Technical Memorandum

Date: March 15, 2021

From: Christina Toms, WRMP TAC Chair

To: WRMP Steering Committee

Subject: WRMP Benchmark Site recommendations

Introduction

The Technical Advisory Committee (TAC) of the San Francisco Estuary Wetlands Regional Monitoring Program (WRMP) provides scientific and technological advice to the Steering Committee (SC) of the WRMP. The TAC has the following fundamental duties:

- Recommend the science and technology content of the WRMP,
- Assure the relevance, credibility, and veracity of the WRMP's content and findings,
- Advise the SC on technical, scientific, and engineering matters,
- Advise the SC on the interpretation and communication of WRMP data and information, and
- Establish and manage Workgroups and oversee Special Studies as needed to perform its other duties.

The purpose of this memo is to recommend for approval by the SC a set of priority Benchmark Sites (see below) for the WRMP to establish. The TAC voted to approve these recommendations on March 11, 2021 with the understanding that they will be formally voted on by the SC on March 23, 2021. This memo describes the process the TAC used to develop the recommendations, and briefly summarizes the technical justification for selecting these sites. The memo also presents a preliminary suite of indicators that the TAC recommends monitoring at the selected Benchmark Sites. It is important to note that as the TAC develops the recommended science content of the WRMP, that these recommendations – including but not limited to site selection/classification, selection criteria, and indicators – will be subject to further revision. The TAC will periodically summarize these changes for adoption by the SC.

The work of the TAC is guided by the science framework articulated in the WRMP Phase 1 Program Plan, which is focused on developing information to answer the following Guiding Questions:

- Guiding Question 1: ***Where are the region's tidal wetlands and wetland projects, and what net landscape changes in area and condition are occurring?***
- Guiding Question 2: ***How are external drivers, such as accelerated sea level rise, development pressure, and changes in runoff and sediment supply, impacting tidal wetlands?***
- Guiding Question 3: ***How do policies, programs, and projects to protect and restore tidal marshes affect the distribution, abundance, and health of plants and animals?***
- Guiding Question 4: ***What new information do we need to better understand regional lessons from tidal wetland restoration projects in the future?***
- Guiding Question 5: ***How do policies, programs, and projects to protect and restore tidal wetlands benefit and/or impact public health, safety, and recreation?***

Since the WRMP is a new program that is intended to grow in scope and scale over time, the Program Plan established numerous science priorities for near-term (3-5 year) implementation that reflect the WRMP Guiding Questions and build on each other:

1. **Conduct regional baseline and subsequent routine surveys and inventories of the distribution, abundance, diversity, and condition of tidal wetlands throughout the region**, using existing tools and metrics to the extent practicable and new tools and metrics where necessary.
2. Establish the WRMP Monitoring Site Network (dependent on available funding and resources), starting with the **Benchmark Site Network**.
3. **Conduct repeated surveys (detect change) of living organisms and their habitats (indicators)**, and standardize the metrics and reporting for indicators that are common to projects and baseline/subsequent ambient monitoring, across the range of project designs and restoration practices.
4. **Analyze data on the relative roles of estuarine and upland/watershed sources of sediment** to counter the threats of marsh drowning, mudflat loss, and shoreline erosion driven by sea level rise.
5. **Assess the broad range of interactions between people and wetlands** that should be monitored for the safety of people and health of the wetlands. This process should better integrate flood control and mosquito and disease vector control into project planning and assessment, and similarly integrate wetland restoration into flood control planning.

Portions of Priority (1) are currently being addressed by an EPA-funded effort to produce a Baylands Change Basemap that will address regional tidal wetland distribution and abundance; some of this work may also address tidal wetland diversity. This effort is led by members of the WRMP Core Team and will be supported by the WRMP TAC. To address regional tidal wetland diversity and condition as well as Priorities (3)-(5), the WRMP must first establish a network of Benchmark Sites (Priority (2)). The monitoring site network proposed in the WRMP science framework includes three types of sites in each subregion of the Estuary[1]:

- **Benchmark Sites** are remnant ancient (millennial) tidal wetlands that are relatively undisturbed and assumed to be in equilibrium with governing physical processes (e.g. hydrologic and geomorphic). Benchmark Sites are meant to provide early warning of landscape-scale change that could affect the condition of other tidal wetlands throughout the region, including Reference and Project Sites (below).
- **Reference Sites** are generally younger (centennial) tidal wetlands at mid- to late stages of evolution that represent target geomorphic and ecological endpoints for tidal wetland restoration sites. Older, mature restoration projects may be classified as Reference Sites.
- **Project Sites** are tidal wetland restoration projects implemented over roughly the past 20 years, that represent a variety of design and management approaches.

