Marin County Parks

McInnis Marsh Restoration Project

Introductions

- Marin County Parks
- Marin County Flood Control District
- Las Gallinas Valley Sanitary District
- California Department of Fish and Wildlife
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service
- Point Blue
- San Francisco State University
- ESA team
- Others?

McInnis Marsh Restoration Project Goals

- Increase current & future ecological values
  - Re-establish natural tidal and fluvial processes to McInnis Marsh and to estuaries of Miller and Gallinas Creeks
  - Create additional nesting, foraging, and refuge habitat for four targeted focal species and others
  - Expand estuarine conditions to both Miller and Gallinas creeks
  - Create improved access to a migration corridor for fish and wildlife via Miller Creek
- Increase the natural geomorphic capacity of the corridor to adapt to sea-level rise
- Maintain public access to the new shoreline
- Add protection to existing park & water treatment facilities
- Not increase erosion/scour or flood risk in surrounding areas

Goals for the Day

- Shared understanding of the habitat needs
  - Focal species and other target species
  - Baseline habitat requirements and possible enhancements
  - Synergies or trade-offs between species
- Physical dynamics that would drive or enable the intended habitat outcomes to develop
- Anticipated marsh evolution
  - Consider both “generic” SF Bay marsh evolution and site-specific trends
- Articulate “acceptable” range of habitat outcomes at project site
  - Consider long-term and interim stages of habitat evolution
- Discuss potential design elements for site restoration
  - Shift discussion from habitat goals and physical dynamics to implementable design concepts

Ground Rules

- We have 3 hours and a lot to cover;
  - Let's stay out of the rabbit holes
- Workshop laid out in hour-long segments
  - Let's try to keep to those
- One conversation at a time
- Generate ideas - not decisions
- Create options - not barriers
- Trying to build a bridge
  - Link species/habitat needs to actions we can take or dynamics we can unleash
  - "Designs" will come later

Planned Schedule and Process

- Hour 1 = Species and habitat needs
- Hour 2 = Marsh evolution and physical processes
- Hour 3 = Restoration concepts planning
- We have a notetaker (laptop) & scribe (easels) to track words and ideas
  - Stop us if we don’t capture yours correctly

Four Focal Species

- Marin County Parks has identified 4 target species:
  - Salt Marsh Harvest Mouse
  - California Ridgway's Rail
  - California Black Rail
  - Central California Coast Steelhead

Salt Marsh Harvest Mouse Habitat Requirements

- Tidal and diked salt and brackish marshes
- Dense year-round vegetation cover, often dominated by pickleweed
- Feed on pickleweed, and other vegetation such as rabbitsfoot grass and fat hen
- High tide refuge habitat
  - Broad transition zones dominated by upland terrestrial vegetation
  - Well-distributed tall vegetation (emergent tall vegetation cover above water surface/wave crests at all high tides)
  - Pacific cordgrass, bulrush, tule, gumplant and grassland also used for cover and high tide refugia
- Plant species less important than…
  - Vegetation structure and maturity
  - Depth of marsh, density of vegetation, and size and continuity of cover
- Habitat characteristics positively associated with SMHM found to be negatively associated with competitors
  - Reducing habitat patchiness in tidal marshes may reduce competition with house mice
  - Restoring tidal action may reduce habitat competition with voles

SMHM – Movement and Dispersal

- Average home range of approximately 0.5 acre
- Average distance moved in 2-hour period: 11.9 m
- Movements greatest in June, least in November
- Mice will cross levee roads (3-4 m), narrow levees (1-2 m) and narrow canals (2 m) – water and barren habitat not an absolute barrier to dispersal
  - Increased risk of predation associated with these movements
- Isolated habitat patches should be within documented dispersal distances

Habitat Function and Use – SMHM

Species		Habitat Types					
Common Name	Scientific Name	Large Channels	Small Channels	Low Intertidal	Low Marsh	High Marsh	Upland Transition Zones
Salt marsh harvest mouse	*Reithrodontomys raviventris*					Adult – Foraging, Breeding Juvenile – Foraging, Rearing (*taller vegetation cover*)	Adult – Foraging Juvenile – Foraging, Rearing (*taller vegetation cover*)

California Ridgway's Rail Habitat Requirements

- Tidal salt and brackish marshes
- Well developed tidal channel network - high density of large and small tidal channels
- Invertebrate food supply found in channels and mudflats
- Higher marsh and vegetation elevations for nesting and escape cover during extreme high tides: cover located adjacent to channel bank; minimize travel away from cover during high tides
- Rely on marsh plants such as Pacific cordgrass, alkali bulrush, and pickleweed for breeding and cover
- Population density declines sharply at marshes less than 125 acres; density increases with marsh size, but slows after 250 acres – continuous, large, and compact marshes reduces access for predators and more likely to provide a mosaic of microhabitats
- Threats include: contaminants, especially mercury; sea-level rise;

Habitat Function and Use – CA Ridgway's Rail

Species		Habitat Types					
Common Name	Scientific Name	Large Channels	Small Channels	Low Intertidal	Low Marsh	High Marsh	Upland Transition Zones
California Ridgway's rail	*Rallus obsoletus obsoletus*	Adult – Foraging Juvenile – Foraging (*channel edges*)	Adult – Foraging Juvenile – Foraging (*channel edges*)	Adult – Foraging Juvenile – Foraging	Adult – Foraging Juvenile – Foraging	Adult – Foraging, Breeding Juvenile – Foraging , Rearing	Adult – Foraging Juvenile – Foraging

California Black Rail Habitat Requirements

- Mostly found in tidal salt and brackish marshes, also freshwater wetlands inland
- Larger, higher-elevation marshes positively correlated with abundance
- Tall and dense vegetation, high proportion of pickleweed, but also found in alkali bulrush and saltgrass
- Short distance daily movements within home range (20-30m) and longer ones to high tide refuge (30-70m)
- Vegetation structure that allows nests to be built high enough to avoid flooding by high tides
- Feed on marsh surface, invertebrate prey
- Low degree of urbanization in surrounding area

Habitat Function and Use – CA Black Rail

Species		Habitat Types					
Common Name	Scientific Name	Large Channels	Small Channels	Low Intertidal	Low Marsh	High Marsh	Upland Transition Zones
California black rail	*Laterallus jamaicensis coturniculus*		A/F, J/F (channel edges)	Adult =Foraging Juvenile = Foraging	Adult =Foraging Juvenile = Foraging	Adult = Foraging, Breeding Juvenile = Foraging, Rearing	Adult = Foraging Juvenile = Foraging, Rearing

Steelhead Habitat Requirements

- Forage and rear within tidal freshwater and brackish marshes during migrations
- Well-developed tidal channel networks within marsh plains
- Channel edge habitat complexity and cover
- Seasonally inundated floodplain surfaces
- Tidal- and seasonal-time-scale variability
- Residence/inundation times to activate food web and provide forage
- Water quality (DO, water temperature, salinity)
- Connectivity to quality upstream habitat

Habitat Function and Use – CCC Steelhead

Species		Habitat Types					
Common Name	Scientific Name	Large Channels	Small Channels	Low Intertidal	Low Marsh	High Marsh	Upland Transition Zones
Central California Coast steelhead	*Oncorhynchus mykiss*	Adult = Migration, Foraging Juvenile = Migration, Foraging	Juvenile = Migration, Foraging	Juvenile = Migration, Foraging	Juvenile = Migration, Foraging	Juvenile = Migration, Foraging	Indirect Juvenile = shade, cover, carbon inputs

NMFS CCC Steelhead Recovery Plan Actions for Miller Creek

Miller Creek, Central California Coast Steelhead (Coastal San Francisco Bay) Recovery Actions			
Action ID	**Level**	**Attribute**	**Action Description**
MiC-CCCS-1.1	Objective	Estuary	Address the present or threatened destruction, modification, or curtailment of the species habitat or range
MiC-CCCS-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat
MiC-CCCS-1.1.1.1	Action Step	Estuary	Develop an estuary rehabilitation and enhancement plan in efforts to reclaim historically tidal influenced areas.
MiC-CCCS-1.1.1.2	Action Step	Estuary	Identify potential habitat features that will increase current and future estuary habitat values for rearing steelhead.
MiC-CCCS-1.1.1.3	Action Step	Estuary	Investigate water quality (D.O., temperature, salinity) conditions for rearing steelhead in potential tidal marsh rehabilitation sites.
MiC-CCCS-1.1.1.4	Action Step	Estuary	Increase the inner estuary hydrodynamics that have been altered by levees, dikes, culverts, and tide gates.
MiC-CCCS-1.1.1.5	Action Step	Estuary	Develop a plan and implement the plan to restore the engineered channel across the diked historic baylands.

Habitat Function – All 4 Focal Species

Species		Habitat Types					
Common Name	**Scientific Name**	**Large Channels**	**Small Channels**	**Low Intertidal**	**Low Marsh**	**High Marsh**	**Upland Transition**
Salt marsh harvest mouse	*Reithrodontomys raviventris*					A/F, J/F, B, R	A/F, J/F, R
California Ridgeway's rail	*Rallus obsoletus obsoletus*	A/F, J/F (channel edges)	A/F, J/F (channel edges)	A/F, J/F	A/F, J/F	A/F, J/F, B, R	A/F, J/F
California black rail	*Laterallus jamaicensis coturniculus*		A/F, J/F (channel edges)	A/F, J/F	A/F, J/F	A/F, J/F, B, R	A/F, J/F, R
Central California Coast steelhead	*Oncorhynchus mykiss*	A/M, A/F, J/M, J/F	J/M, J/F	J/M, J/F	J/M, J/F	J/M, J/F	

Life Stage: (A) – Adult, (J) = Juvenile, (L) = Larval

Habitat Function: (B) = Breeding, (R) = Rearing, (F) = Foraging, (M) = Migrating

Other Important Plants & Wildlife and their Habitats

- Shorebirds, ducks and other water birds – mudflats, shallow ponds and open water
- Raptors (white-tailed kite, Northern harrier) and short-eared owl – grassland/marshland
- American and least bittern – brackish and freshwater marsh
- Saltmarsh common yellowthroat – brackish marsh
- San Pablo song sparrow – salt and brackish marsh
- River otters – creeks and sloughs
- Longfin smelt – creeks and sloughs, San Pablo Bay
- Native fish and invertebrates (prey items) – tidal channels, tidal marsh
- Salt marsh bird's-beak – salt marsh (high marsh)

