current or Most Recent Metric		
2			Value	Units	Measurement Justification
3	Habitat	Percent Habitat	57	%	Marsh above 0.75 m NAVD88 (high marsh)
4					
5					
6					
7					
8					

Instructions | Regulatory Checklist | Horizontal Position | Vertical Position | Biology | Hydrology | Soil Condition | Water Ch



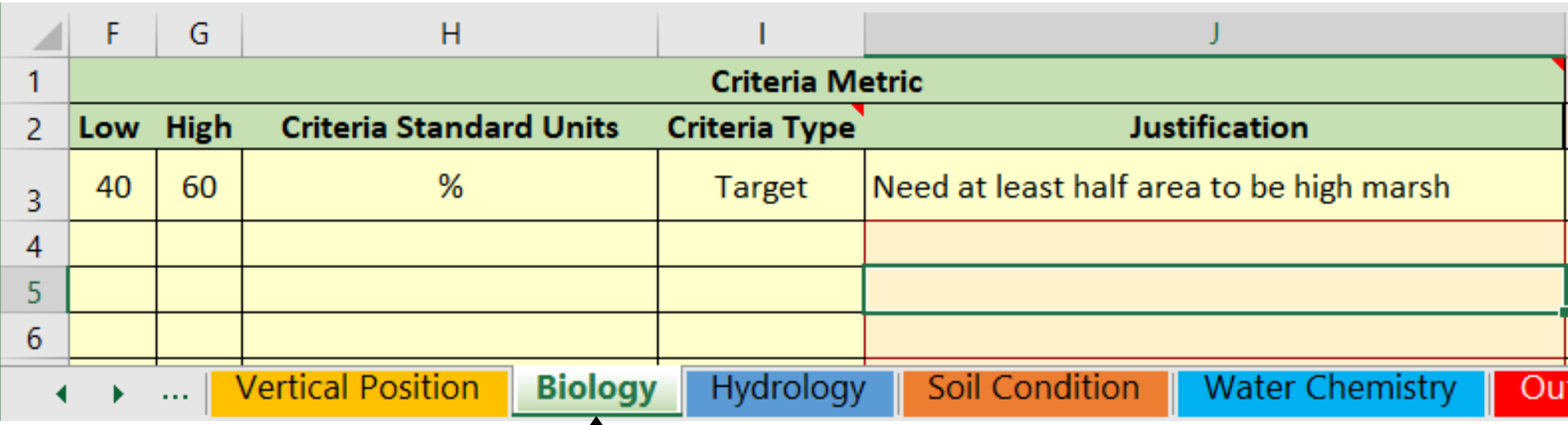
Data: what might we *need*?

BIOLOGY

- Elevation: 0.8 – 1 m NAVD88 → ***Quality criteria****
  - Possible range of high marsh
  - Mean higher high water at Cape May is 0.74 m NAVD88
  - Std Err buffer for lower
  - Upland for upper
- Habitat composition: 40-60% high marsh → ***Target criteria***
  - About half marsh tract viable habitat

*Quality criteria developed by using site specific information relative to patterns of *S. alterniflora* distribution in McKee and Patrick 1988.

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



	F	G	H	I	J
1	Criteria Metric				
2	Low	High	Criteria Standard Units	Criteria Type	Justification
3	40	60	%	Target	Need at least half area to be high marsh
4					
5					
6					

... Vertical Position | Biology | Hydrology | Soil Condition | Water Chemistry | Ou

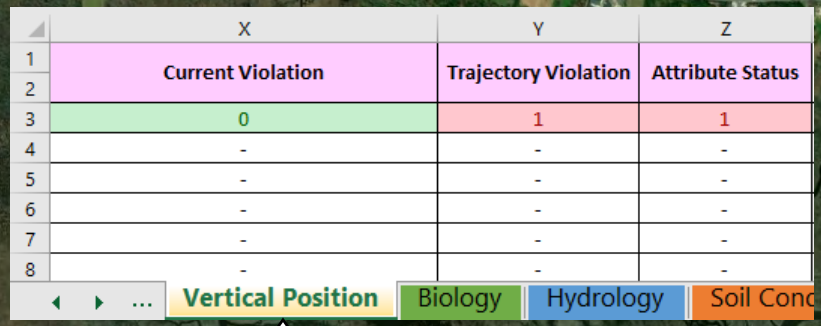
Data: integrating what *need* and *know*

TODAY

- Elevation: 0.8 – 1 m NAVD88
  - **Median elevation is 0.804 m NAVD88**

TOMORROW

- If elevation change is 1-2 mm/yr and sea level is rising ~5 mm/yr…
  - In 10 years, new criteria range would be between **0.850 – 1.05** m NAVD88 and the marsh elevation would be **0.814 – 0.824**



	X	Y	Z
1	Current Violation	Trajectory Violation	Attribute Status
2			
3	0	1	1
4	-	-	-
5	-	-	-
6	-	-	-
7	-	-	-
8	-	-	-

... Vertical Position | Biology | Hydrology | Soil Cond

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Data: integrating what *need* and *know*

TODAY

- Habitat composition: 40-60% high marsh
  - **57% of area is greater than MHHW**