[1] The TAC is currently focused on identifying potential WRMP sites in the Central Delta/Suisun, North Bay, Central Bay, South Bay, and Lower South Bay subregions, consistent with the geographic classification system used by the Bay Regional Monitoring Program (Bay RMP). The TAC has expressed an interest in eventually building out the network to include sites throughout the Delta, in collaboration with Delta monitoring entities, to facilitate a singular tidal wetland science enterprise for the Estuary.

Development of the Benchmark Site Recommendations

In fall 2020, the TAC tasked itself with addressing Priority (2) and recommending a suite of Benchmark Sites for early implementation to the SC. The TAC also committed to identifying which indicators (based on the "Master Matrix" of indicators in the Phase 1 program plan) would be a priority to monitor at the Benchmark Sites. The TAC's process to identify the priority Benchmark Sites and accompanying indicators can be summarized by the following steps:

1. The TAC coalesced around a suite of criteria for Benchmark Sites that built upon and modified the initial criteria listed in the Phase 1 program plan:
    a. The site represents one of the Estuary's five major subregions downstream of the Delta (Suisun/Central Delta, North Bay, Central Bay, South Bay, Lower South Bay).
    b. The site represents a major sub-basin along the main estuarine gradient (e.g. a major source of freshwater and/or sediment to the Estuary).
    c. The site will help assess the influences of and/or the development of numerical models of specific existing and future hydrologic, geomorphic, and/or ecological processes (e.g. flooding, sediment deposition, support for target species, etc.).
    d. The site is associated with the network of stations proposed by the Bay Regional Monitoring Program (RMP) to monitor salinity, tides, and suspended sediment.
    e. The site represents a sub-region or Operation Landscape Unit (OLU)[2] with numerous existing and/or anticipated tidal wetland restoration projects.
    f. The site would leverage related, ongoing, or historic monitoring and/or research projects.
    g. The site is relatively easy and safe to access, with access likely to be granted by the landowner.
    h. The site can be tied to stable uplands using optical surveys to measure vertical landscape movement through existing or WRMP geodetic benchmarks.
    i. The site's geomorphic setting supports connectivity (with upland migration space, adjacent habitats, salinity gradients, and/or fluvial habitats), especially consistent with the definition of "complete tidal wetlands" in the Baylands Ecosystem Habitat Goals Science Update (BEHGU)[3]
    j. The site is known to be highly vulnerable to drowning/downshifting (is an island, has minimal migration space, is experiencing subsidence, etc.).
    k. The site is known to support one or more rare and/or special-status plant or animal species.

2. The TAC developed a list of remnant ancient tidal wetlands in the Estuary, and used their best professional judgment to qualitatively assess how each of the sites addressed the criteria listed above. It's important to note that the list of candidate sites is short (there are *very* few ancient, relatively intact marshes left in the Estuary), and that this was not a precisely quantitative exercise: the degree to which a particular site met a particular criterion was not quantified, and no

[2] OLUs are defined in the San Francisco Shoreline Adaptation Atlas (https://www.sfei.org/adaptationatlas) as "*connected geographic areas that share common physical characteristics and that would accordingly benefit from being managed as individual units. OLUs cross traditional jurisdictional boundaries of cities and counties, but adhere to the boundaries of natural processes like tides, waves, and sediment movement.*"

[3] BEHGU (https://www.sfei.org/projects/baylandsgoals) defines a "complete tidal wetland" as a wetland with habitat connectivity along a gradient that spans the open Bay, mudflats, tidal marsh, and estuarine-terrestrial transition zone (including, in some cases, streams & floodplains). The concept *"emphasizes all the aspects of the baylands ecosystem and the full gradient of ecological functions and ecosystem services"* along this gradient.

criteria were numerically weighted more or less than others. However, in subsequent discussions during TAC meetings, it became clear that certain pragmatic criteria (especially geographic representation, site accessibility/safety, and relationships to existing and/or planned restoration projects) merited special emphasis, and justified selecting some sites over others.

3. The TAC assembled a draft recommendation that consisted of a list of priority Benchmark Sites, and a preliminary list of priority indicators at each of these sites. Not every Benchmark Site was proposed to feature the same suite of indicators. The TAC listed priority Benchmark Sites in two categories:

   a. ***Geographic core*****:** A core suite of sites that are necessary to achieve representative geographic coverage within all five of the Estuary's major subembayments, and address all Guiding Questions and Phase 1 Program Plan science priorities.

   b. ***Process-focused*****:** A complementary suite of sites that further enhance the WRMP Benchmark Site network's geographic coverage, and are targeted at addressing a subset of Guiding Questions and science priorities.