What Focal Spp. Habitat Requirements Tell Us

- High marsh and high tide refuge habitat - ensure there is nesting, foraging, high tide refuge habitat and movement corridors (channels and cover between these) within potential small home range areas
- Create ‘complete’ salt marshes, which include:
  - Broad upper marsh plains dominated by pickleweed
  - Transition into terrestrial ecotone and upland habitats
  - Network of tidal channels and higher elevation drainage features
- Complex channel network moving water and organisms back and forth into and out of marsh Higher elevation terraces that get activated in storms/floods
- Connect existing and restored salt marshes within and adjacent to the project area, and in close proximity to existing occupied habitat
- Habitat and hydrological heterogeneity

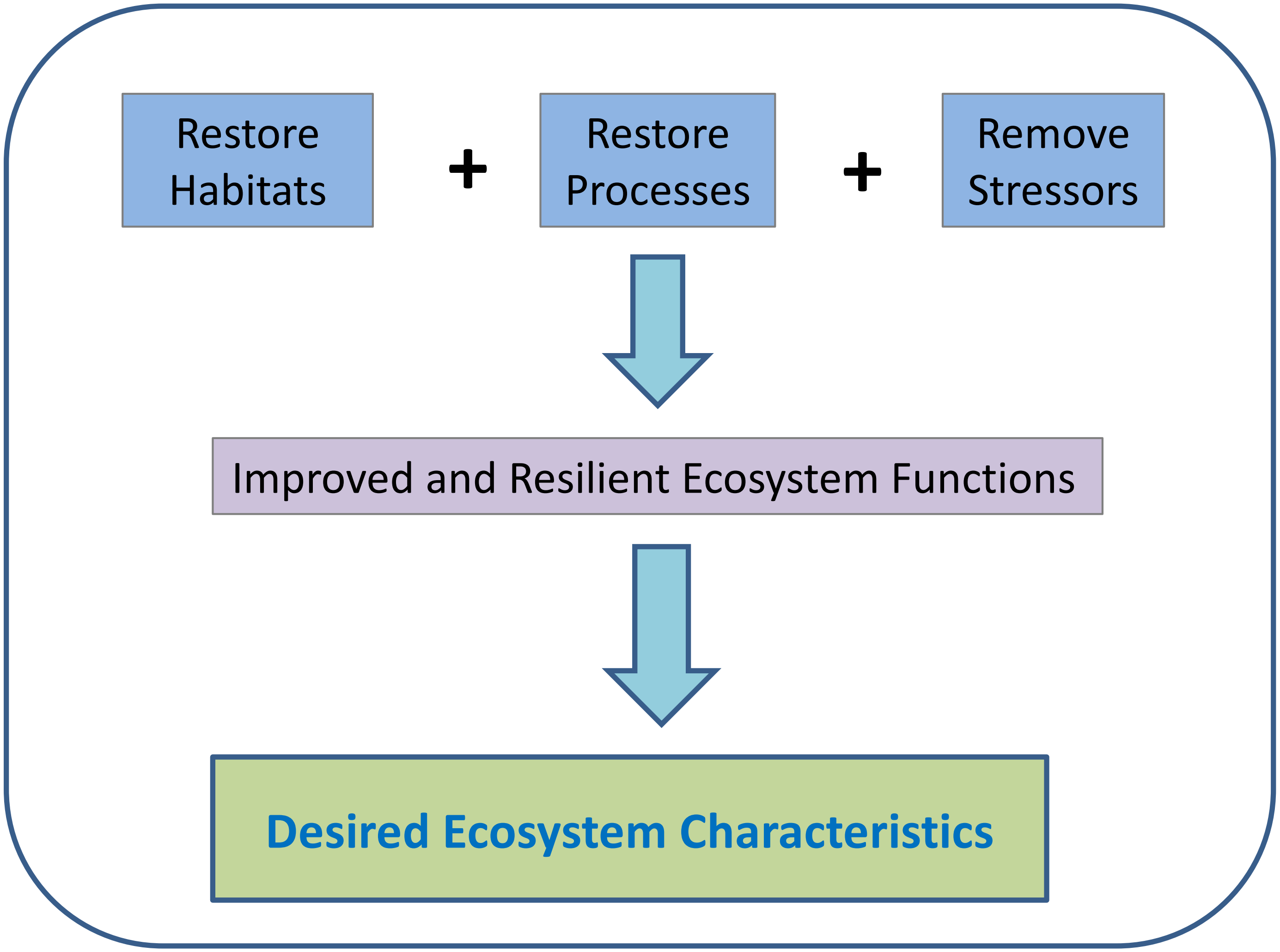
Workshop: Species Habitat Requirements

Insert picture …. Wildlife???

Drivers of Tidal Marsh Evolution

- Drivers
  - Tides
  - Freshwater flows
  - Sediments, nutrients, and pollutants
  - Solar radiation
  - Marshplain elevation
  - Waves