TOMORROW

- We didn't input trajectory information!
  - Next step could be to find some…

	T	U	V
1	Current Violation	Trajectory Violation	Attribute Status
2			
3	0	-	-
4	-	-	-
5	-	-	-
6	-	-	-

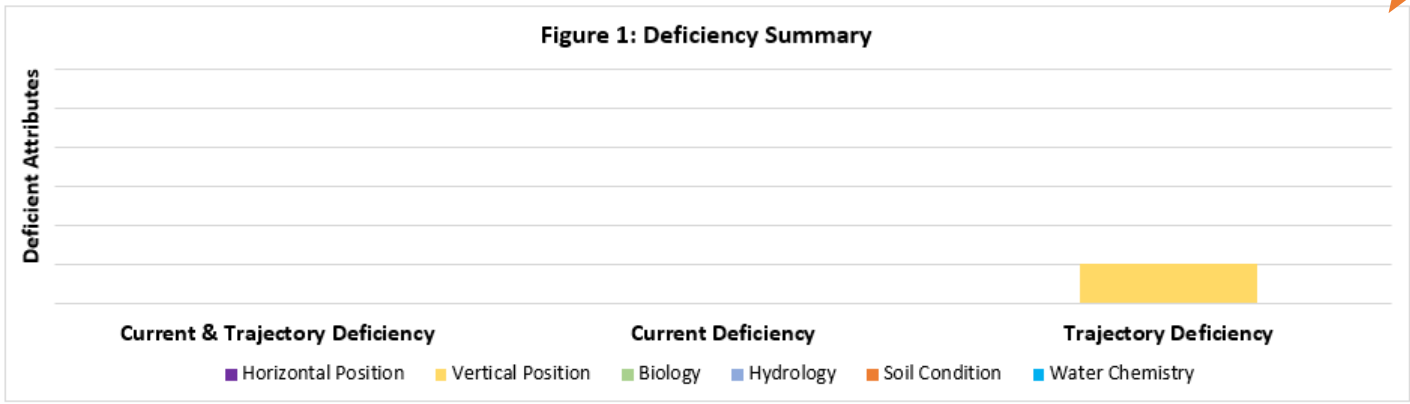
... Vertical Position | Biology | Hydrology | Soil C

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Table 1: Site-wide Deficiency Detected	
Attribute	Violation
Horizontal Position	
Vertical+Biology	
Vertical+Hydrology	
Vertical+Soil Condition	
Hydrology+Soil Condition	
Biology+Hydrology	
Vertical+Biology+Hydrology	

Table 2: Attributes of Concern		
Attribute	Violation	Associated Attributes for Continued Monitoring
Horizontal Position		N/A
Vertical Position	X	Biology, Hydrology
Biology		
Hydrology		
Soil Condition		
Water Chemistry		

Table 3: Violations Summary							
	Horizontal Position	Vertical Position	Biology	Hydrology	Soil Condition	Water Chemistry	Status
Attribute Violations	0	1	0	0	0	0	FER
Current Violation	*0*	*0*	*0*	*0*	*na*	*0*	
Trajectory Violation	*0*	*1*	*0*	*0*	*na*	*0*	



... | Regulatory Checklist | Horizontal Position | Vertical Position | Biology | Hydrology | Soil Condition | Water Chemistry | Output Summary

Circling back to goals

Revisit question/goal

- Concern: Decreasing breeding habitat suitability

Did we observe a decrease in breeding habitat?

- We found that future elevation is likely the foundational issue

Data to Decisions, Opportunity to Need

1. Restoration opportunities abundant, *but where is there <u>evidence</u> of need?*
2. Existing data and tools for ecological context can guide need-based restoration
   - MACWA, WATCH
   - Relative Wetland Vulnerability Framework
3. A community of practitioners will best support these efforts
   1. Where are there data gaps?
   2. What worked?
   3. ***What didn't work?***

Output Evaluation Using WATCH

Joshua Moody
Restoration Programs Manager

WATCH Workshop
March 30, 2021

Output Interpretation & Evaluation

Outputs are dependent on inputs

1. Do we have confidence in our metric of choice (Biology attribute)
2. Timeframe considerations (Horizontal Position attribute)
3. Selecting appropriate criteria (Hydrology attribute)
4. Context with global attributes (Soil Condition Attribute)

Next Steps

NFWF DWCF – October 31, 2022

- Add Sedimentation attribute
  - Vertical Position, Hydrology
- Field-test/validation at long-term MACWA stations
- Established a Tech Advisory Group
  - Steering Committee (NJDEP & DNREC)
  - Sedimentation work group
  - Evaluation work group
- Want your input & will follow up early 2022

Questions?

jmoody@delawareestuary.org
lhaaf@delawareestuary.org

Partnership for the DELAWARE ESTUARY

Alignment with Other Tools

Today's presentation

- Using other tools in concert with WATCH
- Example EPA tools
  - Relative Wetland Vulnerabilities Framework (RWVF)
  - Causal Analysis/Diagnosis Decision Information System (CADDIS)
  - Adaptation Design Tool (ADT)
- Spotlight: Using RWVF with WATCH
  - High marsh nesting habitat case study
  - Conceptual crosswalk
- Questions

cert

Level 1: Site Prioritization

Where should we focus resources (dependent on goals)?

