Mapping Nature - Based Adaptation Opportunities for San Francisco Bay

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SAN FRANCISCO ESTUARY INSTITUTE

- **Research institute** with over 80 staff working in the Bay Area and California
- We **deliver visionary science** to empower people to revitalize nature

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Mapping nature - based adaptation opportunities

- Adaptation Atlas

- Baylands Resilience Framework

- Beneficial Baylands

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- *San Francisco Bay Shoreline Adaptation Atlas:*

Operational Landscape Units: Where do shoreline jurisdictions need to be working with neighbors?

Suitability: What areas are suitable for nature - based solutions?

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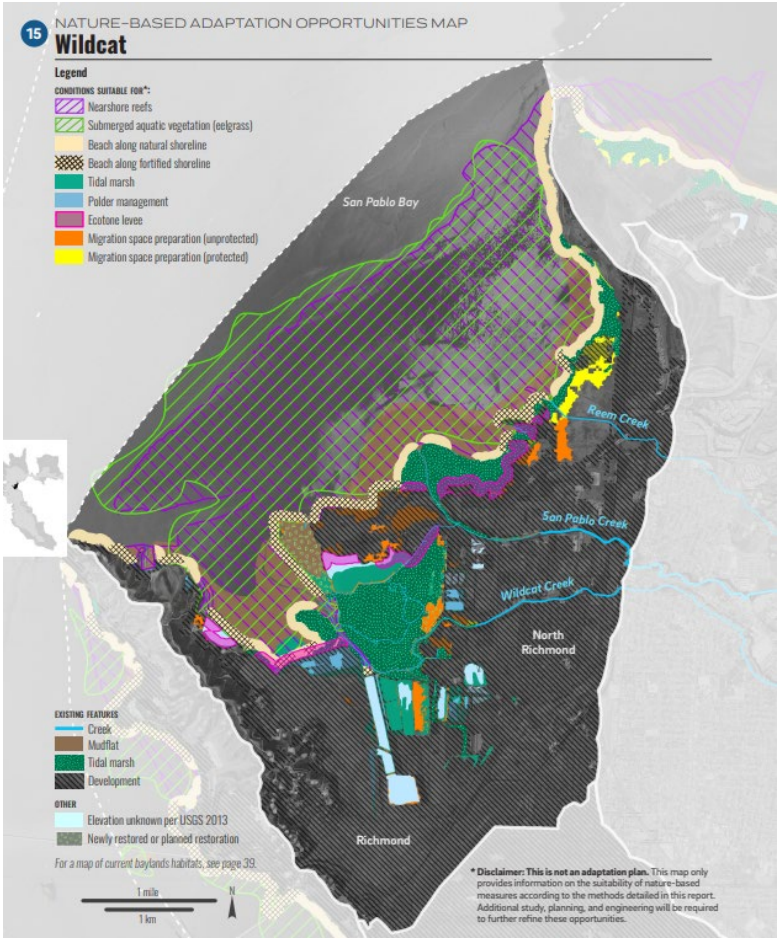
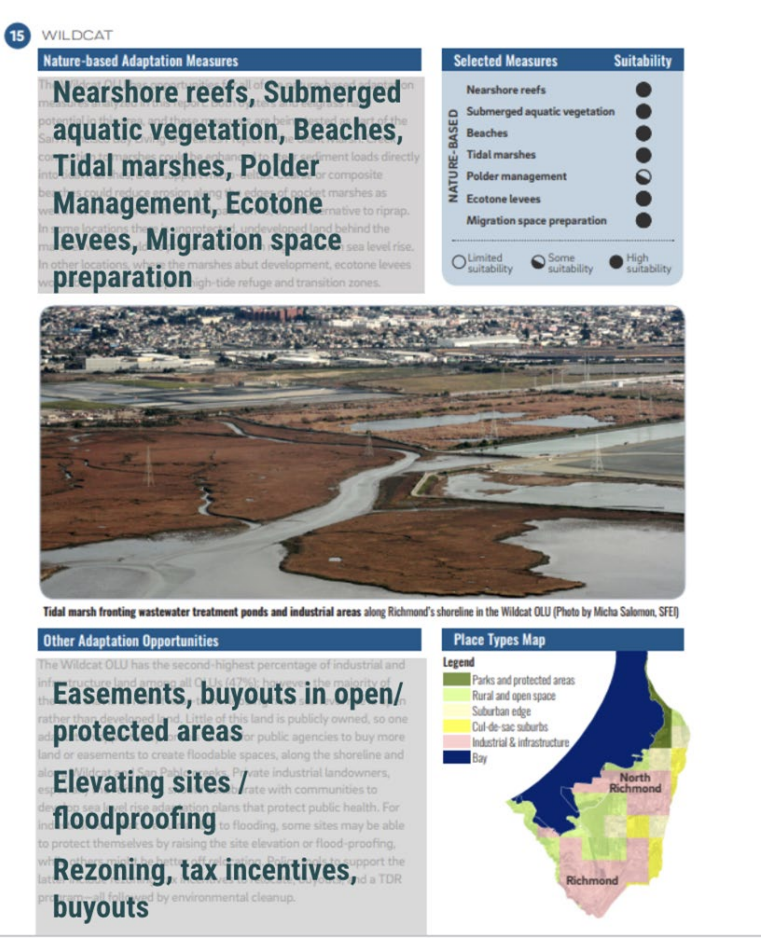
Adaptation Atlas





- ***Adaptation Atlas:***

  Suitability: What areas are suitable for nature-based solutions?

- ***Baylands Resilience Framework:***

  Effectiveness: Where are nature-based solutions needed and why?