   The TAC recommended these categories in an attempt to reconcile the science priorities in the Phase 1 program plan with an acknowledgment that early program funding may not be sufficient to fund early establishment of all sites in both categories.

   On December 10, 2020, the TAC unanimously approved the Benchmark Site recommendation below. This list includes the proposed Benchmark Sites as well as a brief (not mean to be exhaustive!) summary of why the TAC selected them. Maps of proposed Benchmark Sites are shown in Figures 1 through 5 (basemap courtesy of EcoAtlas, www.ecoatlas.org). On each map, geographic core sites are labeled in **bold**; process-focused sites are not.

   Geographic core:

   - **Suisun/Central Delta: Rush Ranch** – leverages existing monitoring through the SF Bay National Estuarine Research Reserve, is located near multiple North Suisun restoration projects, supports study of marsh transgression along a natural estuarine-terrestrial transition zone
   - **North Bay: China Camp** – leverages existing monitoring through the SF Bay National Estuarine Research Reserve, is located near multiple North Bay restoration projects, supports study of marsh transgression along a natural estuarine-terrestrial transition zone
   - **Central Bay: Wildcat Creek Marsh** – leverages Bay RMP studies, is located near multiple restoration sites along the North Richmond shoreline, supports study of marsh transgression along a natural estuarine-terrestrial transition zone, bookends watershed sediment supply and wave erosion conditions in the Central Bay (high sediment supply, low wave energy), is located near significant subtidal habitat (eelgrass beds)
   - **South Bay: Inner Greco Island** – the most intact and geomorphically complex ancient marsh in the South Bay, is located near multiple existing and planned restoration projects, represents conditions along the western shoreline of the South Bay
   - **Lower South Bay: Laumeister Marsh** – highly accessible ancient, geomorphically complex marsh that is located near multiple existing and proposed restoration sites

   Process-focused:

   - **Suisun/Central Delta: Brown's Island** – leverages past monitoring and research, captures the

influence of Delta inflows, and informs restoration planning in West Suisun

- **North Bay: Older Coon Island/Fagan Marsh** [4]– leverages past monitoring and research, captures the influence of Napa River inflows, is located near the considerable number of restoration projects within the lower Napa basin; **Petaluma Marsh** – leverages past research and informs restoration planning within the Petaluma baylands
- **Central Bay: Heerdt Marsh** – supports study of an area with documented marsh retreat, leverages past research on marsh-mediated wave attenuation, and bookends watershed sediment supply and wave erosion conditions in the Central Bay (low sediment supply + high wave energy)
- **South Bay: Whale's Tail** – leverages new Bay RMP research of wave- and tidally-mediated sediment transport and marsh accretion, is located near the Eden Landing restoration complex, represents conditions along the eastern shoreline of the South Bay (wind fetch)
- **Lower South Bay: Older Warm Springs Marsh** – captures the influence of Coyote Creek inflows, and informs future restoration at the South Bay Salt Ponds; **Dumbarton Point** – large, geomorphically complex marsh with offshore mudflats similar to many Lower South Bay restoration projects, near Dumbarton Bridge sediment monitoring site

While selecting these sites, the TAC wished to emphasize the following points:

- Since there are so few remaining intact, ancient marshes left in the Bay, the resulting geographic distribution of Benchmark Site candidates is uneven, with some subembayments (such as the relatively less developed North Bay) supporting multiple large, relatively intact, ancient marshes, and others (such as the relatively more developed South Bay) supporting mostly smaller fragments of less pristine ancient marsh, embedded within highly modified landscapes. This will make it challenging to assemble monitoring site networks within all five subembayments that are equally spatially coherent. Data collection and interpretation at Benchmark Sites must consider these landscape contexts, especially if/when data is compared between Benchmark Sites in different subembayments.

- Because different Benchmark Site candidates meet the site selection criteria in different ways, and exhibit varying relative degrees of "intactness" and landscape disturbance, there is some overlap between the Benchmark and Reference Site categories (the same is also true for Reference and Project Sites). Some sites that are not great Benchmark Site candidates may make excellent Reference Site candidates. For example, Steamboat Slough is the only remaining fragment of ancient marsh that remains in the Sonoma Baylands. While its relatively small size and modified conditions make it a less-than ideal Benchmark Site candidate, it can serve as a critical Reference Site to inform tidal wetland restoration planning in the Sonoma Baylands.[5] Site labels ultimately matter less than how and why the information generated from monitoring sites is contextualized and applied.

- The eastern and western shores of the South Bay are very different from each other for multiple reasons, including the considerable wind fetch that primarily affects the eastern

[4] TAC members did not have enough information to decide between Coon Island and Fagan Marsh, and can revisit this during future deliberations.