Level 2: Site-specific Issue Diagnosis

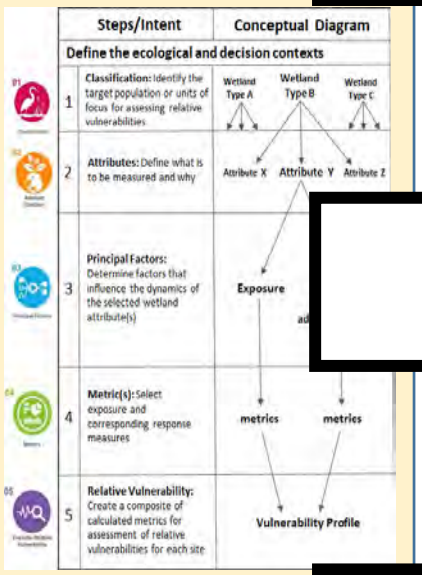
What is the problem and where is it located?

Is the problem occurring now or upcoming?

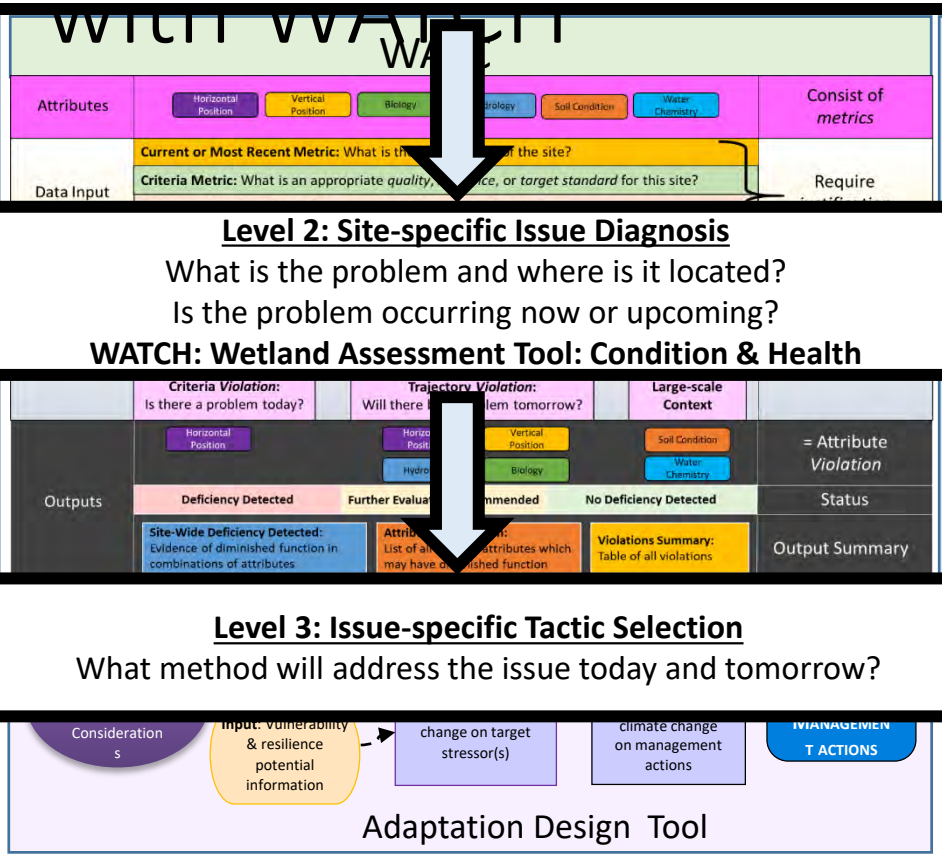
WATCH: Wetland Assessment Tool: Condition & Health

Level 3: Issue-specific Tactic Selection

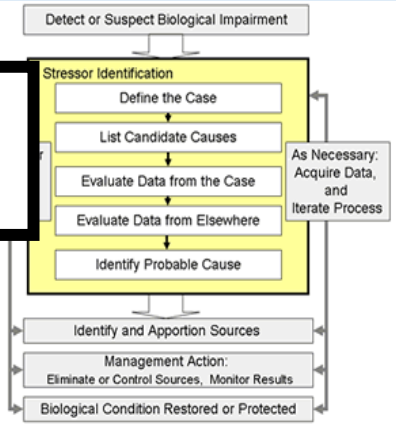
What method will address the issue today and tomorrow?