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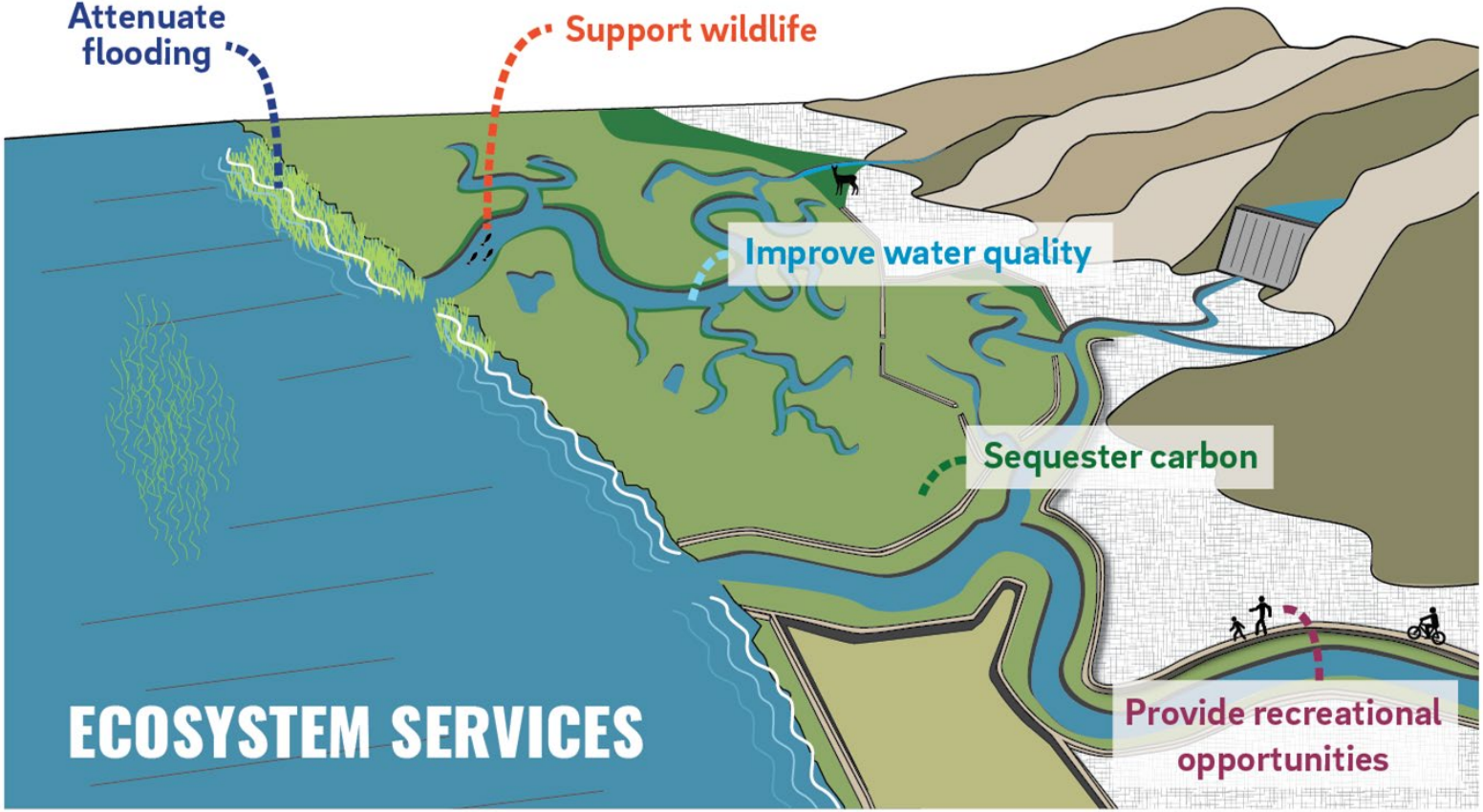
What does “baylands resilience” mean?

As sea levels rise, marshes and mudflats continue to…



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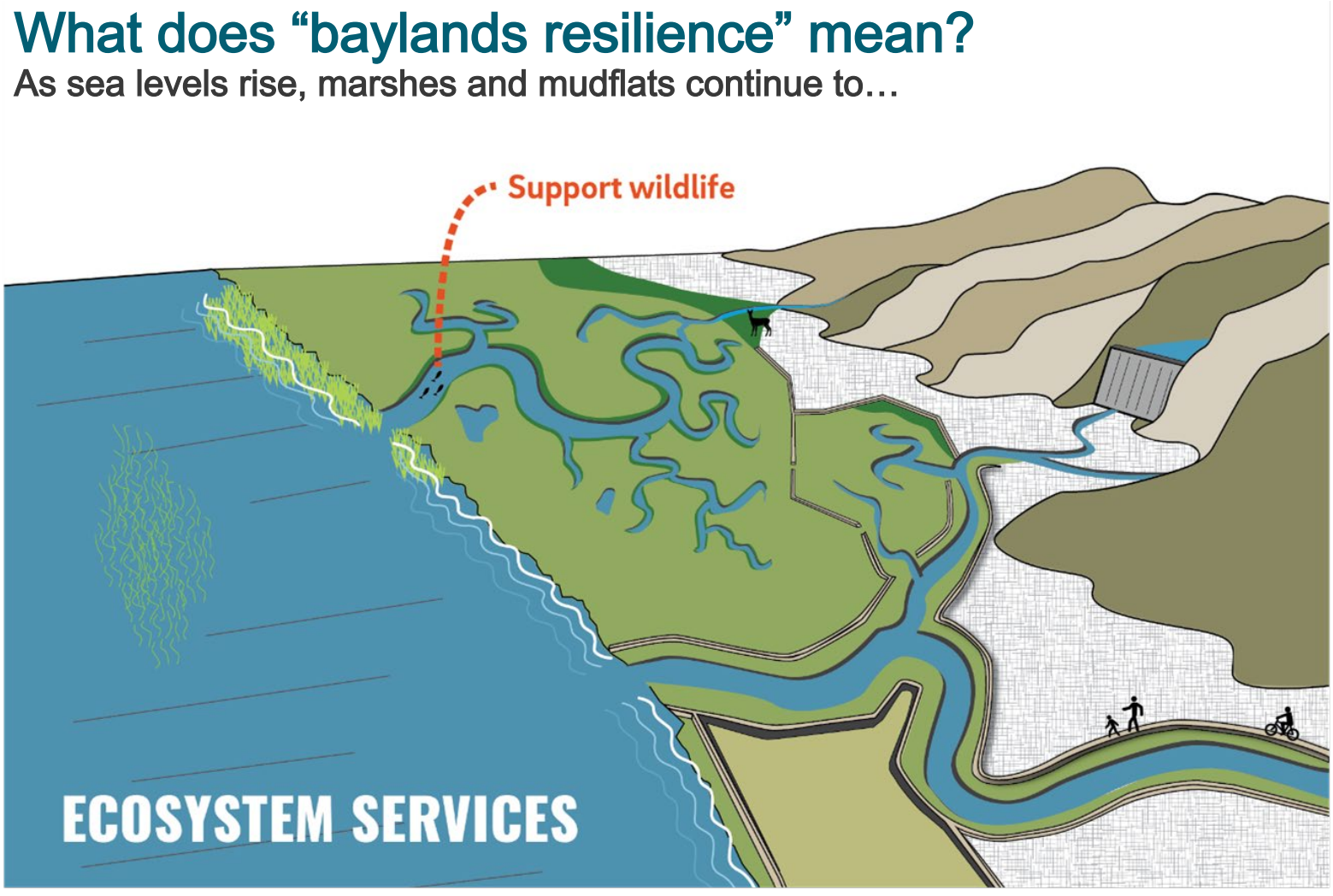