[5] See the Sonoma Creek Baylands Strategy, which calls for the near-term restoration of roughly 10,000 acres of tidal wetlands in the region: https://www.sfei.org/projects/sonoma-creek-baylands-strategy

shoreline due to dominant N/NW winds. As the WRMP monitoring site network in the South Bay is built out, it will effectively require separate eastern and western subnetworks to accommodate these differences.

4. While assigning indicators to priority Benchmark Sites, TAC members expressed a desire to refine the list of indicators in the Phase 1 program plan, particularly those that address monitoring questions related to ecological processes and biological communities (e.g. fisheries, birds, mammals, and their habitats). Therefore, the indicator recommendations presented below focus only on Level 1[6] remote sensing indicators, Level 2 rapid assessment indicators, and Level 3 indicators related to physical processes and vegetation. The TAC is in the process of establishing specialized workgroups to refine the ecological and biological indicators, and will prepare a separate related proposal for future SC approval.

   Level 1 (remotely sensed/mapped indicators)

   - Mapping of habitat types and elements (vegetated tidal marsh, tidal flats, diked marsh types, levees, channels, pannes, etc), including:
     - Estuarine-terrestrial transition zones and marsh migration space
     - "Complete marsh habitats" as defined by BEHGU
     - The lateral extents of natural foreshores (e.g. tidal marshes, beaches, etc.)
     - Calculation of geomorphic metrics such as drainage network length, channel density, channel width, ratio of vegetated/unvegetated areas
   - Mapping of tidal wetland elevations and elevation capital
   - Mapping of major dominant tidal wetland vegetation communities
   - Mapping of tidal wetland special-status species habitat

   Level 2 (rapid assessment indicators)

   - California Rapid Assessment Method (CRAM) site scores

   Level 3 (site-specific indicators)

   - Elevations in tidal marshes (including marsh plains, flats, channels, transition zones, etc.)
   - Percent cover, height, and patch characteristics of major dominant vegetation communities (including select non-native, invasive species)
   - Suspended sediment concentrations (SSC) in tidal marsh channels
   - Frequency, duration, and depth of tidal inundation (including calculation of SLR)
   - Salinity in tidal marsh channels
   - Salinity along porewater gradients

Figure 6 presents a conceptual schematic diagram of how monitoring efforts within a Benchmark Site could potentially be arranged. Some Level 3 indicators, such as elevation, vegetation, and porewater salinity, would likely be co-located along transects across the tidal wetland landscape. Again, it's important to note that as the Benchmark Site network is built out, the TAC will likely adjust the suite of recommended indicators at each site over time, and bring these updates to the SC for their approval.

[6] The use of Level 1, 2, and 3 here is consistent with the Wetland and Riparian Area Monitoring Plan (WRAMP) developed by the California Wetland Monitoring Workgroup (CWMW): https://www.mywaterquality.ca.gov/monitoring_council/wetland_workgroup/

Next Steps

Throughout 2021, the TAC will further refine the WRMP science framework, including elements of these Benchmark Site recommendations. Aside from establishing the previously mentioned indicator workgroups and refining the suite of biological and ecological indicators, the TAC expects to:

- Work with Cristina Grosso and Tony Hale to develop the WRMP data management strategy, including advising the fit-gap analysis and Baylands Change Basemap project to develop Level 1 mapping standards and datasets for tidal marsh habitats
- Identify SOPs for each WRMP indicator (Level 1, 2, and 3), in collaboration with indicator workgroups and related projects by TAC members (e.g. efforts separately funded by the Bay RMP, Delta Science Program, NERR Science Collaborative, and others)
- Identify appropriate Reference Sites and Project Sites consistent with the Benchmark Site proposal
- Obtain enough information about Older Coon Island and Fagan Marsh to make a decision re: Benchmark Site status
- Advise the WRMP Core Team and Steering Committee on related matters as-needed