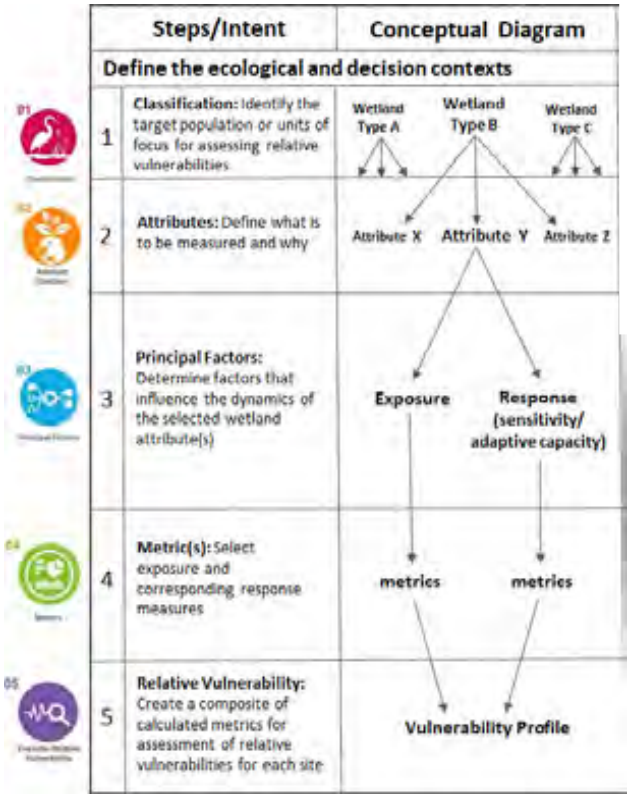
Relative Wetland Vulnerabilities Framework



Causal Analysis/Diagnosis Decision Information System



Example 1: Relative Wetland Vulnerabilities Framework (RWVF)

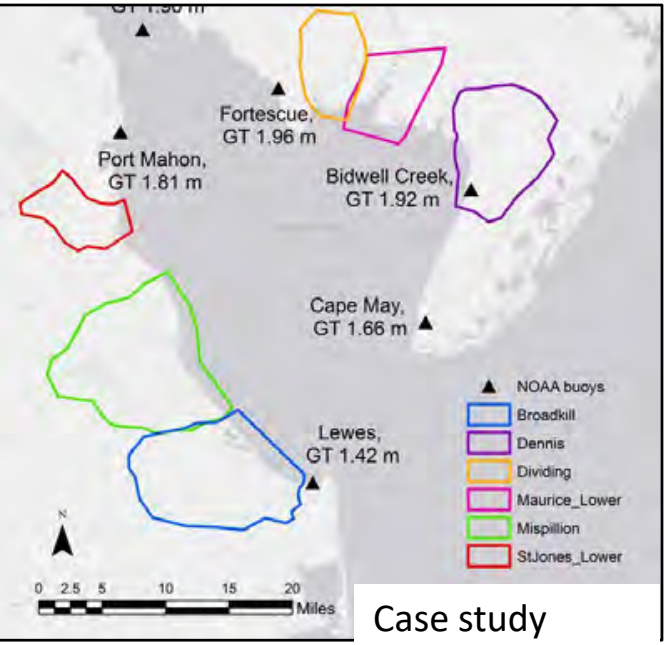


https://doi.org/10.1002/ecs2.2561

A framework and methodology that:

- Leads practitioners through the construction, implementation, and interpretation of a **climate change vulnerability assessment**
- Focuses assessment steps by **defining ecological and decision contexts**
- Separately examines **exposure and response** components of vulnerability
- Generates vulnerability profiles that can be linked to evaluation of **management tactics** to support adaptation

Example 1: How the RWVF can work in conjunction with WATCH

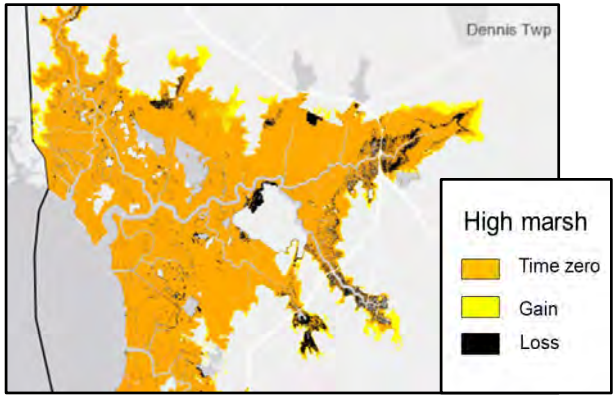


Case study areas

1. Can use the RWVF to perform a relative vulnerability assessment with components of
   - **Exposure**: Relative Sea Level Rise (SLR)
   - **Response**: Change in marsh acreage (SLAMM)

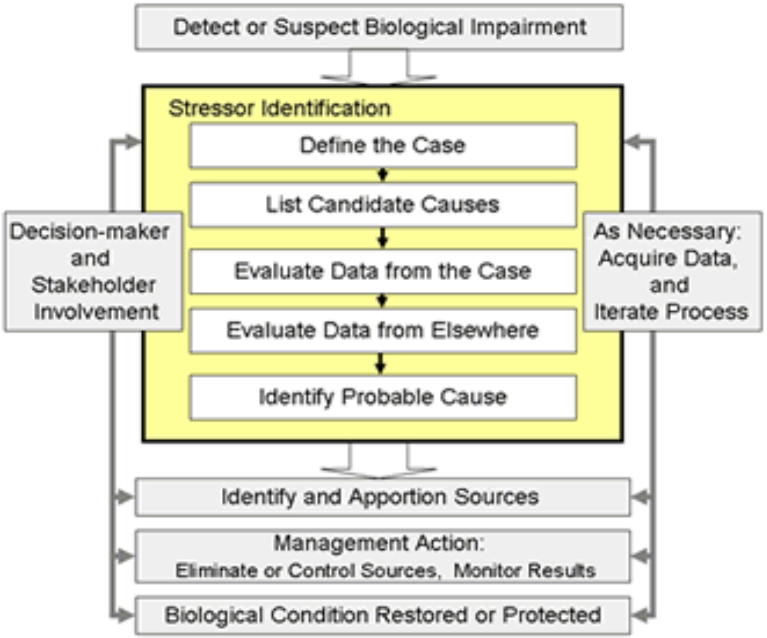
2. Results can help identify sites/areas that are potentially suitable for management activities **both now and in the future**