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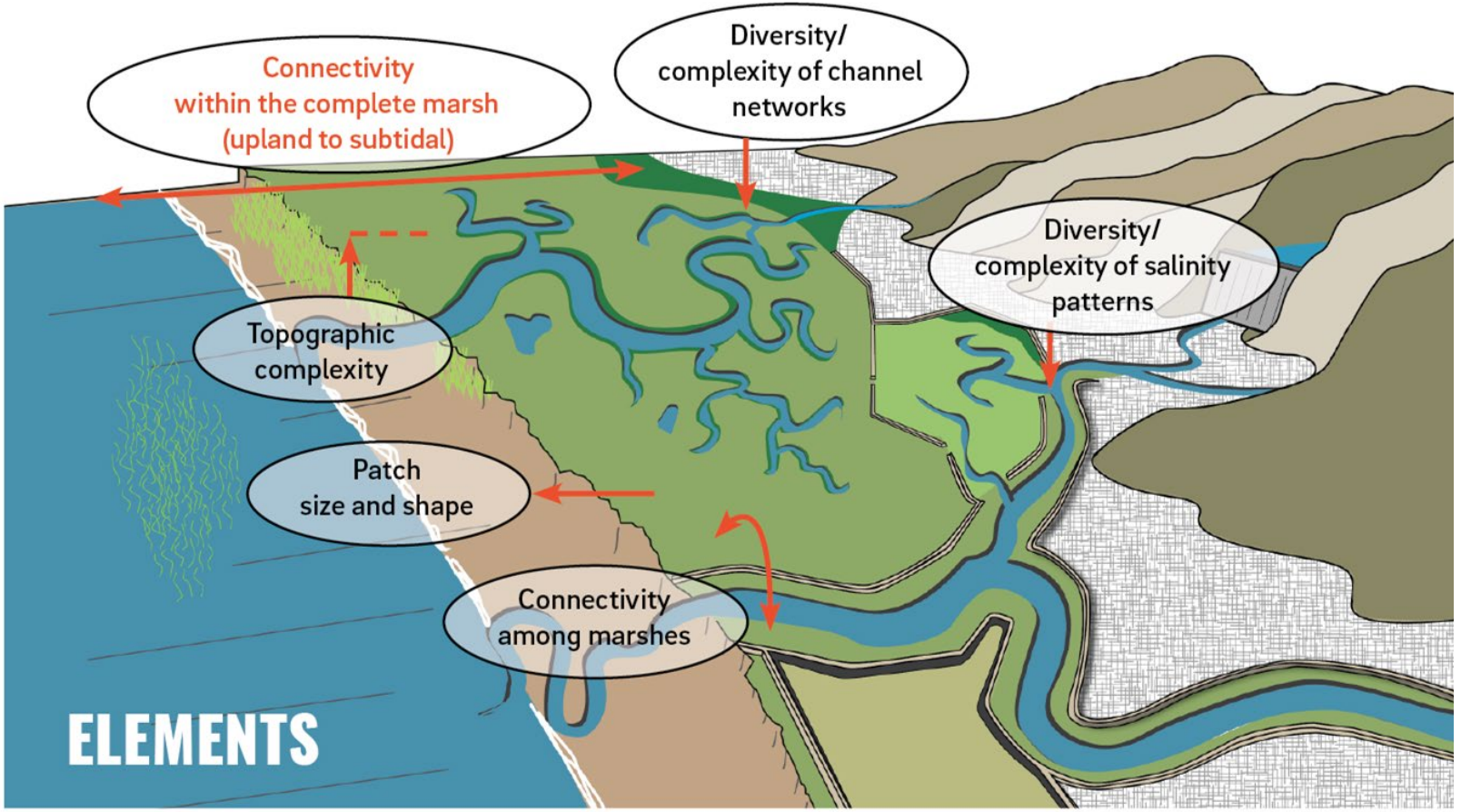
What does “supporting wildlife” mean?