More than just physical habitat restoration is needed

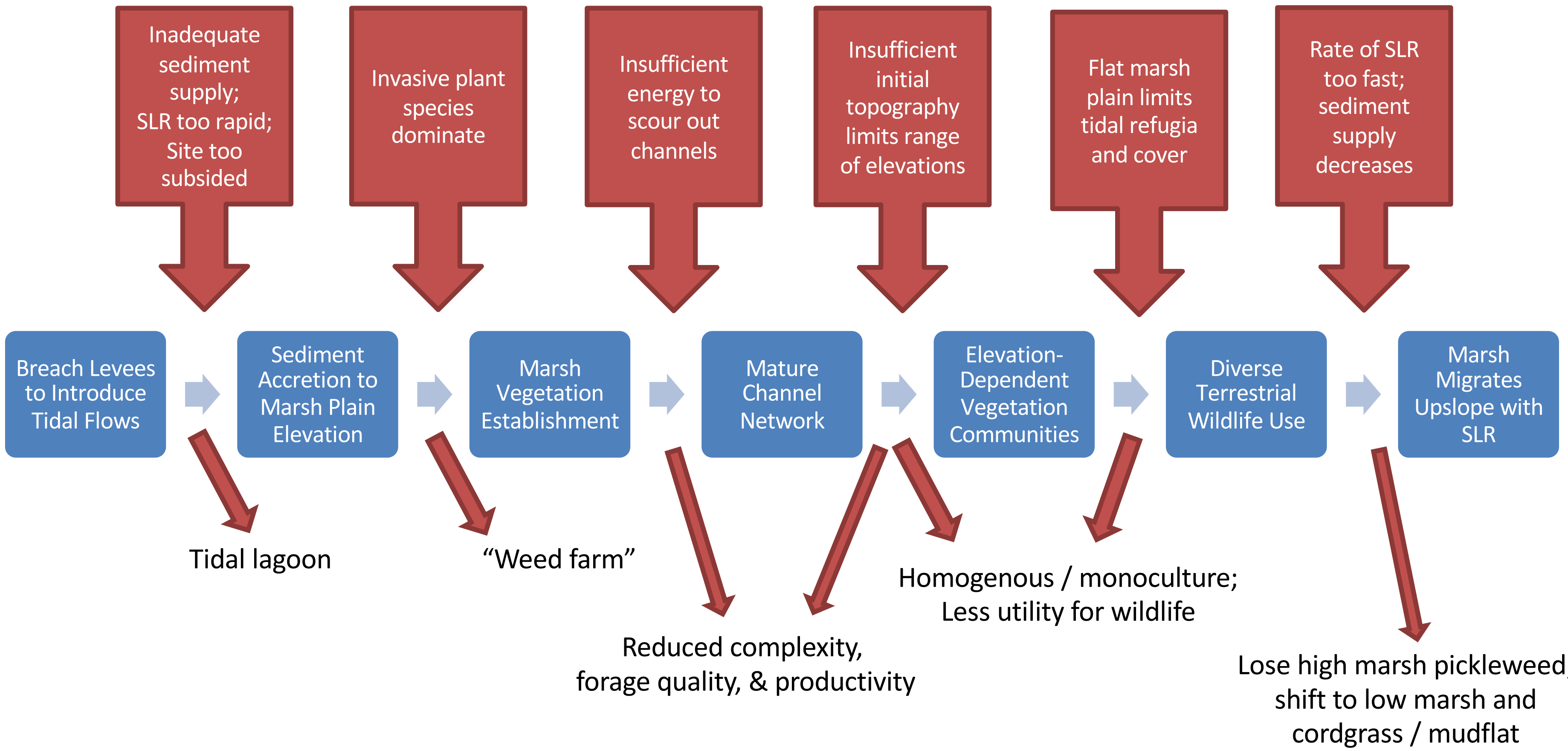


Restored Tidal Marsh – Evolution Over Time

Basic concept of how it's *supposed* to work

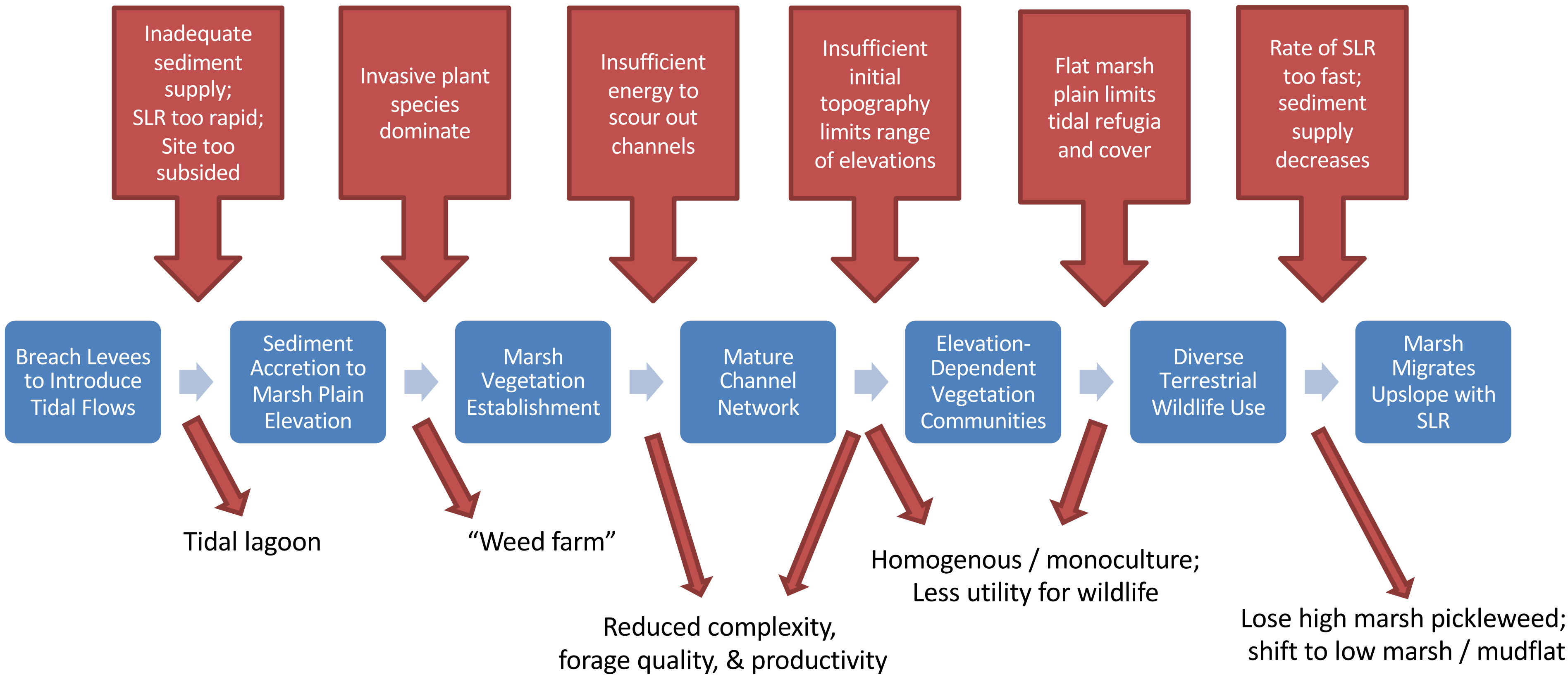
Restored Tidal Marsh – Evolution Over Time

Ways the concept fails



Restored Tidal Marsh – Evolution Over Time

Ways we can manage that



Add initial complexity, connectivity, topography
Plan for sea-level rise
Manage invasive vegetation
Work with initial conditions / accept ‘imperfect’ outcomes

Expected Marsh and Stream Evolution -SLR

Habitat Evolution Projections

- Subtidal (-2.4 to -1.8m)
- Mudflat (-1.8 to -0.6m)
- Low Marsh (-0.6m to -0.3m)
- Mid Marsh (-0.3 to .02m)
- High Marsh (.02 to 0.3m)
- Upland (.3m and up)

Existing Conditions
(2010)

2110
+1.7ft SLR
"Low Sediment"

2110
+5.4ft SLR
"Low Sediment"

2110
+5.4ft SLR
"High Sediment"

Veloz, S., M. Fitzgibbon, D. Stralberg, S. Michaile, D. Jongsomjit, D. Moody, N. Nur, L. Salas, J. Wood, M. Elrod, and G. Ballard. 2014. Future San Francisco Bay Tidal Marshes: A climate-smart planning tool. [web application]. Petaluma, California. (www.pointblue.org/sfbayslr).

Restored Tidal Marshes – what can we realistically expect?

Historic Tidal Marsh

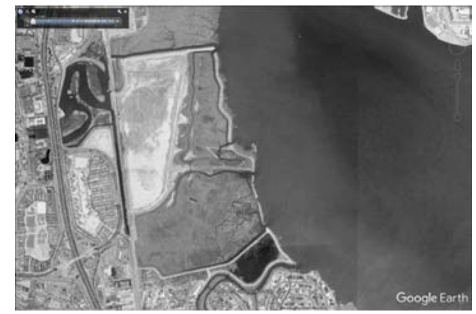
China Camp

Restored Tidal Marshes

Bahia Wetlands

Sonoma Baylands

Muzzi Marsh



Historic Tidal Marsh

China Camp

2017

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Restored Tidal Marshes

Bahia Wetlands (Breached in 2008)

2008

2017

Restored Tidal Marshes

Sonoma Baylands (Breached in 1995)

2003

2017

Restored Tidal Marshes

Muzzi Marsh

1987

2017

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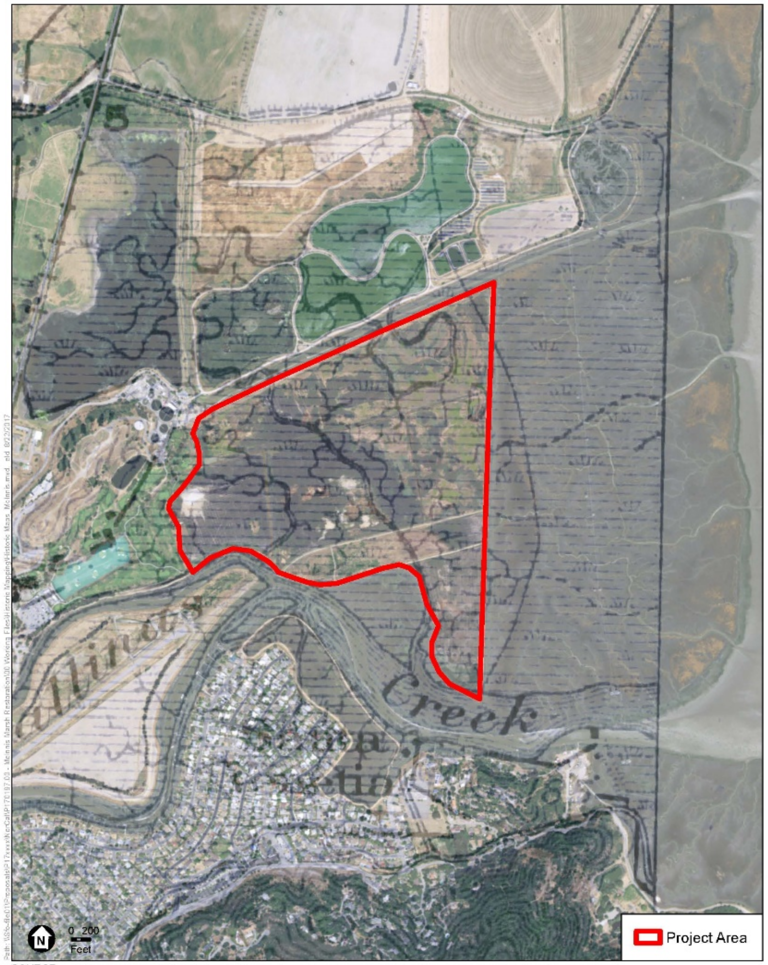
Workshop: Marsh Evolution