3. With WATCH, could **aid in**
   - **Prioritization** of sites for WATCH application
   - **Comparison** of vulnerabilities of multiple WATCH sites
   - Consideration of **within-site factors** that could affect WATCH criteria standards and trajectories



Dennis 2050

Example 2: Causal Analysis/Diagnosis Decision Info System (CADDIS)

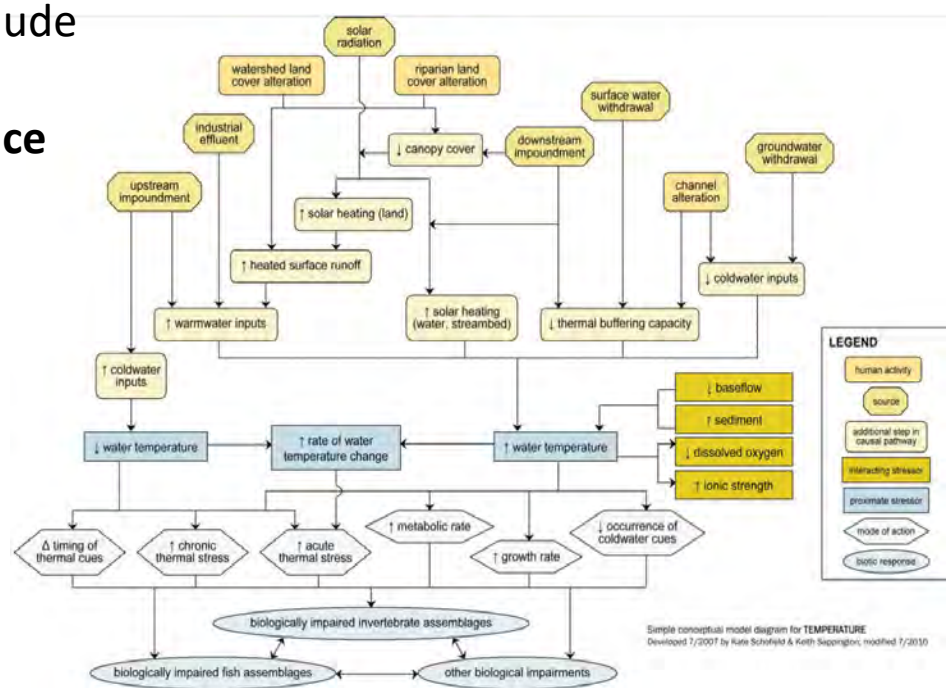


An online application for causal assessment that:

- Weighs relevant evidence to identify the **most likely causes** of undesirable biological effects
- Helps users decide which candidate causes to include in an assessment and **develop cases for or against those causes**
- Provides **examples** of practical applications
- Provides information on different **analytical techniques** that can be applied
- Provides tools for finding, storing, and displaying relevant **literature-based information** to help evaluate different causal pathways

Example 2: How CADDIS can work in conjunction with WATCH

- Could develop conceptual diagram(s) that include WATCH **attributes and metrics**
- And develop checklists of **sources**, **site evidence** and **ecological effects** for each attribute to understand exposure-response relationships
  - ✓ Example **sources**
    - -Land cover alteration
    - -Channel alteration
    - -Diking
    - -Water withdrawals
  - ✓ Example **site evidence**
    - -Channel erosion
    - -Marsh elevation loss
    - -Increased time flooded
    - -Shoreline loss
  - ✓ Example **ecological effects**
    - -Vegetative cover loss
    - -Decrease in bird nesting success
    - -Loss in plant diversity