Some elements of resilience include…



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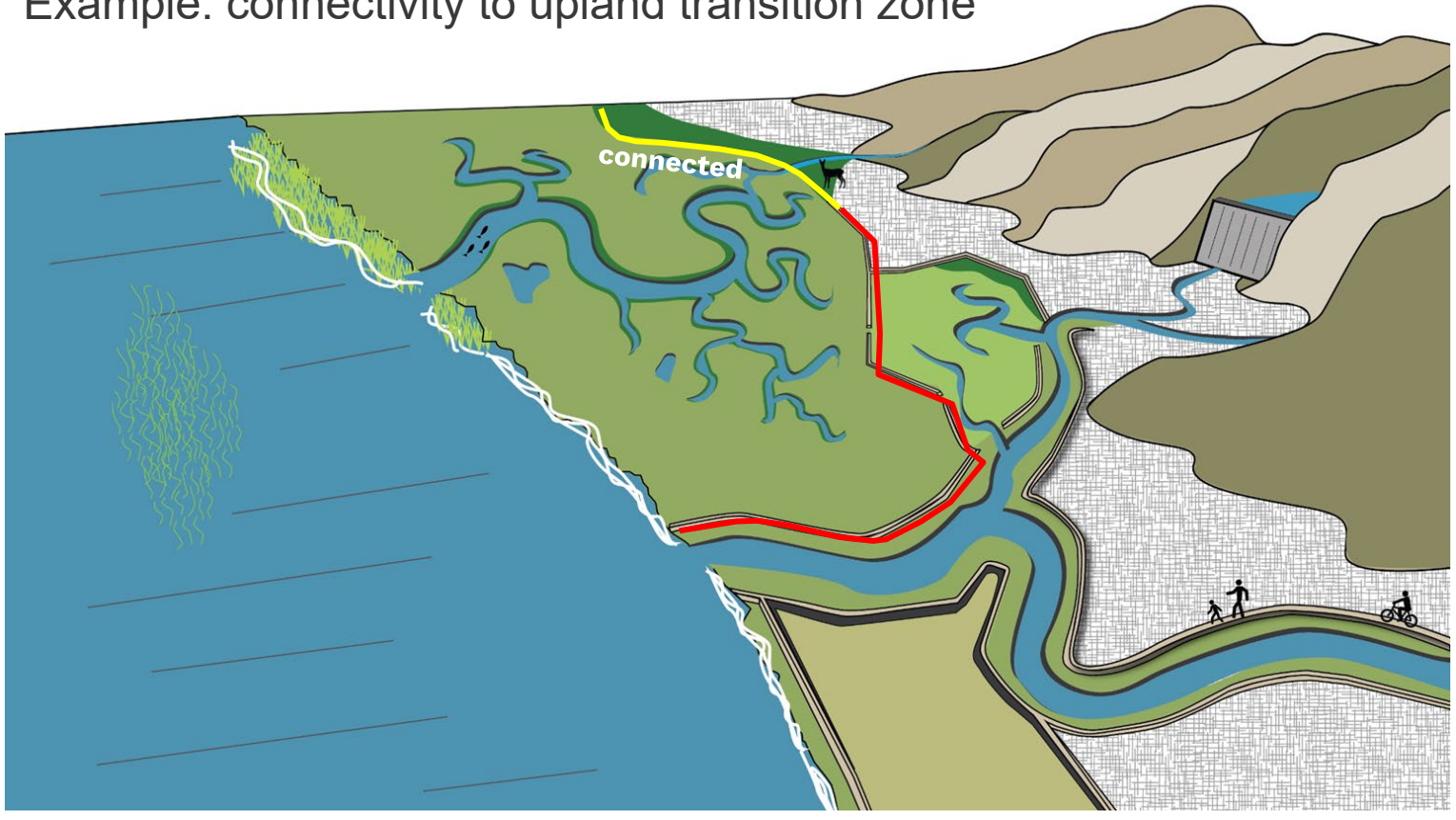
Developing metrics

Example: connectivity to upland transition zone



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Baylands Resilience Framework

Metrics focused on:

- Marshes
- Diked baylands

Current metrics for:

- Wildlife support
- Flood attenuation
- Sediment placement feasibility

Future metrics will include:

- Carbon sequestration
- Recreation access
- Water quality improvement

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Analysis units

Across San Francisco Bay:

- 1,163 diked bayland units
- 805 marsh units
- Ranging in size from 2.5 - 7,000 ac