Figures

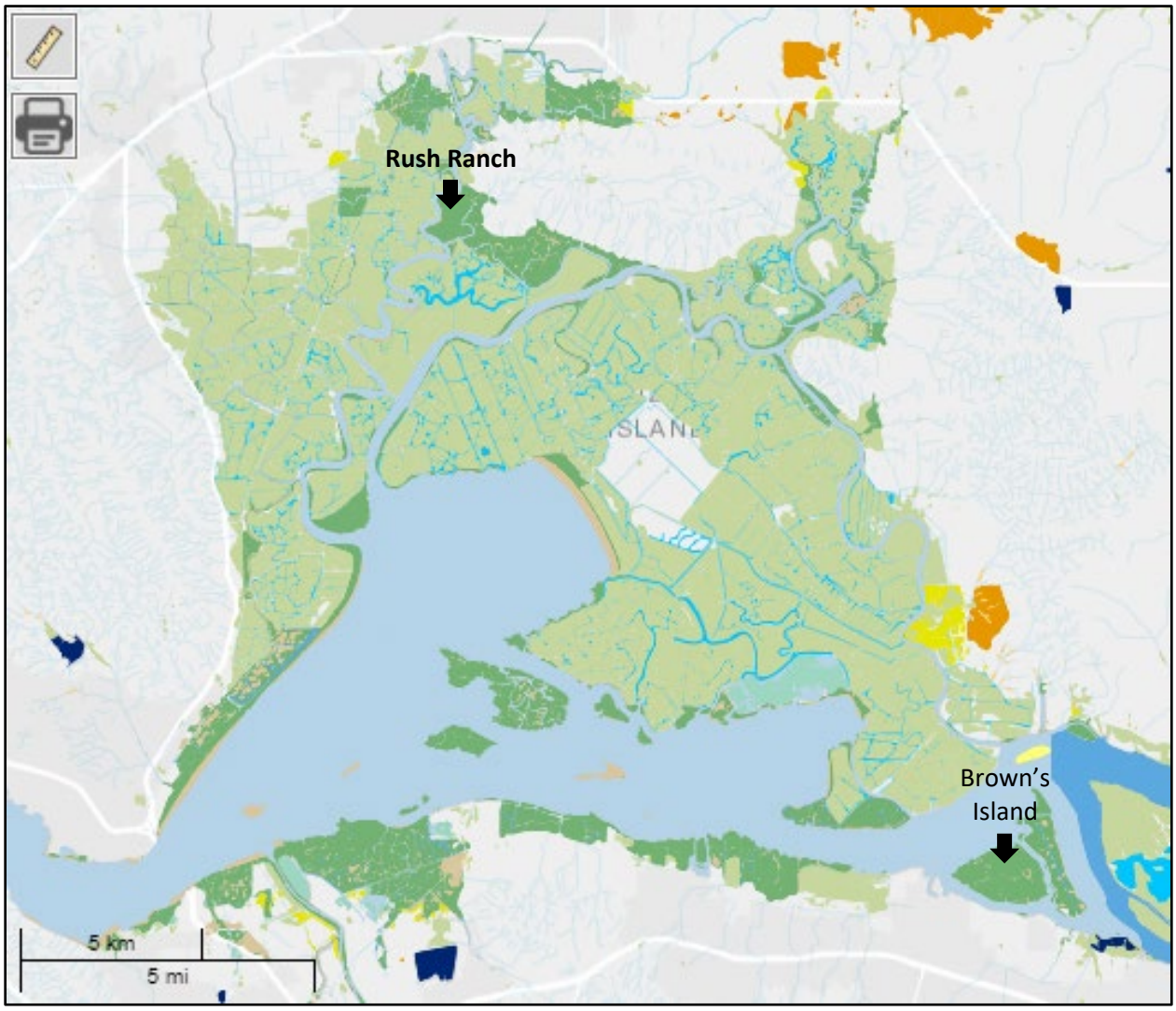

Figure 1. Proposed Benchmark Sites in the Suisun/Central Delta subregion.