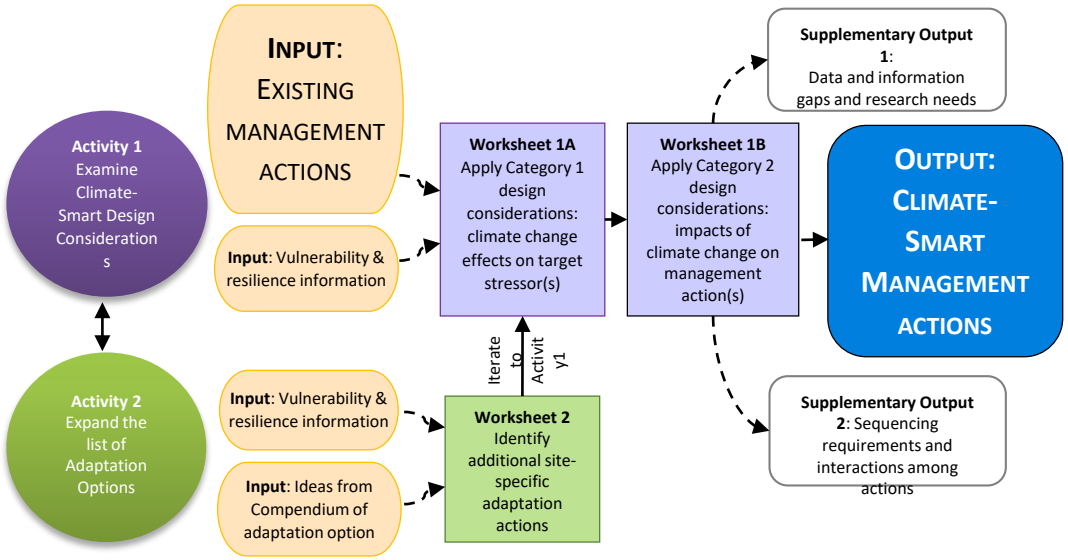


CADDIS conceptual diagram (stream example)
https://www.epa.gov/caddis-vol2

Example 3: Adaptation Design Tool (ADT)

A structured approach that guides users through a series of steps to:

- Apply **climate-smart design considerations** to management tactics
- Brainstorm **additional adaptation activities** that may be critically needed
- **Identify and record** insights on:
  - ❖ Information gaps & research needs
  - ❖ Synergies, conflicts & sequencing considerations



https://www.coris.noaa.gov/activities/CCAP_design/

Example 3: How the ADT can work in conjunction with WATCH

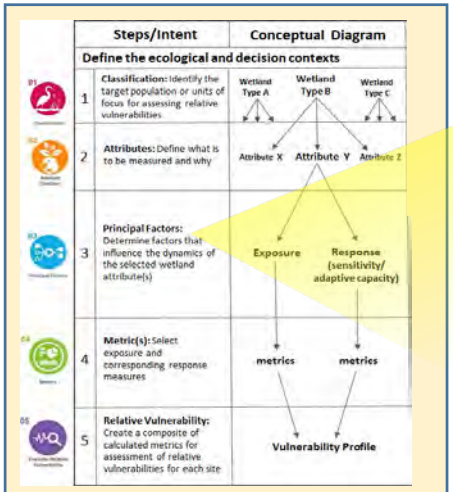
Worksheet 1B
Category 2 design considerations: CC effects on management actions (watershed example)

Worksheet 1A
Category 1 design considerations: CC effects on stressor(s) of concern (watershed example)

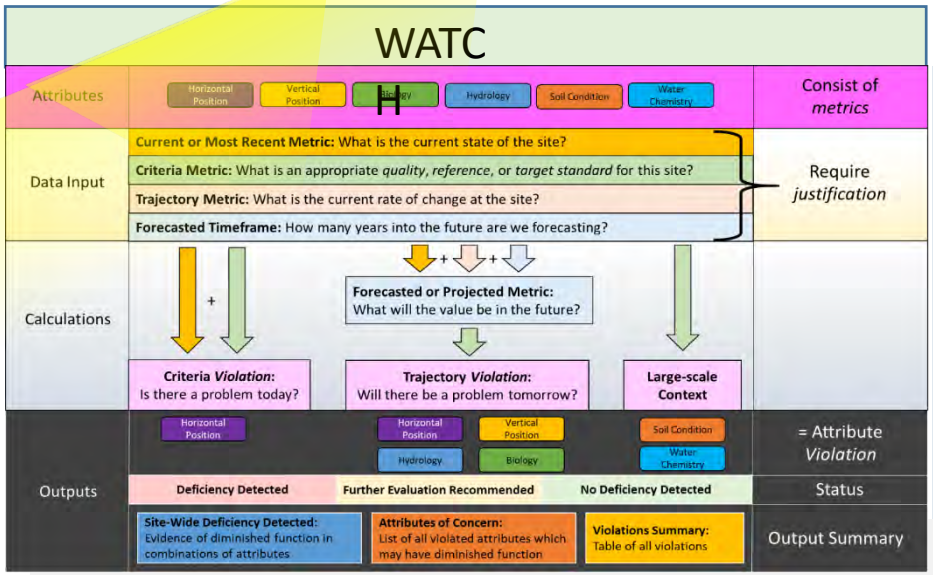
B1	B2	B3	B4	B5	B6	B7	B8
Action number	Existing Management Action	Changes in effectiveness of action due to: climate impacts on target stressors	Changes in effectiveness of action due to: climate impacts on management action	Timeframe or constraint for using the action and implementation (e.g., urgency, longer or shorter term)	Notes	What changes are needed to adapt the action (place, time, design)	Climate-Smart Management Action
1	Install terraces adjacent to dirt roads	Install terraces adjacent to dirt roads Heavy rainfall events following dry periods may overwhelm capacity of terraces	Sediment/ nutrients Terraces themselves could be destroyed by extreme events	dry periods will lead to increased runoff; changing seasonal patterns less understood (moderate magnitude, high uncertainty) Life of these practices is 5-10 yrs; need to plan ahead for strategic placement in combination with other actions dry periods already occurring, trends of increasing summer heavy rainfall events observed	How will heavy rainfall event destroy a standard terrace? Monitoring will have to be timed/located to catch effects of extreme events coupled with dry periods	Need to adapt action spatially, design terraces to withstand extreme events Need to adapt patte of dry an rainf and locat of wo eros	Install and maintain a series of terraces of sufficient capacity, resistant to extreme events and adjacent to roads prioritized as having worst erosion