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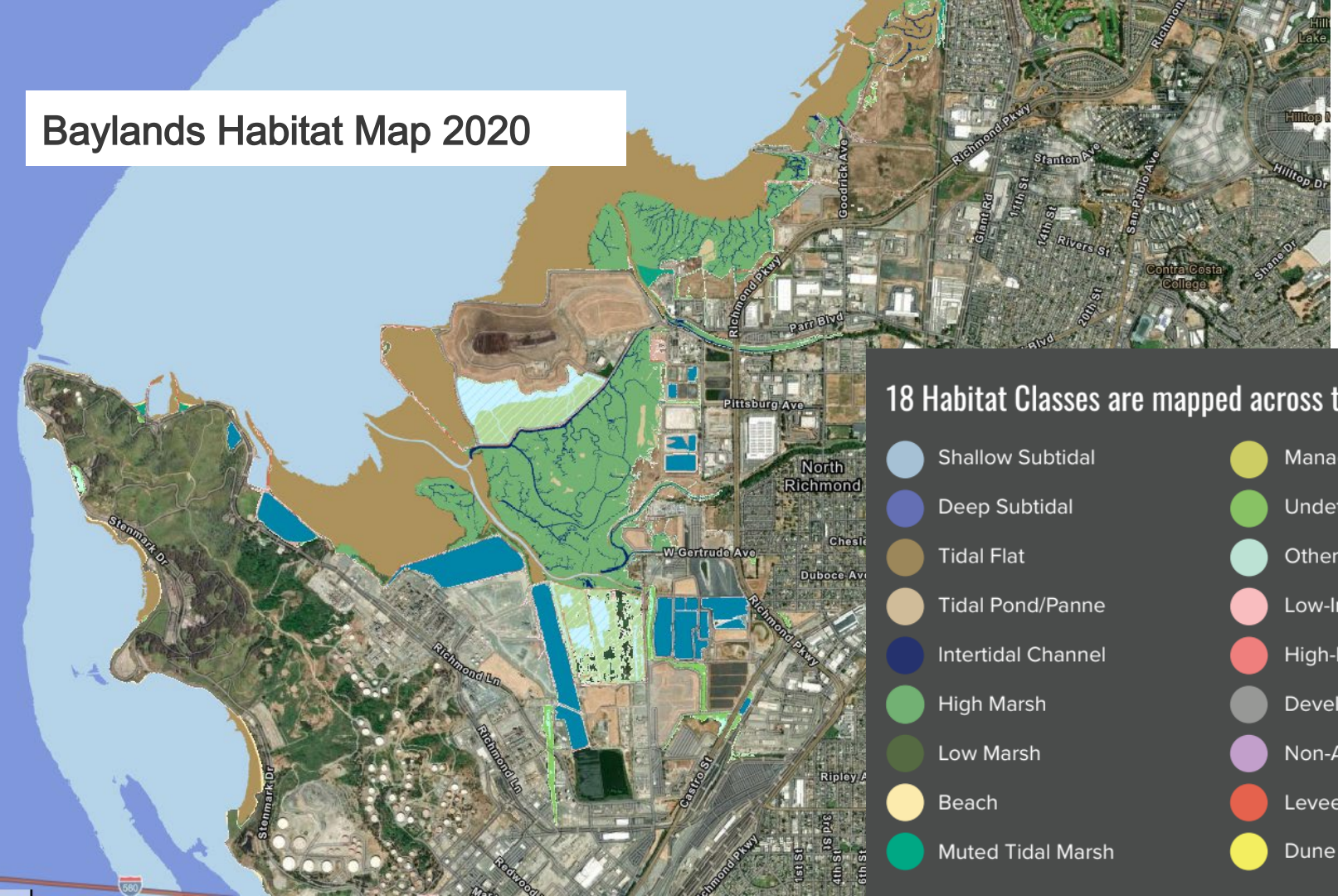
Baylands Habitat Map 2020



18 Habitat Classes are mapped across the Bay and Suisun

- Shallow Subtidal
- Deep Subtidal
- Tidal Flat
- Tidal Pond/Panne
- Intertidal Channel
- High Marsh
- Low Marsh
- Beach
- Muted Tidal Marsh
- Managed Marsh
- Undetermined Other Marsh
- Other Open Water
- Low-Intensity Agriculture
- High-Intensity Agriculture
- Developed/Urban
- Non-Aquatic Diked Bayland
- Levee
- Dune

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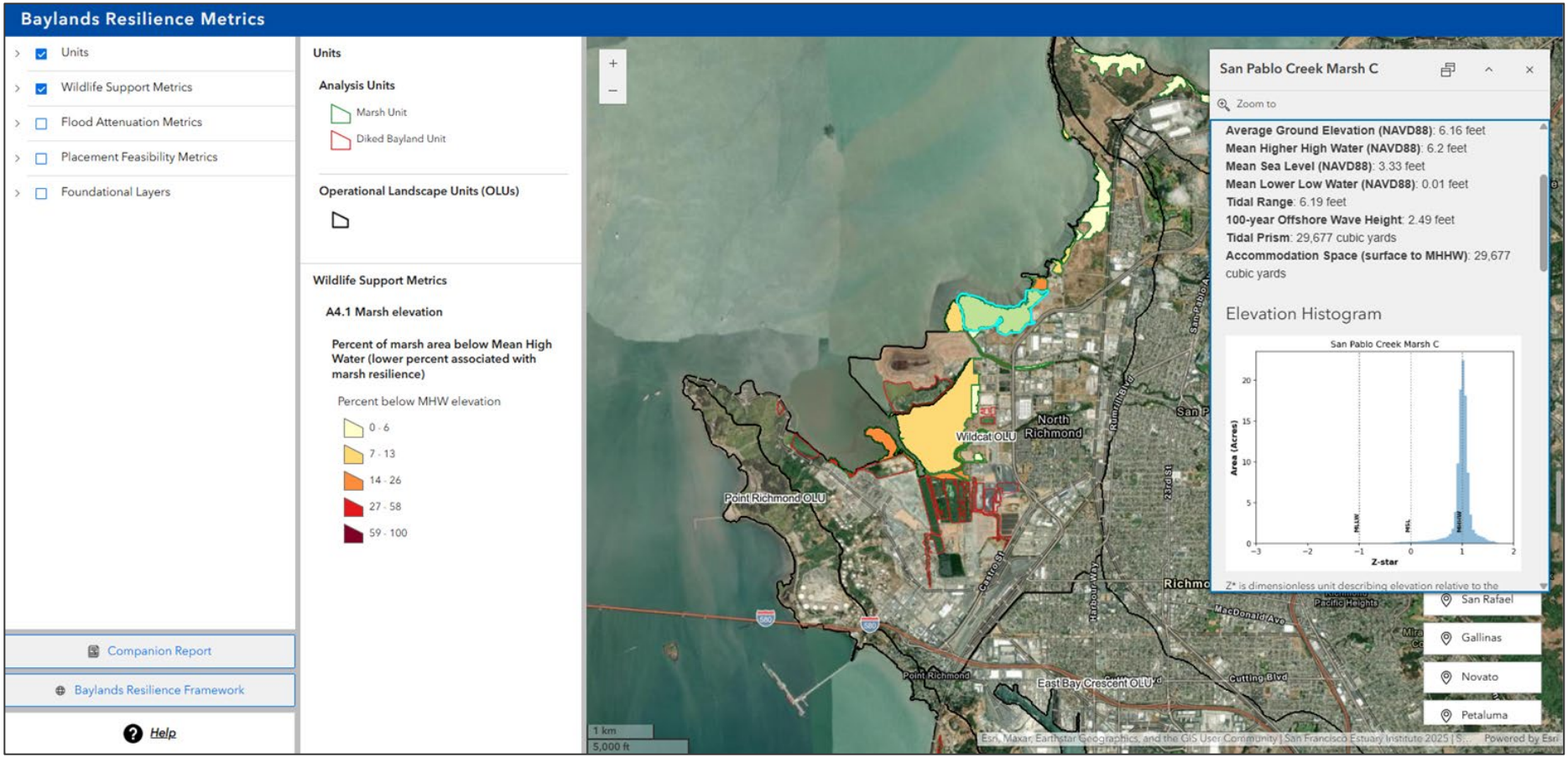