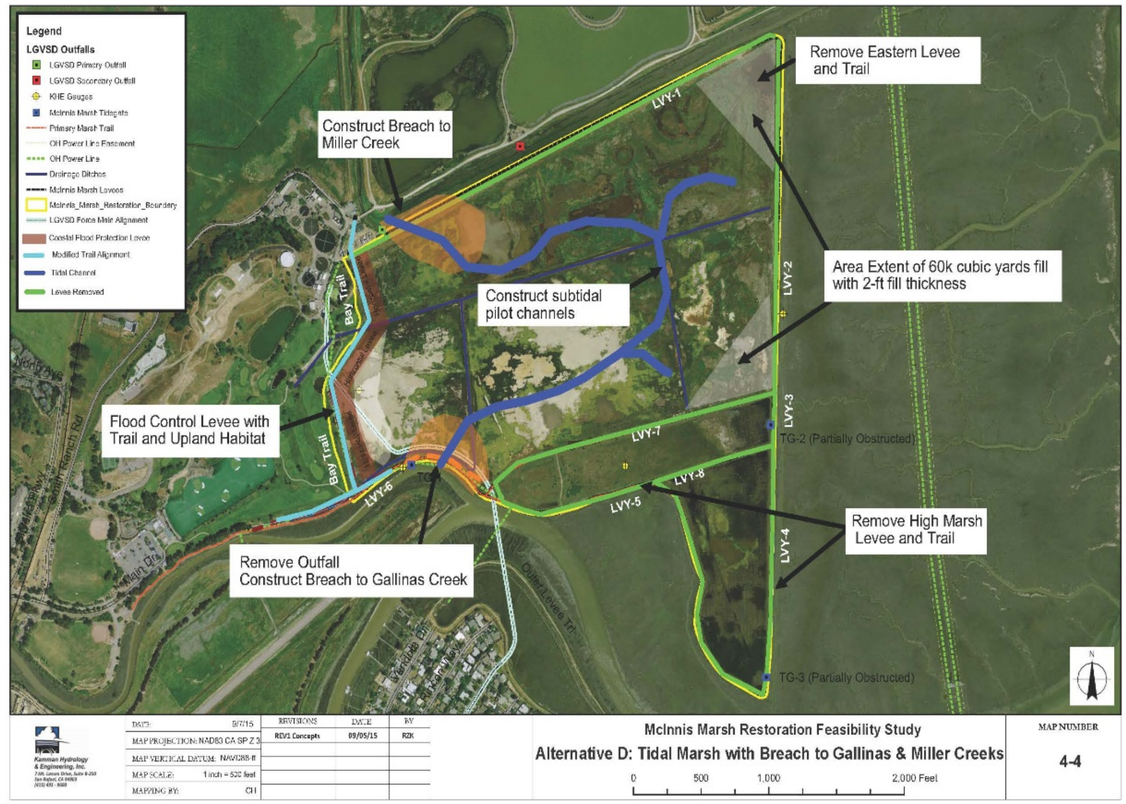
Restoration Concept Planning



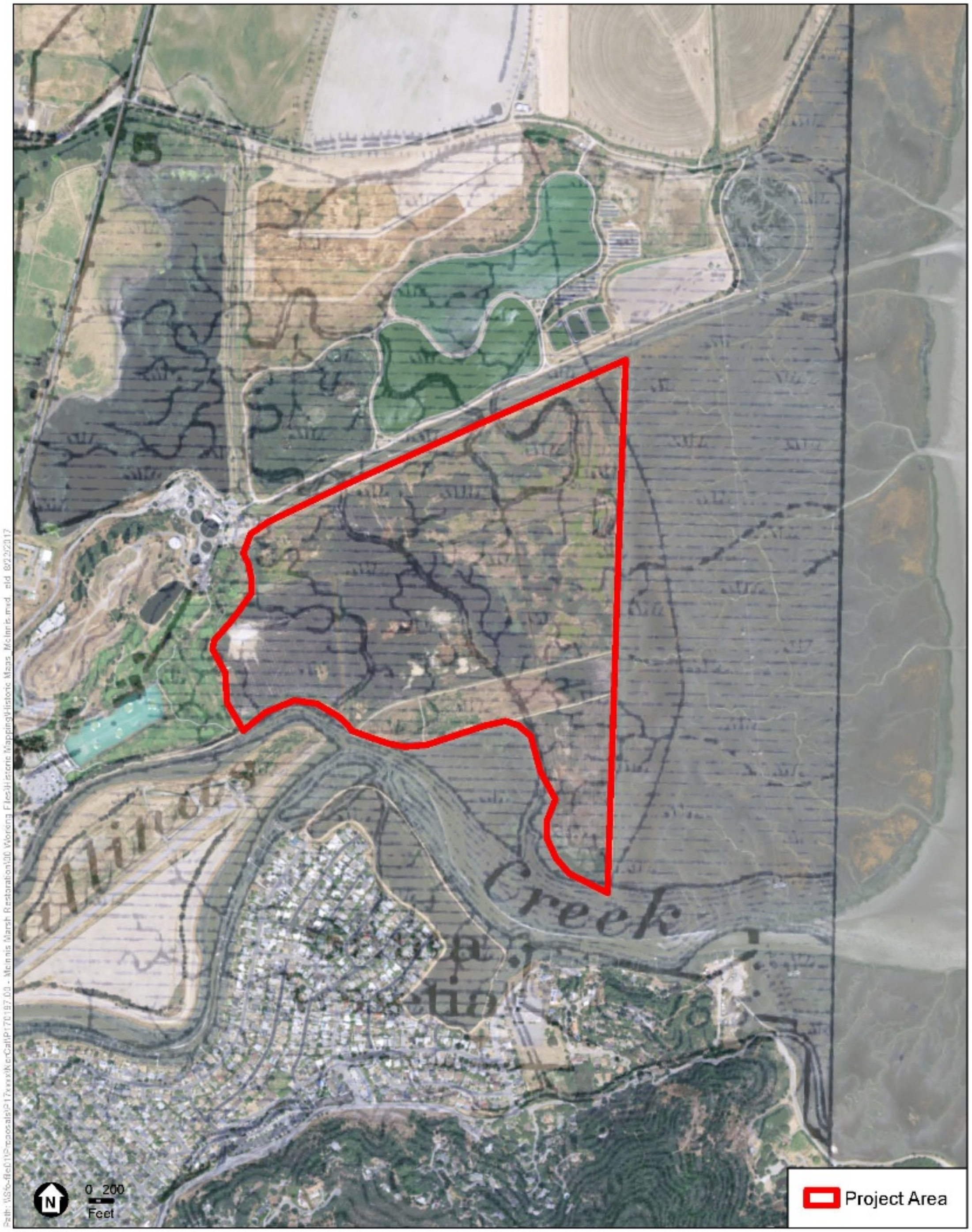
SOURCE:
USGS, Petaluma [1914], 1:62500 Topographic Quadrangle Map

McInnis Marsh Restoration Proposal

Historic Marsh



Feasibility Study Preferred Alternative

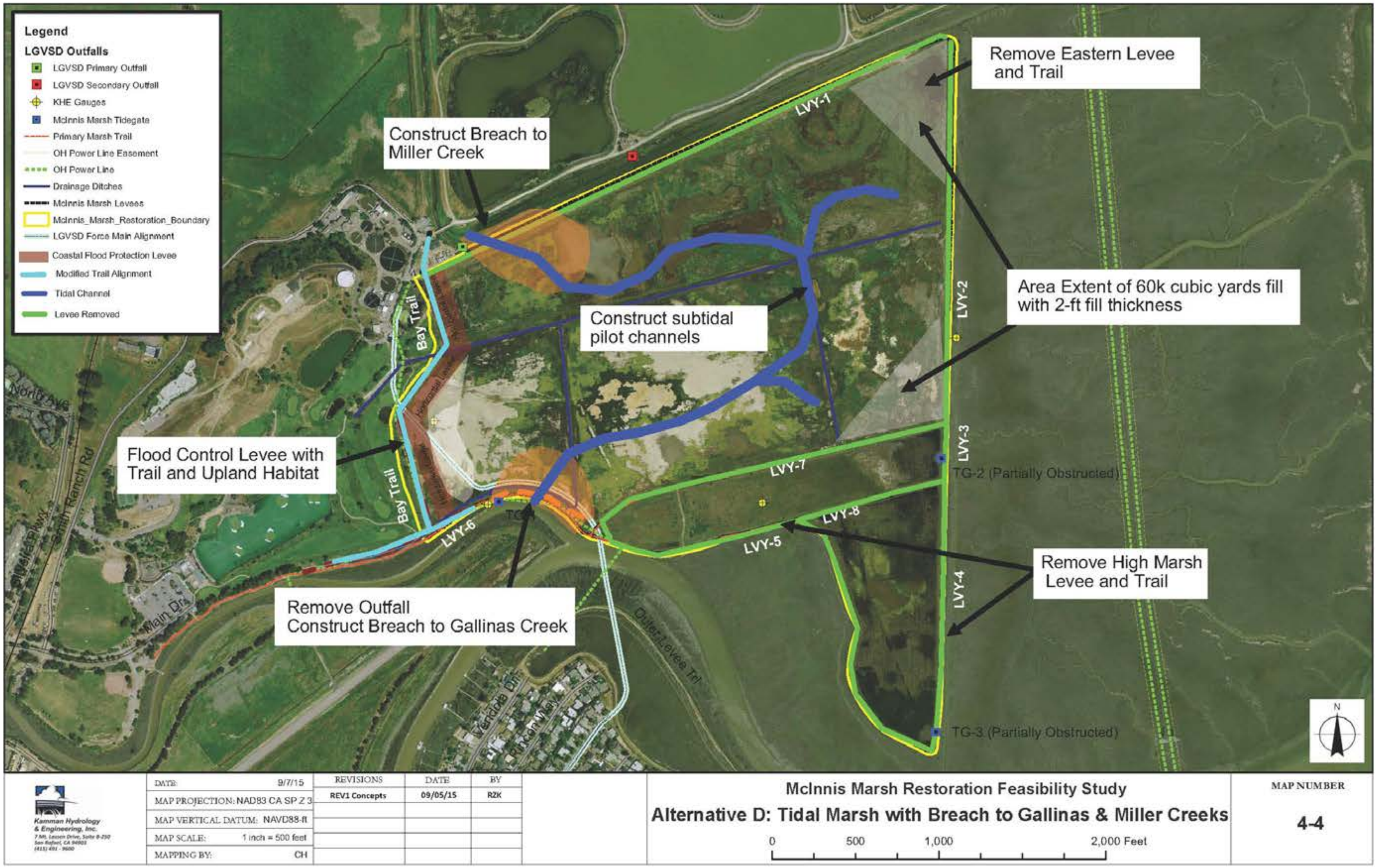


SOURCE:

USGS, Petaluma [1914], 1:62500 Topographic Quadrangle Map

McInnis Marsh Restoration Proposal

Feasibility Study Preferred Alternative



Toolbox for Marsh Restoration

- Create initial topography
  - Build habitat transition zones / ecotones / horizontal levees
  - Excavate more channels
- Create initial complexity
  - Multiple breaches; branching channels
  - Keep or add high spots in marsh
  - Vary ecotone slopes
  - Add connectivity with healthy surrounding marshes → indirect benefits
- Augment site with material
  - Use material from lowered & breached levees, excavated channels
  - Reuse dredge material
  - Design breaches and channels to maximize sediment delivery to interior

Toolbox for Marsh Restoration

- Revegetation and vegetation management
  - Appropriate initial plantings
  - Weed control
  - Reuse treated wastewater for irrigation
  - Reuse other suitable freshwater (e.g. from golf course)
- Plan for SLR
  - Start as high as you can
  - Ecotone ‘ramps’ for upslope migration
- Think about ‘marsh restoration trajectory’
  - Intermediate habitat stages have value

Restoration Site 'Units'

Physical Dynamics and Restoration Opportunities

- Character of site ‘units’ and how those lend themselves to restoration of certain habitats/conditions?
  - **Northern Unit: subsided diked salt marsh – Dominated by non-native vegetation**
    - Connect to eastern outboard tidal marsh
    - Manipulate elevations to create features for topographic heterogeneity and marsh transgression
    - Lagoon and mudflat successional trajectory
  - **Central Unit: filled high-elevation dredge disposal site (above MHHW) - mix of lowland terrestrial and seasonal wetland**
    - Preserve existing pickleweed where channels and grading doesn’t occur- help the marsh recover and provide usable habitat to rails and mice within short timeframe
  - **Southern Unit: diked, marginally tidal pickleweed marsh with large pans, close to adjacent marsh plain elevation - Tidal connection (spring high tides) to outboard tidal marsh via culvert**
    - Restore tidal marsh (grading to create channels and other features plus enhance existing outboard tidal marsh)
    - Preserve existing pickleweed where channels and grading doesn’t occur

Thank You!