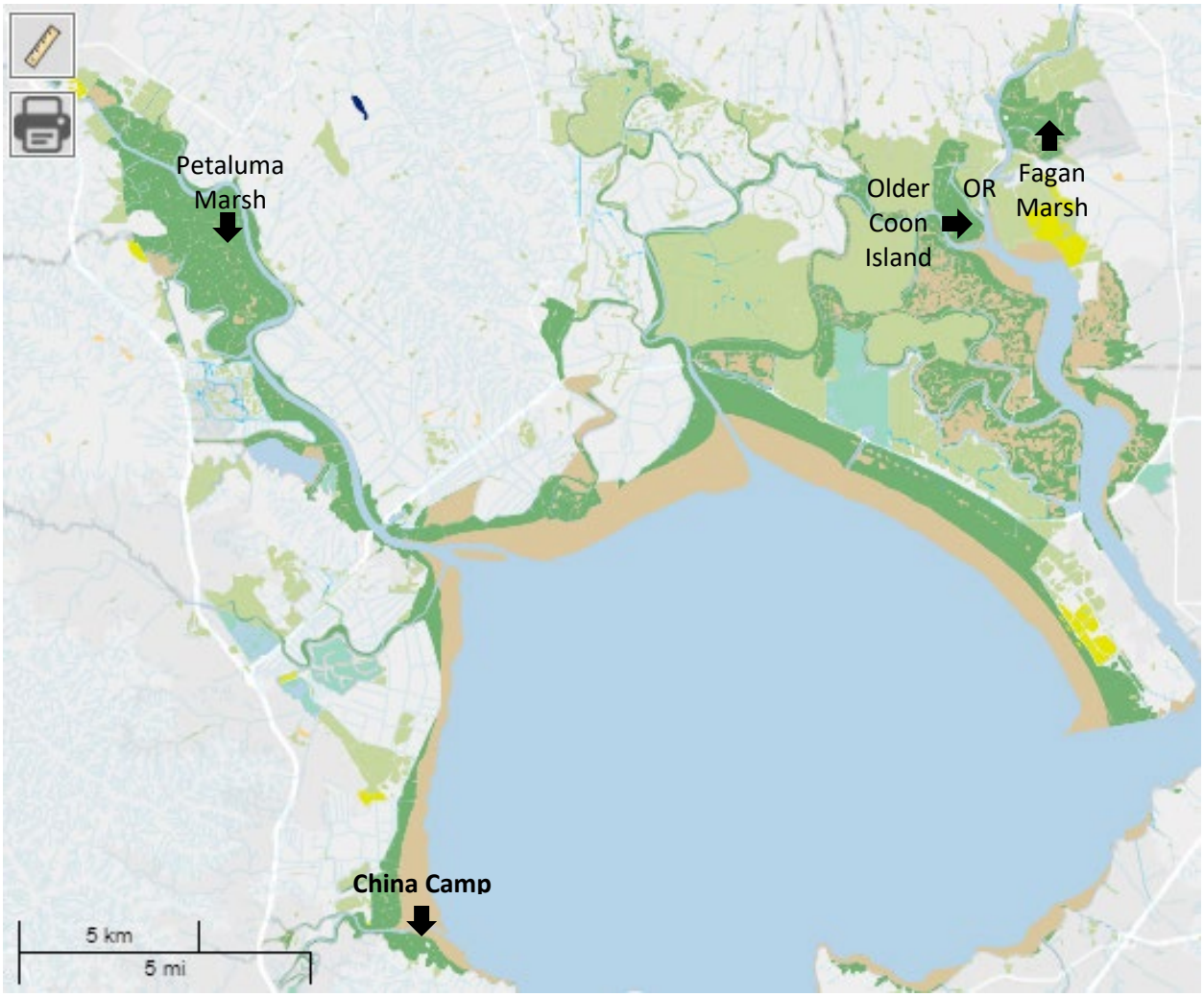

Figure 2. Proposed Benchmark Sites in the North Bay subregion.