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Baylands Resilience Metrics: **Mapbook**

15

Baylands resilience metrics for the **Wildcat OLU**

Though extensive industrial development has encroached on the baylands along the shoreline of the Wildcat OLU, valuable habitat patches remain. The development of railroads, refineries, landfills, and other infrastructure has reduced the historical connectivity and size of key marsh areas, such as Wildcat Marsh, which was once connected to San Pablo Creek Marsh to the east and to marshes to the south in the Port of Richmond area. Though a fragment of its historical size (over 2,000 acres), Wildcat Marsh and surrounding marshes still form the largest marsh patch in the OLU at 480 acres and play a key role in habitat connectivity.

Opportunities in this area include protecting, expanding, and enhancing transition zones, as well as restoring connectivity between creeks and baylands. Currently, areas next to marshes at the mouths of Wildcat and San Pablo Creeks are diked and filled. With a high sediment supply from these creeks, there is potential to improve baylands resilience by reconnecting the creeks through these diked and filled areas, which would allow more freshwater and sediment to nourish tidal marshes. Undeveloped land along the shoreline in this OLU, both on landfills and naturally rising ground, provides an opportunity to protect and enhance transition zones. A particularly promising opportunity exists at San Pablo Creek Marsh, where wide mudflats extend bayward of the marsh, and undeveloped land at migration space elevation lies inland. Due to extensive industrial and refinery activities in this OLU, contamination considerations need to be factored into restoration plans.

How extensive are the baylands in this OLU?

Little of the total acreage of tidal marsh and diked baylands in San Pablo Bay is found in the Wildcat OLU. There are more acres of tidal marsh than diked baylands here.

296 acres of diked baylands — *Orange outlines in map on facing page*

553 acres of tidal marsh — *Green outlines in map on facing page*

SAN PABLO BAY SIGNIFICANCE (AREA)

1% — 1% of diked baylands in San Pablo Bay are located in this OLU

2% — 2% of tidal marsh in San Pablo Bay is located in this OLU

LEGEND (for map on facing page)

Boundaries
- Operational Landscape Unit
- City

Analysis units
- Diked bayland unit
- Tidal marsh unit

Landscape features
- Creek

Tidal baylands*
- Tidal marsh
- Muted tidal marsh
- Intertidal channel
- Mudflat
- Shallow subtidal
- Deep subtidal

Nontidal baylands*
- Developed/urban
- Managed/other marsh
- Other open water
- Agriculture/other non-aquatic diked bayland

Upland connection opportunities
- Marsh migration elevation (connected to Bay)
- Marsh migration elevation (disconnected from Bay)
- Upper boundary transition zone

0.5 mile / 0.5 km

N

*Baylands Habitat Map 2020

Seven ideas to increase baylands resilience in the Wildcat OLU

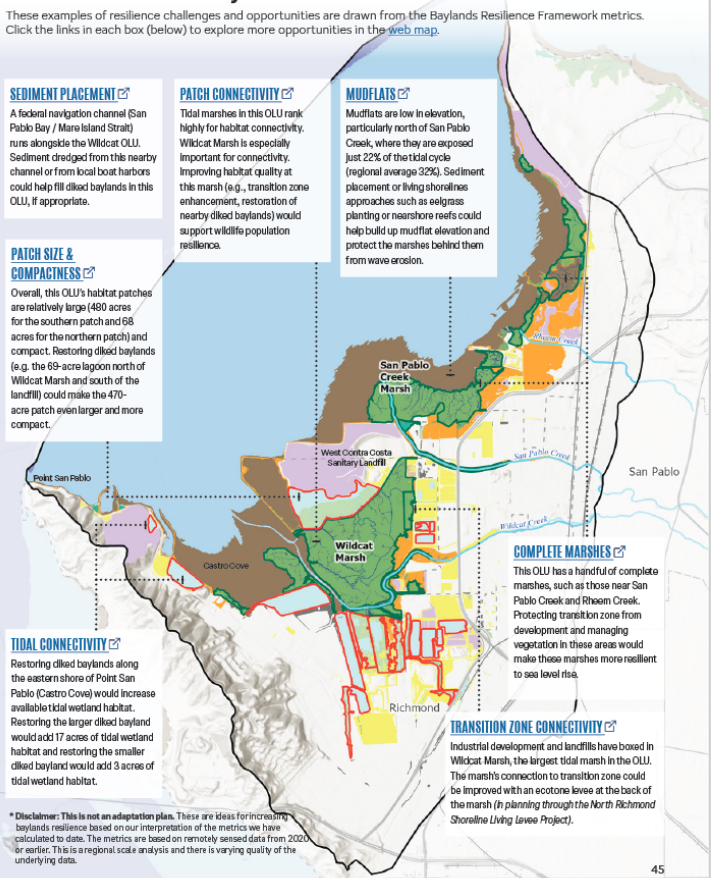
These examples of resilience challenges and opportunities are drawn from the Baylands Resilience Framework metrics. Click the links in each box (below) to explore more opportunities in the web map.