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Random "*maybe we want to use them*" slides follow

- POCKET SLIDES START HERE

Marin County Parks

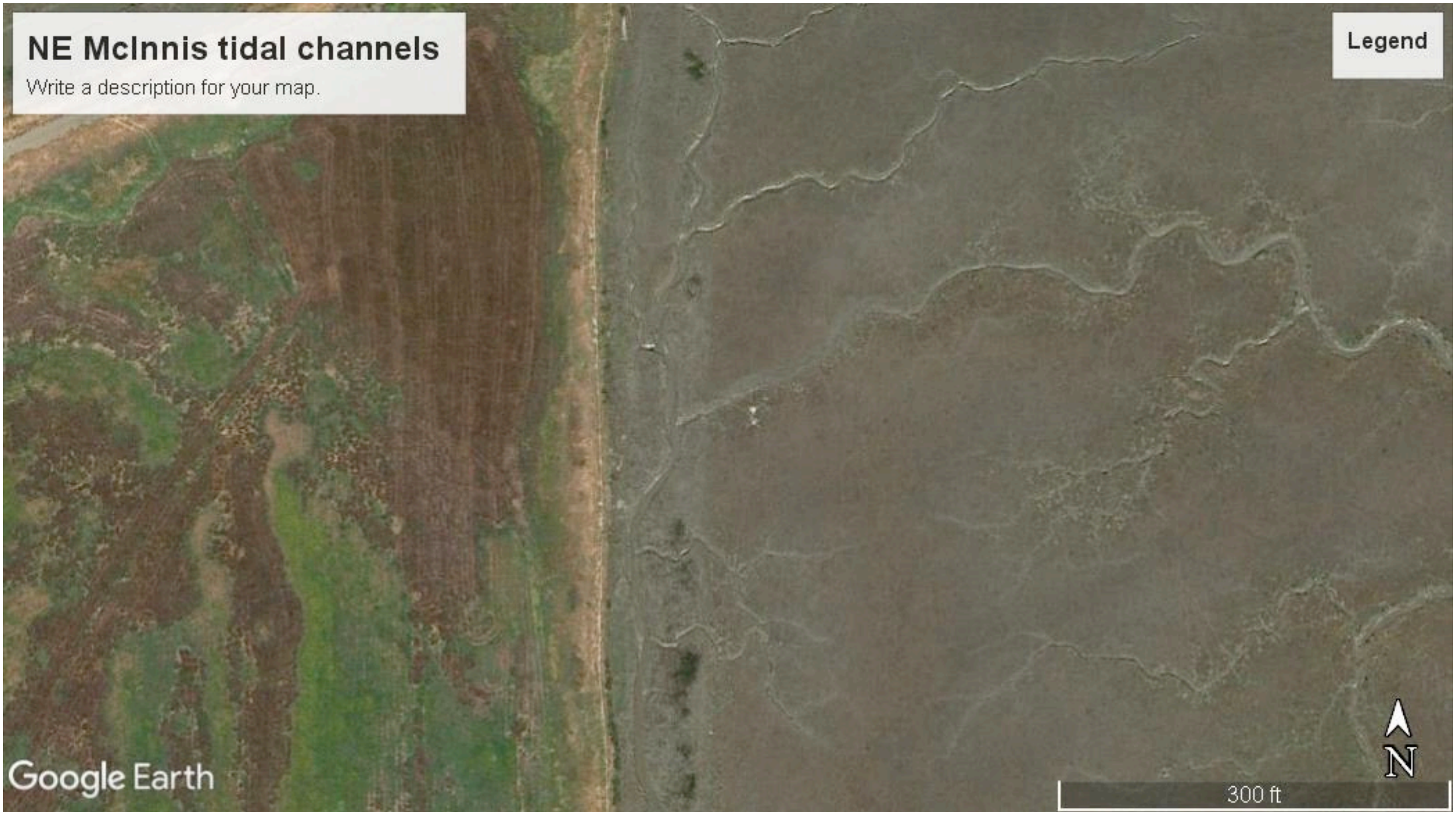
McInnis Marsh Restoration Project

Investigating Trade-offs

	SMHM	CRR	CBR	Steelhead	Native Fish	Shorebirds	Marsh Birds
SMHM		+	++	-	-	-	0
CRR			+	?	?	0	+
CBR				?	?	**?**	?
Steelhead					++	+	?
Native Fish						**?**	?
Shorebirds							+
Marsh Birds							

- Some species benefit from same habitat improvements
- Other changes may involve trade-offs
- Can't be everything for everyone
- ***We want to explore this idea with you***
  - Identify synergies and conflicts
  - Find 'acceptable' mixes, especially over time


North Gallinas Marsh
(low creek density and minimal gumplant)
Eastern levee
Old borrow ditch


NE McInnis tidal channels
Write a description for your map.
Legend
Google Earth
N
300 ft


E central McInnis tidal channels
Legend
Google Earth
N
400 ft


E central McInnis tidal channels
Legend
Google Earth
400 ft
N

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BAHIA – Nov 2012

“horizontal levee” with no freshwater seeps;
gumplant at high tide line pickleweed dominant

“horizontal levee” with no freshwater seeps

Persistent barrens on young acid sulfate sediments – same age, elevation, texture as fully vegetated old dredged sediment

High tide refuge mound at extreme spring high tide
Shorebird roost

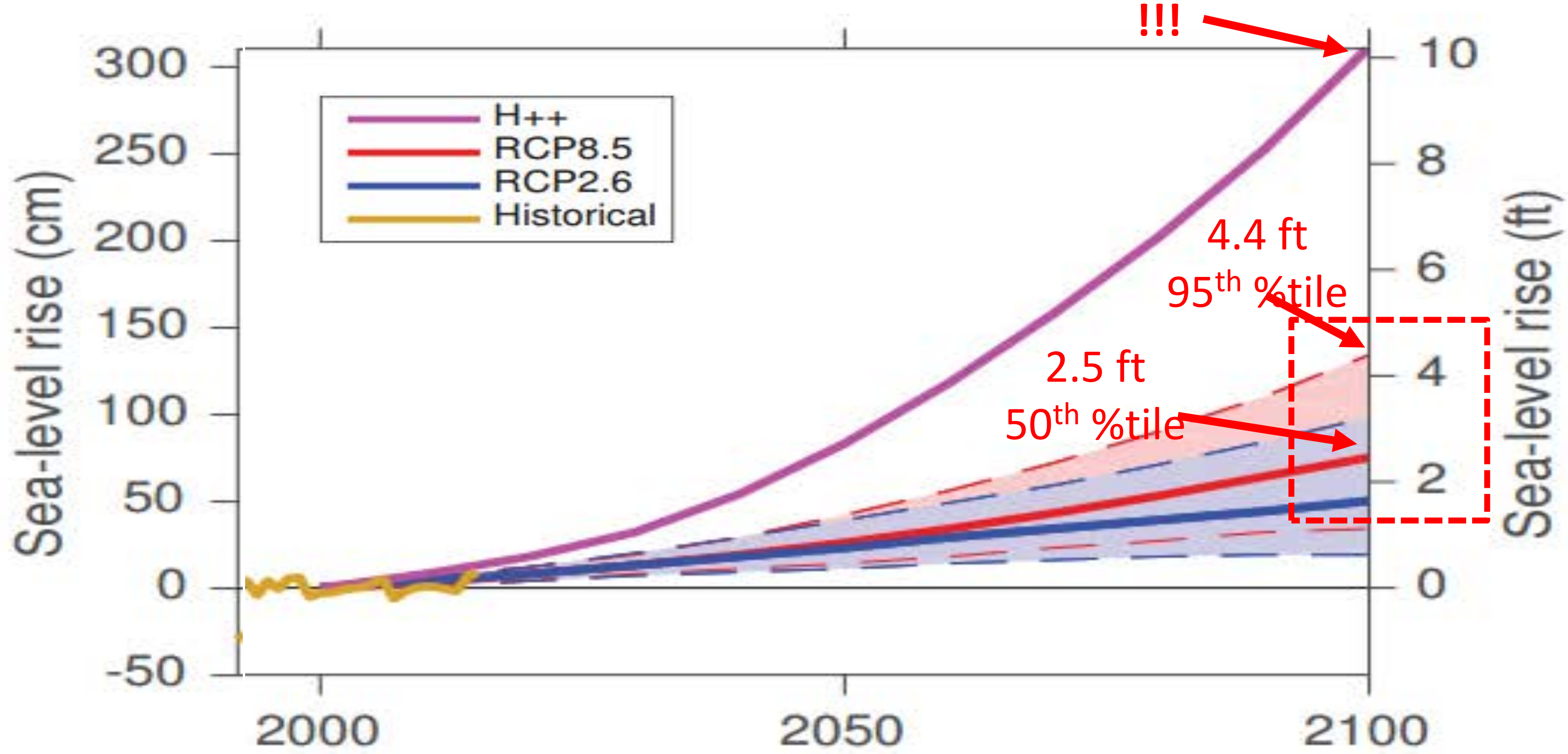
High tide refuge mound at extreme spring high tide
Vegetation 4 yr old with no planting

High tide refuge mound at extreme spring high tide

High tide refuge on berm at extreme spring high tide

High tide refuge mound at extreme spring high tide

California Updates to Sea-level Rise Science



Source: Griggs et al. 2017. Rising Seas in California: An Update on Sea-Level Rise Science.

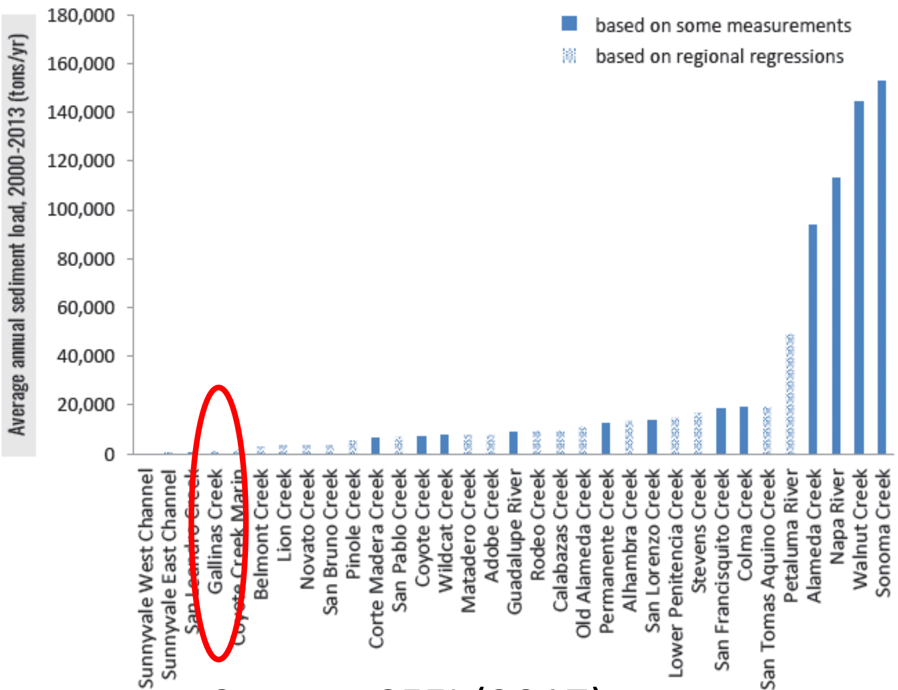
California Updates to Sea-level Rise Science