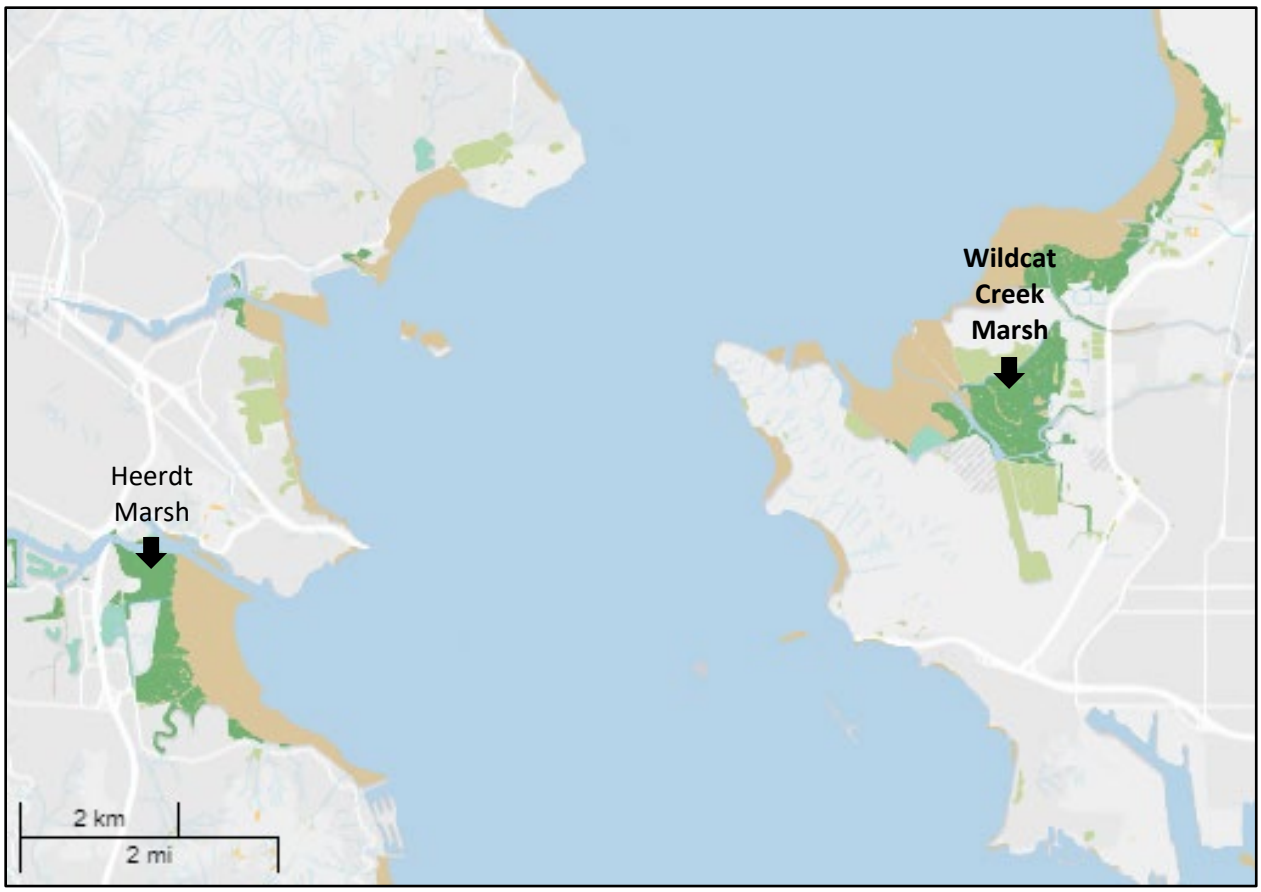

Figure 3. Proposed Benchmark Sites in the Central Bay subregion.

Figure 4. Proposed Benchmark Sites in the South Bay subregion.

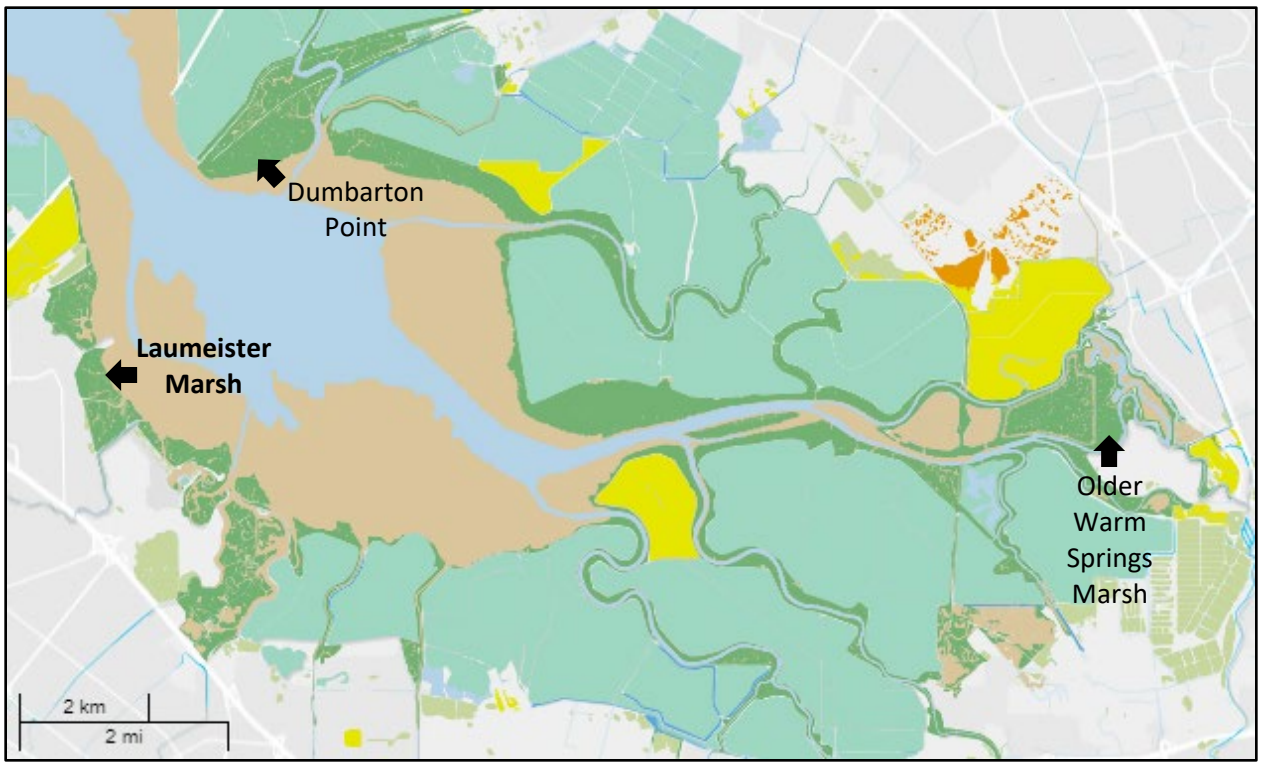

Figure 5. Proposed Benchmark Sites in the Lower South Bay subregion.