SEDIMENT PLACEMENT
A federal navigation channel (San Pablo Bay / Mare Island Strait) runs alongside the Wildcat OLU. Sediment dredged from this nearby channel or from local boat harbors could help fill diked baylands in this OLU, if appropriate.

PATCH CONNECTIVITY
Tidal marshes in this OLU rank highly for habitat connectivity. Wildcat Marsh is especially important for connectivity. Improving habitat quality at this marsh (e.g., transition zone enhancement, restoration of nearby diked baylands) would support wildlife population resilience.

MUDFLATS
Mudflats are low in elevation, particularly north of San Pablo Creek, where they are exposed just 22% of the tidal cycle (regional average 32%). Sediment placement or living shorelines approaches such as eelgrass planting or nearshore reefs could help build up mudflat elevation and protect the marshes behind them from wave erosion.

PATCH SIZE & COMPACTNESS
Overall, this OLU's habitat patches are relatively large (480 acres for the southern patch and 68 acres for the northern patch) and compact. Restoring diked baylands (e.g. the 69-acre lagoon north of Wildcat Marsh and south of the landfill) could make the 470-acre patch even larger and more compact.



COMPLETE MARSHES
This OLU has a handful of complete marshes, such as those near San Pablo Creek and Rhoem Creek. Protecting transition zone from development and managing vegetation in these areas would make these marshes more resilient to sea level rise.

TIDAL CONNECTIVITY
Restoring diked baylands along the eastern shore of Point San Pablo (Castro Cove) would increase available tidal wetland habitat. Restoring the larger diked bayland would add 17 acres of tidal wetland habitat and restoring the smaller diked bayland would add 3 acres of tidal wetland habitat.

TRANSITION ZONE CONNECTIVITY
Industrial development and landfills have boxed in Wildcat Marsh, the largest tidal marsh in the OLU. The marsh's connection to transition zone could be improved with an ecotone levee at the back of the marsh *(In planning through the North Richmond Shoreline Living Levee Project).*

*** Disclaimer: This is not an adaptation plan.** These are ideas for increasing baylands resilience based on our interpretation of the metrics we have calculated to date. The metrics are based on remotely sensed data from 2020 or earlier. This is a regional scale analysis and there is varying quality of the underlying data.

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Uses of the metrics

- Inform sediment placement projects in the US Army Corps of Engineers' Regional Dredged Material Management Plan
- Inform nature-based solution development in regional adaptation planning (e.g. the RSAP)
- Show how proposed projects fit into the surrounding landscape and how they can increase baylands resilience
- Track effectiveness of projects in increasing baylands resilience

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Beneficial Baylands

The project: Develop a decision-support tool for bayland adaptation projects and hone the design of several landscape-scale projects

The goal: Accelerate implementation of nature-based solutions (NbS) that:

- improve water quality
- provide wildlife habitat
- foster the ongoing health of bayland ecosystems and shoreline communities
- enhance other ecosystem functions

The process: Co-develop the tool with future users

Tool focus

Solve the Blank Slate Problem

- Identify opportunities to enhance baylands habitats by implementing NbS
- Evaluate reasons to pursue NbS projects at a given site
- Build on—but don't recreate—existing mapping tools
- Target users: local adaptation/restoration planners and their consultants

Tool functions

Identify suitable NbS measures for a given site

- *Based on updated Adaptation Atlas data*

Explore benefits that NbS measures can deliver

- *Based on Baylands Resilience Metrics*

Tool output:

- ***Site - specific NbS scenario map(s)***
- ***Benefits summary***
- ***Suggested feasibility considerations***

Tool value

Challenge	Solution
Existing information is too distributed	Tool provides a one - stop shop to develop NbS scenarios
Overwhelming amount of available information	Tool walks users through scenario development
Project proponents put forward inappropriate designs	Tool daylights suitability and feasibility considerations
Information is challenging to apply at the relevant scale	Tool provides ideas at the scale of available info and suggests additional studies for more detailed analysis