(b) San Francisco, Golden Gate

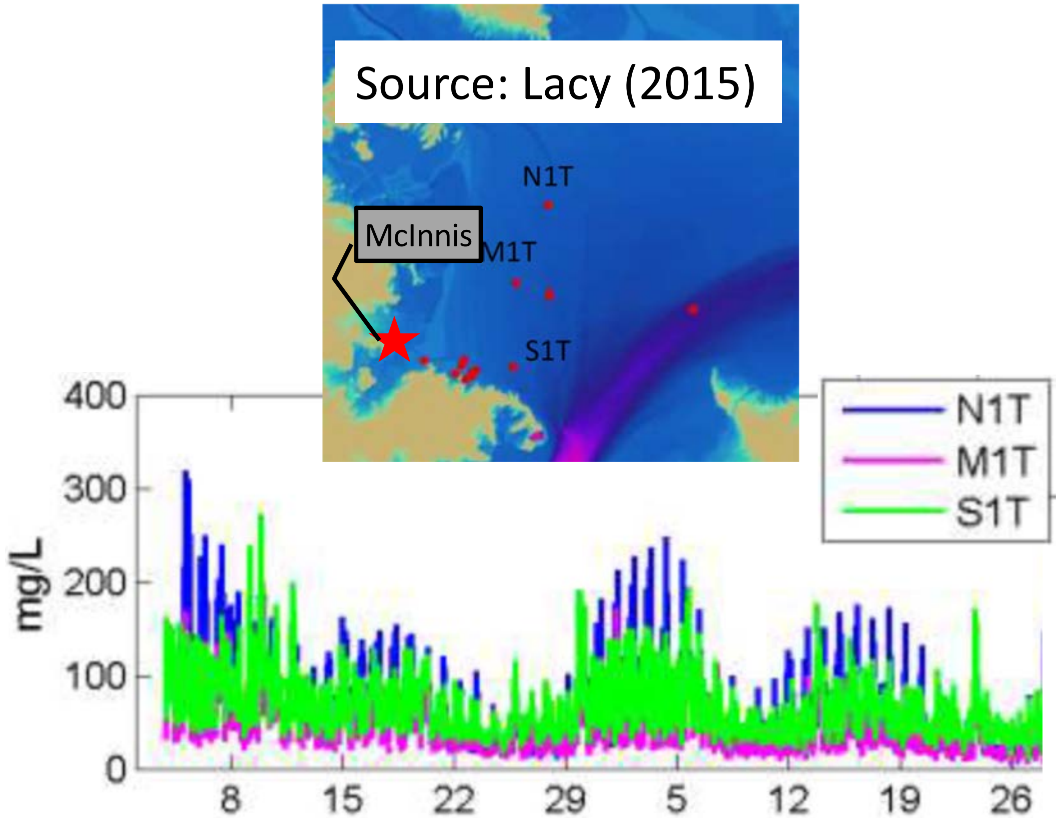
Feet above 1991-2009 mean	MEDIAN	LIKELY RANGE	1-IN-20 CHANCE	1-IN-200 CHANCE
Year / Percentile	*50% probability SLR meets or exceeds…*	*67% probability SLR is between…*	*5% probability SLR meets or exceeds…*	*0.5% probability SLR meets or exceeds…*
2030	0.4	0.3 — 0.5	0.6	0.8
2050	0.9	0.6 — 1.1	1.4	1.9
2100 (RCP 2.6)	1.6	1.0 — 2.4	3.2	5.7
2100 (RCP 4.5)	1.9	1.2 — 2.7	3.5	5.9
2100 (RCP 8.5)	2.5	1.6 — 3.4	4.4	6.9
2100 (H++)	10			
2150 (RCP 2.6)	2.4	1.3 — 3.8	5.5	11.0
2150 (RCP 4.5)	3.0	1.7 — 4.6	6.4	11.7
2150 (RCP 8.5)	4.1	2.8 — 5.8	7.7	13.0
2150 (H++)	22			

Source: Griggs et al. 2017

Geomorphic Evolution – Managing Vertical Capital



Source: SFEI (2017)



Minimum starting elevation to achieve mid-marsh restoration:

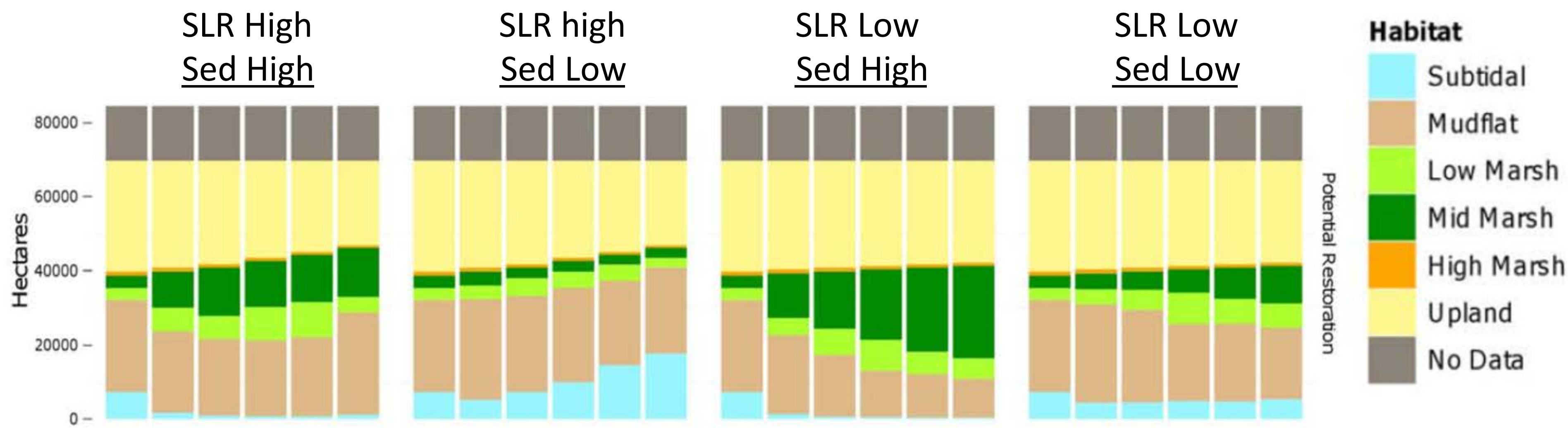
	SLR=1.7 ft	SLR=5.4 ft
SSC, mg/L	ft NAVD	ft NAVD
50	5.5	5.8
100	5.5	5.8
150	4.8	5.1
200	4.2	4.5
250	2.5	3.2
300	-0.4	0.6

Source: Stralberg, Brennan, et al. (2011)

Geomorphic Evolution – Managing Vertical Capital

McInnis restoration demand
840,000 CY

Potential supply
Dredging: 100,000 CY
Creek yields: 125,000 CY
SF Bay: ??



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200	4.2	4.5
250	2.5	3.2
300	-0.4	0.6

Source: Stralberg, Brennan, et al. (2011)