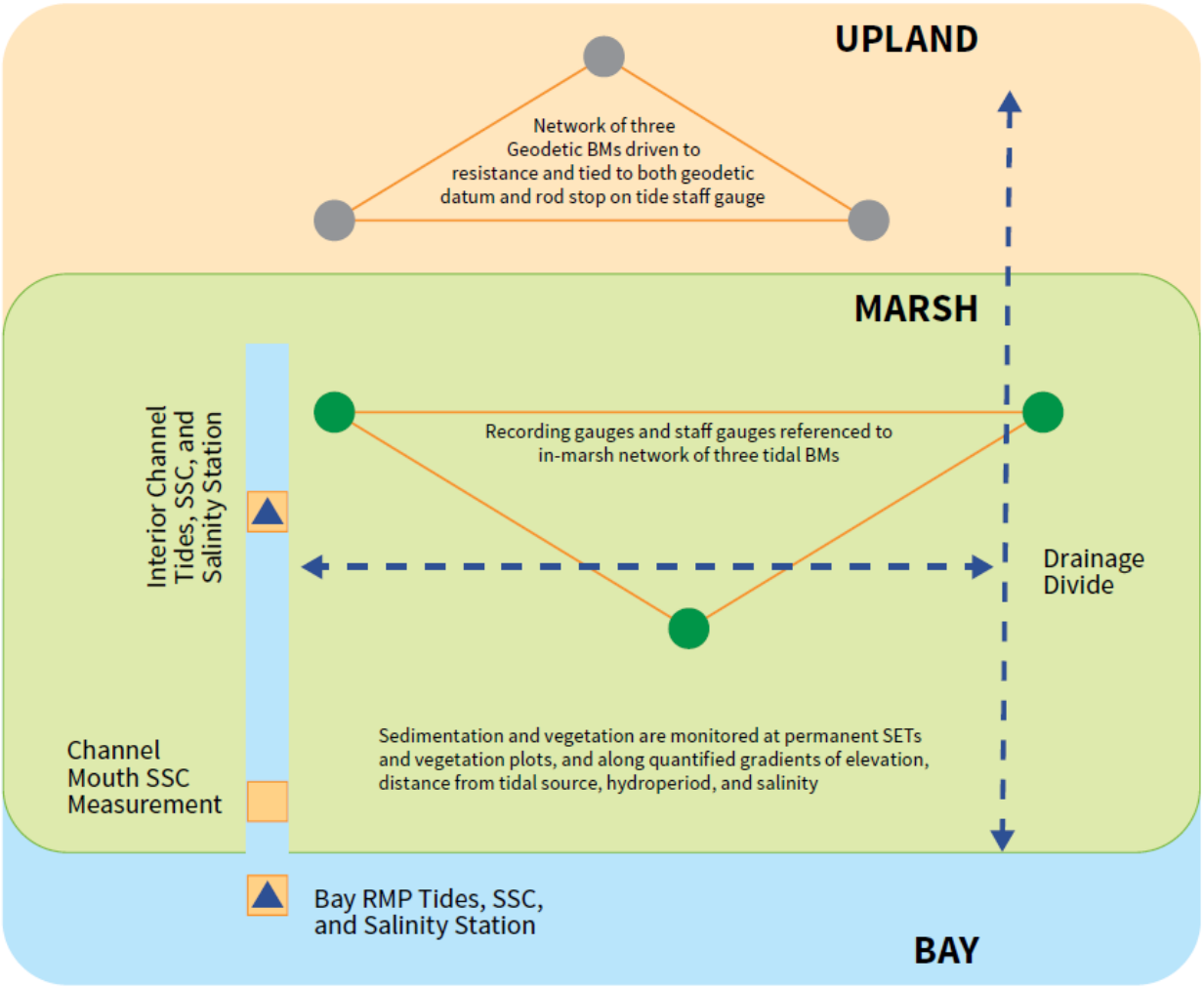

Figure 6. Conceptual diagram of how different monitoring efforts at a Benchmark Site could be arranged. The actual arrangement of monitoring efforts will vary at each site to account for local conditions, WRMP science priorities, the spatial relationships between Benchmark, Reference, and Project sites, and input from the TAC.