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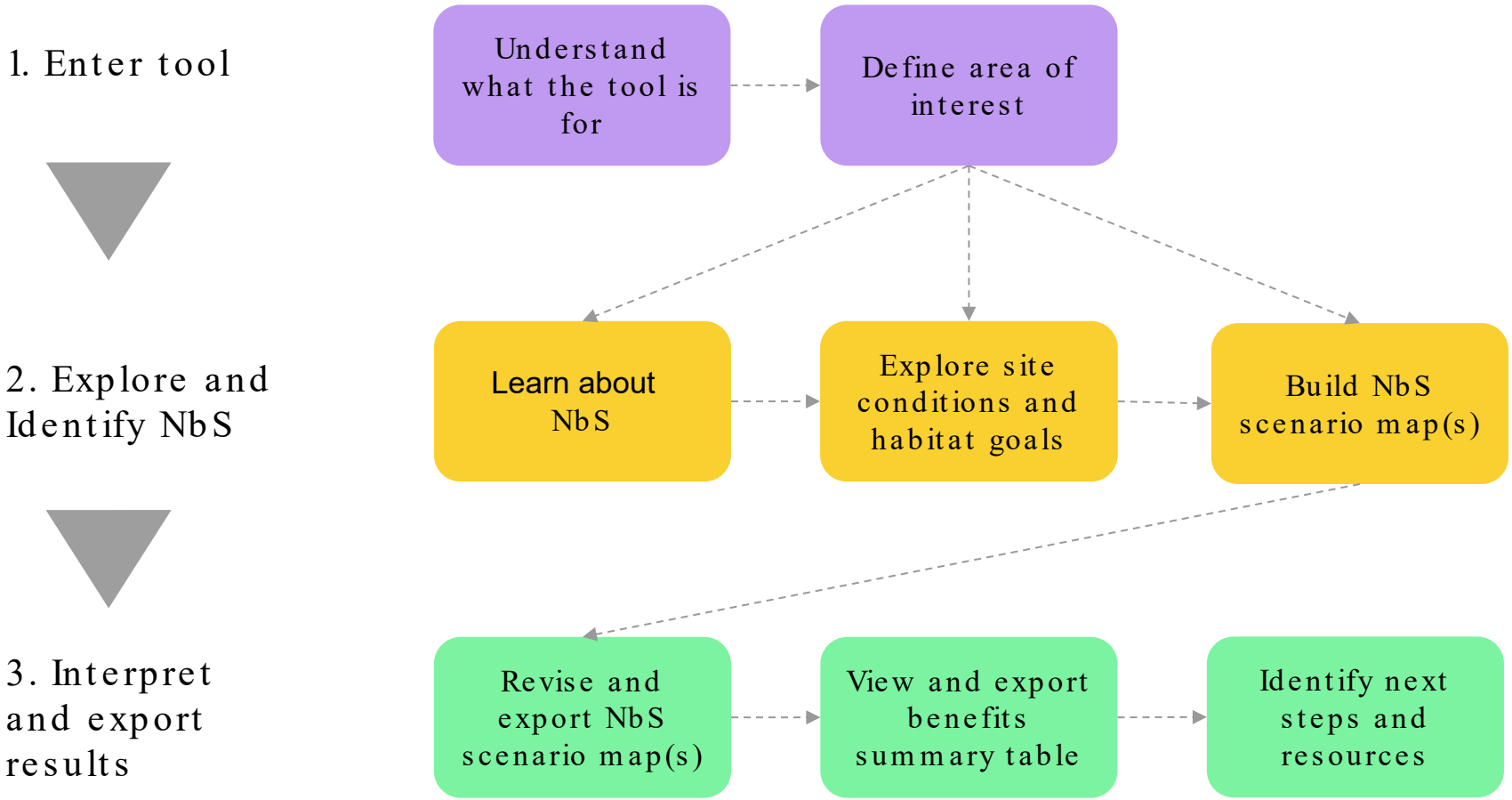
1. Enter tool
Understand what the tool is for
Define area of interest
2. Explore and Identify NbS
Learn about NbS
Explore site conditions and habitat goals
Build NbS scenario map(s)
3. Interpret and export results
Revise and export NbS scenario map(s)
View and export benefits summary table
Identify next steps and resources

Underlying Datasets: Adaptation Atlas & Baylands Resilience Framework

Examples of **Adaptation Atlas** suitability layers:

- Nearshore reefs
- Submerged aquatic vegetation (eelgrass)
- Coarse beaches
- Ecotone levees
- Polder (diked bayland) management
- Tidal marsh restoration

Examples of **Resilience Metrics** :

Wildlife support metrics:

- Patch size and shape
- Patch connectivity
- Connectivity to migration space

Flood attenuation metrics:

- Wave attenuation
- Compound flooding attenuation

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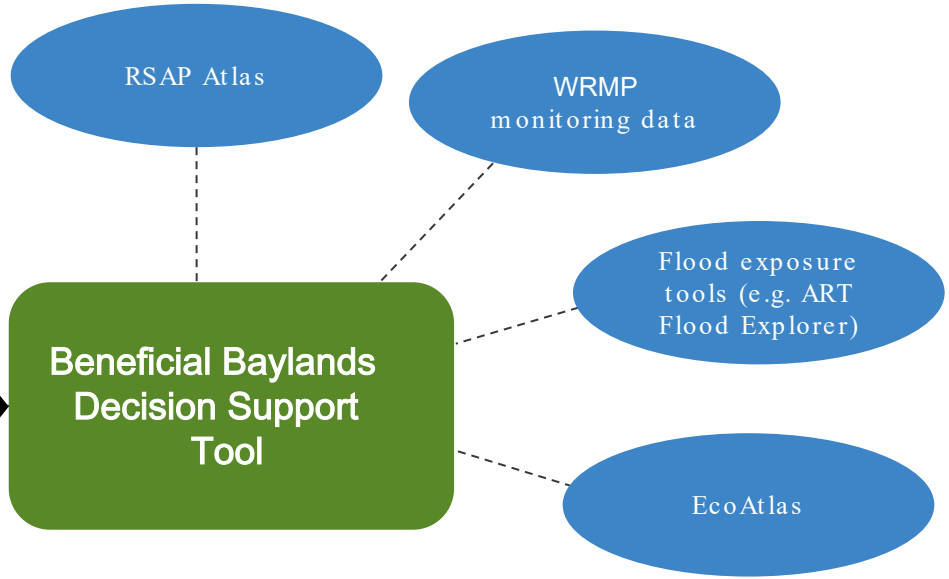
Input Data

- Adaptation Atlas suitability mapping
- SFEI Baylands Resilience metrics
- Subtidal Goals & suitability mapping
- Baylands Habitat Map
- Baylands Ecosystem Habitat Goals
- Regionally Advancing Living Shorelines design guidance
- Additional (new) analyses

Related Tools / Links To…



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Ideas?

Contact:

lydiav@sfei.org

Or fill out this survey:

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Adaptation Atlas and Resilience Metrics Mapbook:
SF Bay Regional Water Quality Control Board

Baylands Resilience Framework:
US Army Corps of Engineers and **Google**

Beneficial Baylands:
EPA Region 9

Contact: ellenp@sfei.org