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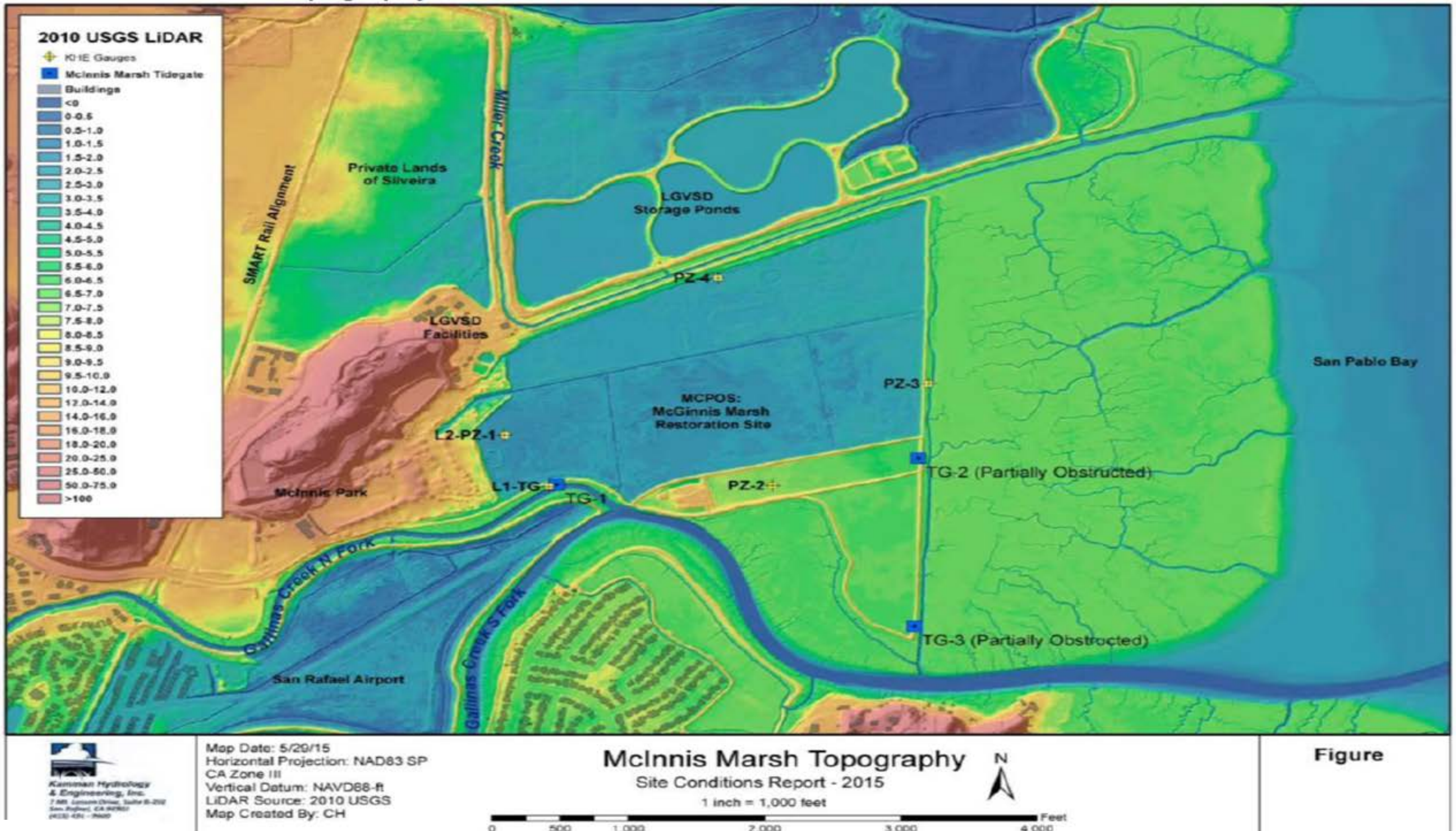
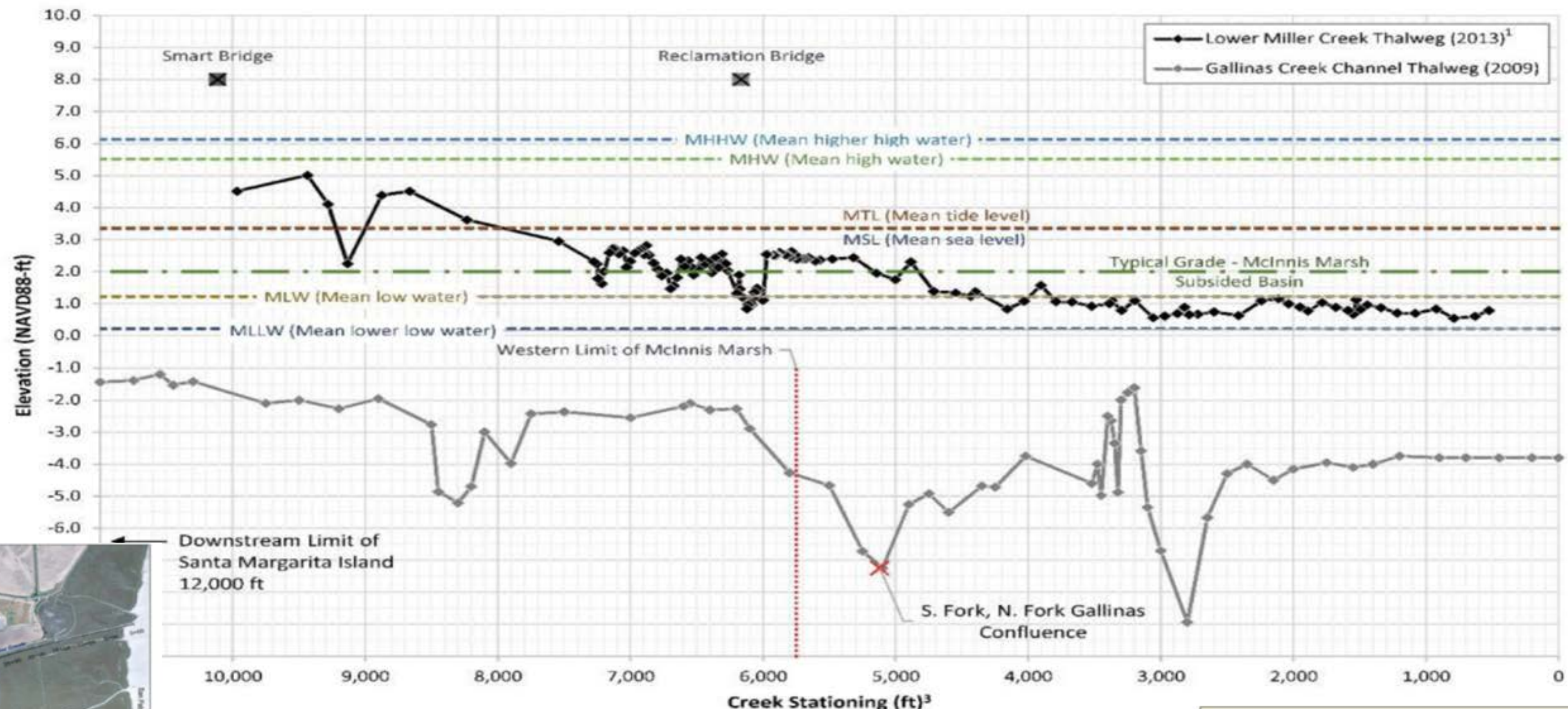
Untitled Map
Red line is my understanding of the levee alignment. (James said a small building would be removed - I think the one I've excluded is that one.)
Blue line is an option, I guess, if they don't need that lot and the classroom building there.
Legend
Las Gallinas Valley Sanitary District
Untitled Path
Untitled Path
Google Earth
©2017 Google
200 ft
N

Topography



Source: KHE (2015)

Bed Elevation Profiles – Miller & Gallinas Creeks



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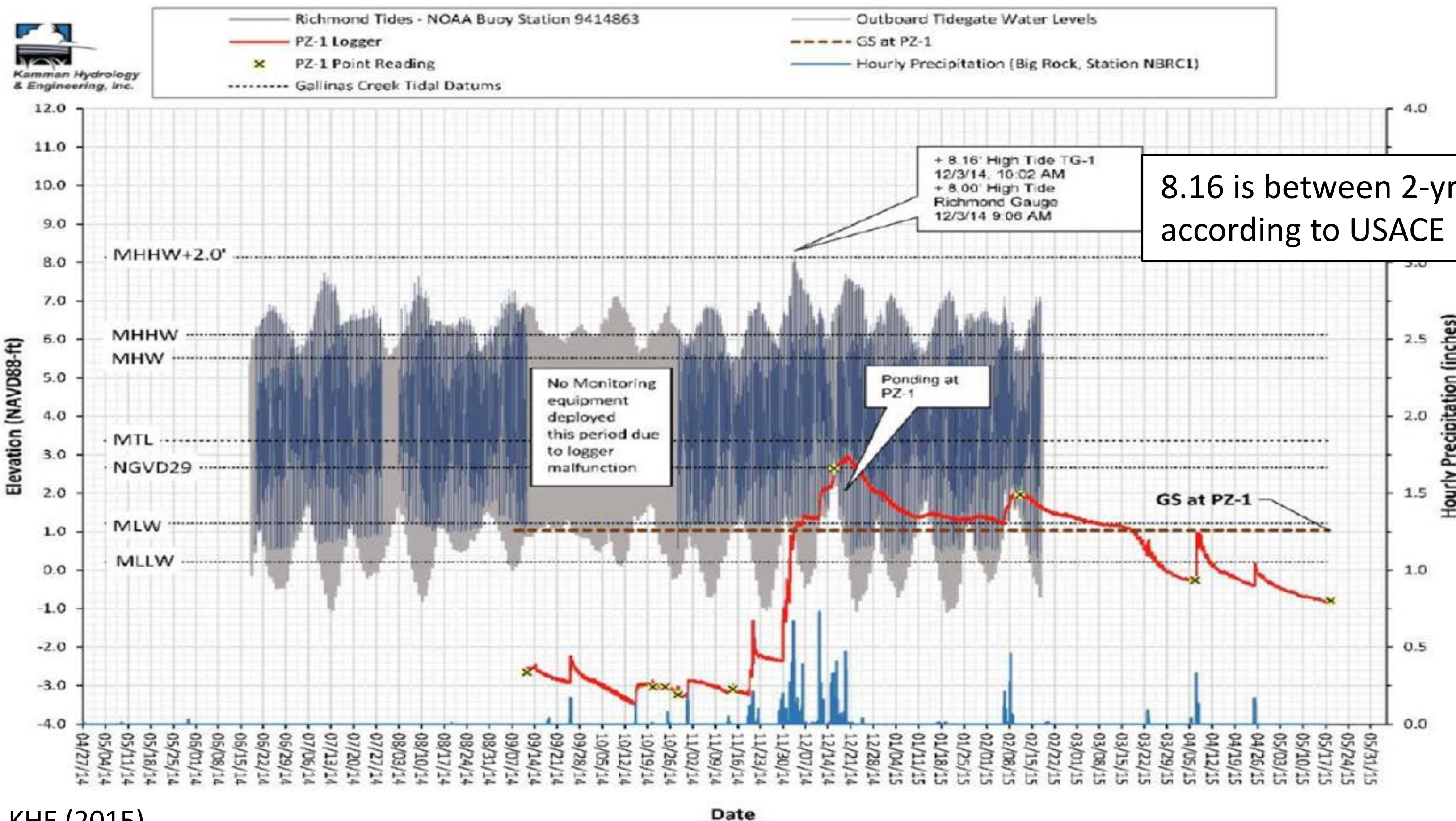
Water Level Monitoring – Tidal & Site Interior