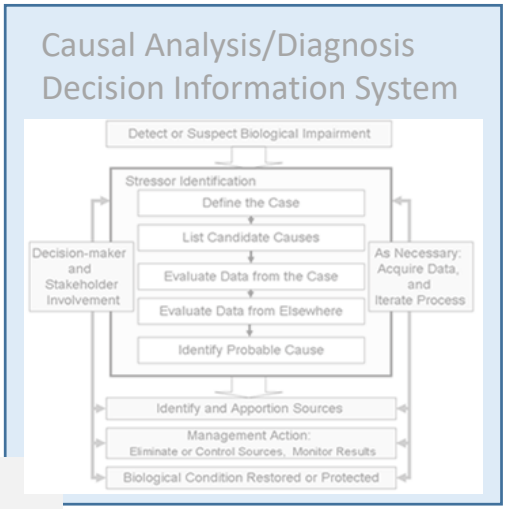
- For management tactics under consideration, worksheets can guide a systematic process of **climate-smart design**
- Design Considerations
  - ✓ Category 1: How will climate change directly or indirectly affect how the **stressor(s) of concern** impact the system?
  - ✓ Category 2: What are the **implications for functionality** of the management action, and how will it need to be adjusted (in terms of location, timing or structural design)?
- Can support **evaluation** of which tactics have the potential for greatest effectiveness in the face of **ongoing environmental changes**

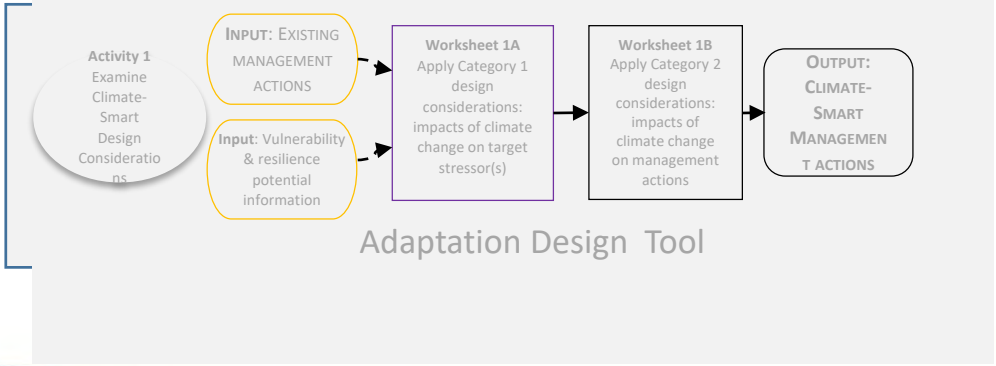
Spotlight: Using RWVF with WATCH



Relative Wetland Vulnerabilities Framework

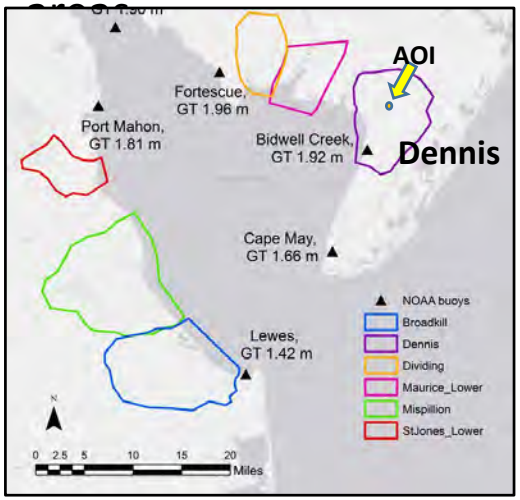






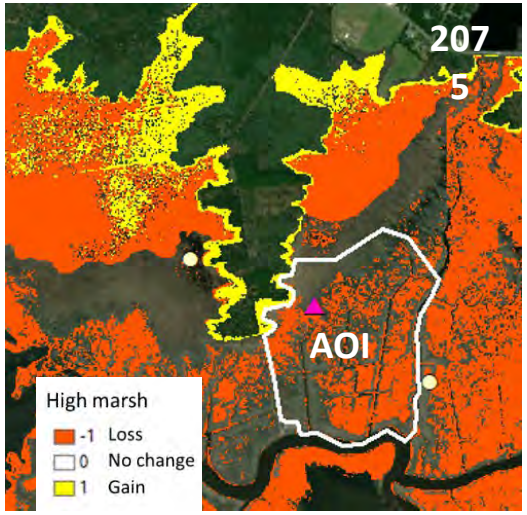
Case study: Dennis high marsh

RWVF case study



Management goal: conserve Saltmarsh Sparrow (SALS) high marsh nesting habitat. A primary threat to SALS is **sea level rise**. Using the RWVF, can determine which sites have **lower vulnerabilities** to SLR than other areas.

Site	High marsh acreage (time zero)	SLR
		% Change in high marsh acreage by 2050
Broadkill (DE)	3239.7	-22.2 %
Mispillion (DE)	4261.6	-2.6 %
St. Jones (DE)	1518.8	2.9 %
Dennis (NJ)	9152.5	0.6 %
Dividing (NJ)	5026.6	-24.0 %
Maurice (NJ)	5225.4	-5.7 %



Within Dennis, we identified an Area of Interest (**AOI**) that has high quality SALS habitat and ran it through the WATCH tool in comparison with the RWVF

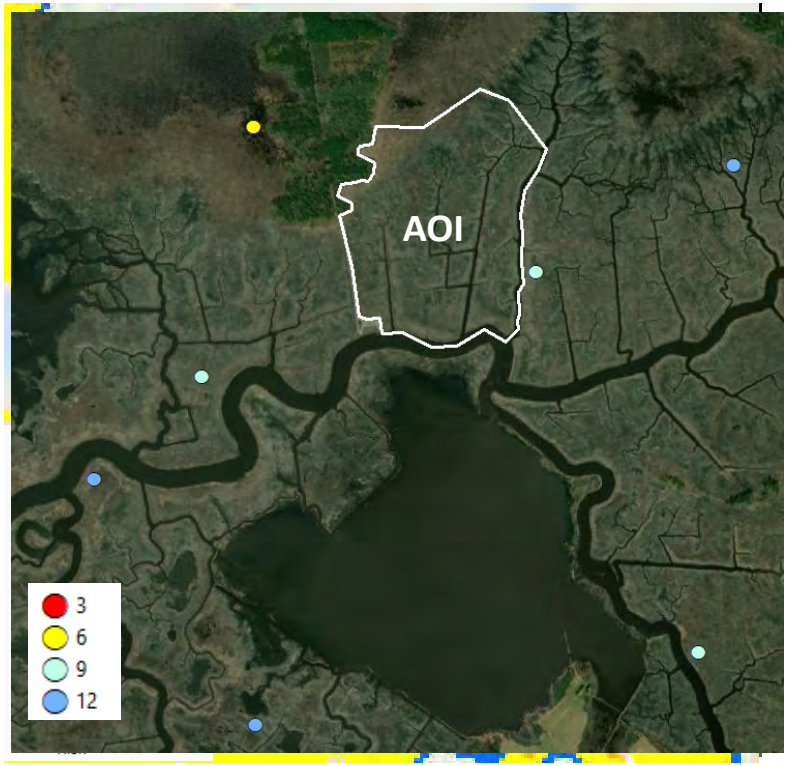
Crosswalk RWVF >> WATCH

<table>
<tr><th>RWVF Steps</th><th>WATCH Walk-Thru – Dennis/Saltmarsh Sparrow case study</th></tr>
<tr><td>Classification/Scenario description</td><td>Objective: Preservation of salt marsh (specifically, high marsh)</td></tr>
<tr><td>Attributes/Scenario description</td><td>High marsh acreage, which provides nesting and foraging habitat for Saltmarsh Sparrows</td></tr>
<tr><td>Principal Factors/ Attributes</td><td>Exposure: Relative Sea Level Rise (SLR)

Responses (by WATCH attribute):
• Horizontal position – shoreline or channel erosion
• Vertical position - marsh platform elevation, accretion rate
• Biology - high marsh habitat, vegetative cover
• Hydrology – degree of alteration

Modifiers: slope, tide range, salt elevation, marsh condition</td></tr>
<tr><td>Metrics/ Metric or Method</td><td>
<table>
<tr><th>WATCH Attribute</th><th>Exposure(s)</th><th>Response metric</th></tr>
<tr><td>Horizontal position</td><td>wave action (boat wakes, fetch), SLR</td><td>change in average shoreline distance relative to 1977</td></tr>
<tr><td>Vertical position</td><td>SLR, subsidence, insufficient sediment supply</td><td>marsh platform elevation</td></tr>
<tr><td>Biology</td><td>SLR, subsidence</td><td>% high marsh habitat</td></tr>
<tr><td>Hydrology</td><td>Past ditching</td><td>mid-TRAM hydrology score</td></tr>
</table>
</td></tr>
<tr><td>Relative Vulnerability/Relative violation seriousness</td><td>Vulnerability considerations could affect projected violations</td></tr>
</table>

Case study: Dennis high marsh



Layering additional **exposures** and **response** info can add richness alongside WATCH

- Sea level rise (exposure)
  - ✓ Could consideration of SLR over longer timeframes affect tactic selection and design?
- Storm surge (exposure)
  - ✓ Effects are extensive over large spatial scales, yet inundation depths vary relative to the AOI
- Condition (modifier of system response)
  - ✓ Could indicate where tactic success is more likely, or condition improvement is critical

Questions?

Thanks!

Contributors:

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Marissa Liang: liang.marissa@epa.gov
Josh Moody: jmoody@delawareestuary.org

Resources:

RWVF: https://www.epa.gov/gcx/about-delaware-bay-wetland-projections (SLAMM); https://doi.org/10.1002/ecs2.2561 (freshwater wetlands pilot)
CADDIS: https://www.epa.gov/caddis
ADT: https://www.epa.gov/gcx/about-adaption-design-tool-adt