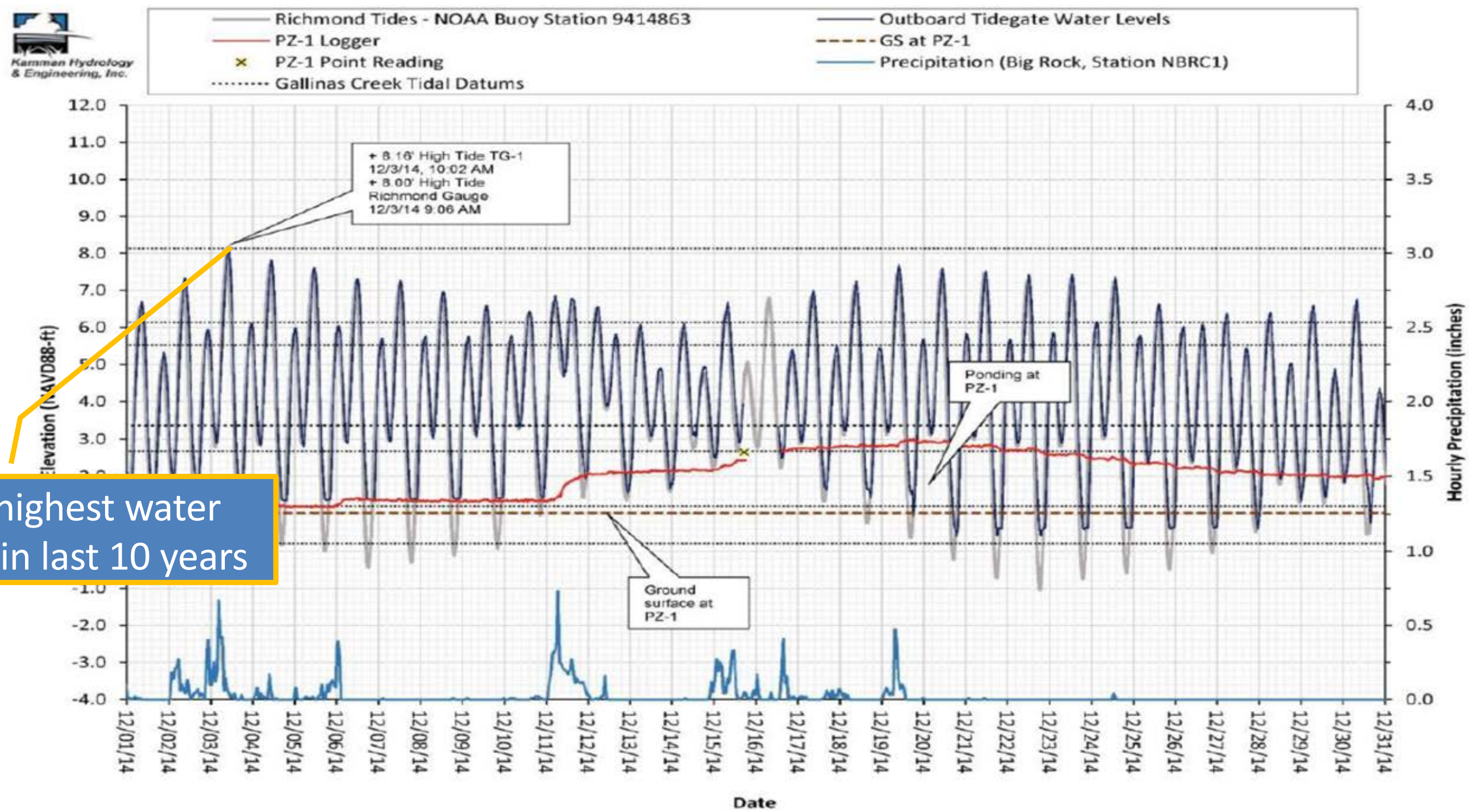


8.16 is between 2-yr & 5-yr according to USACE 2013

Source: KHE (2015)

ESA

Water Level Monitoring – Storm Surge

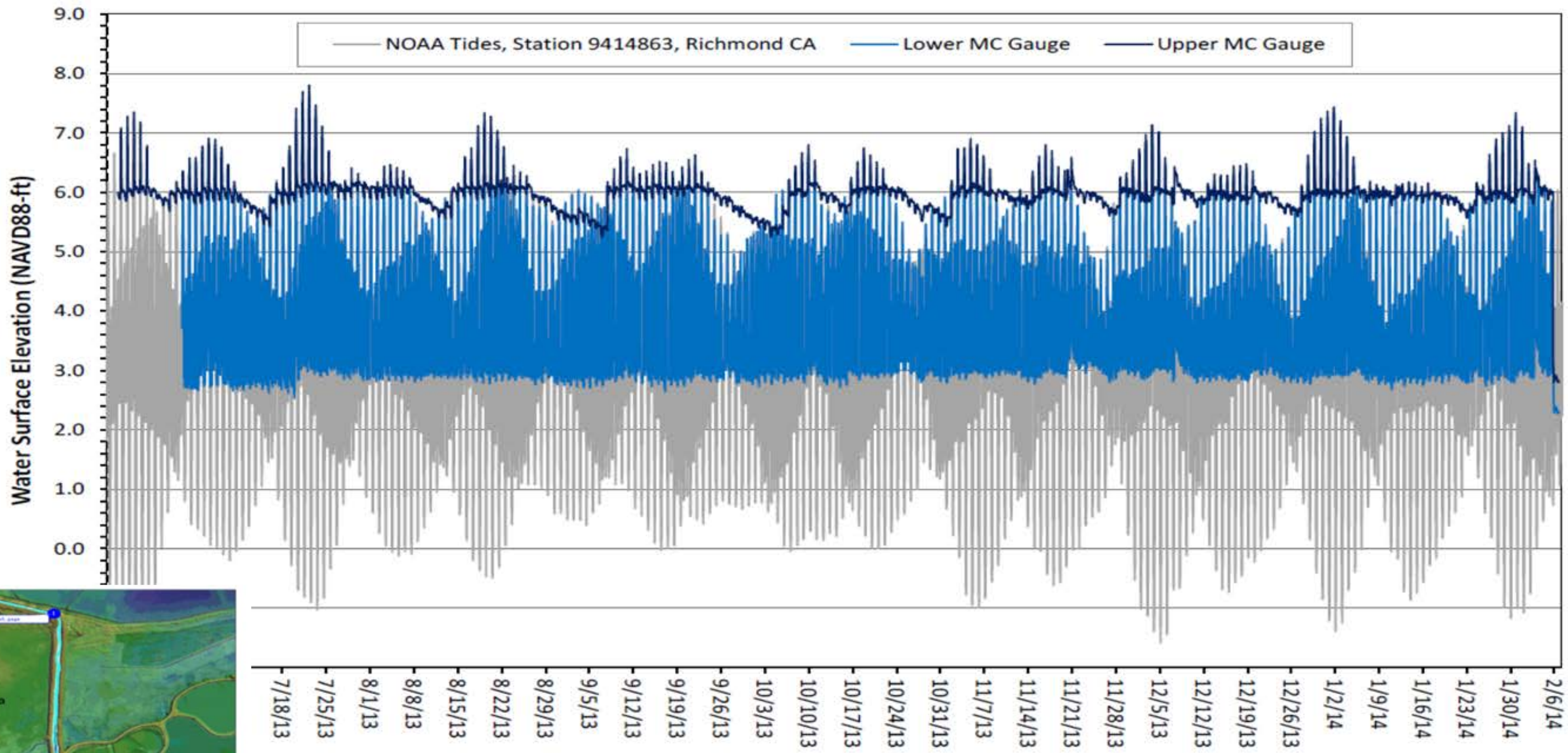


5th highest water level in last 10 years

Source: KHE (2015)

ESA

Water Level Monitoring - Miller Creek

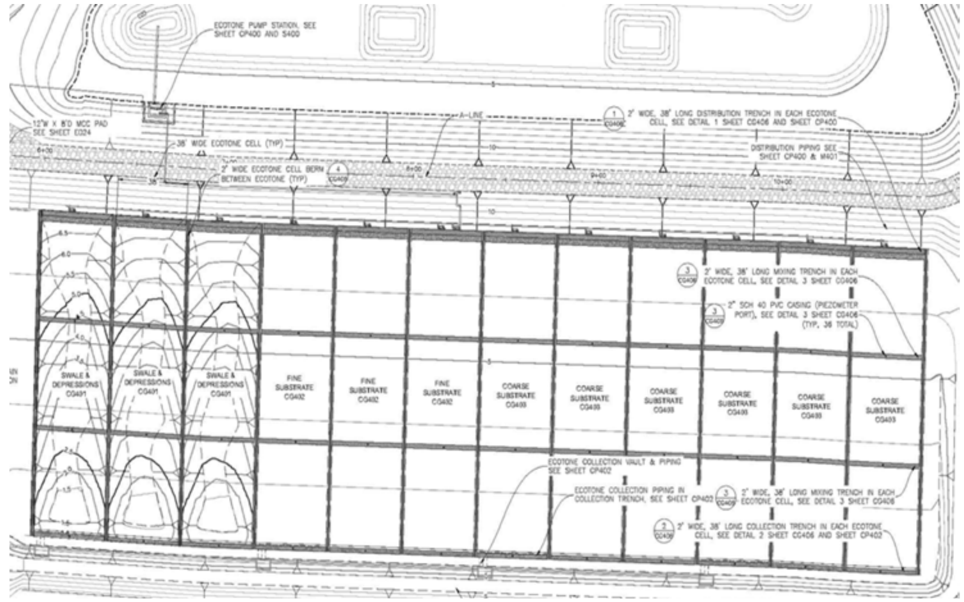


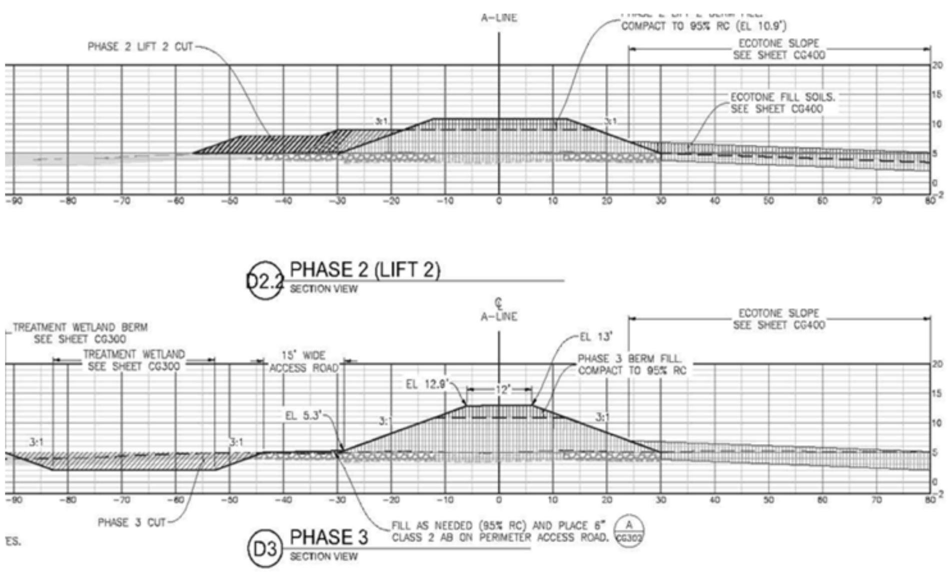
Source: KHE (2015)

ESA

Horizontal Levee Design

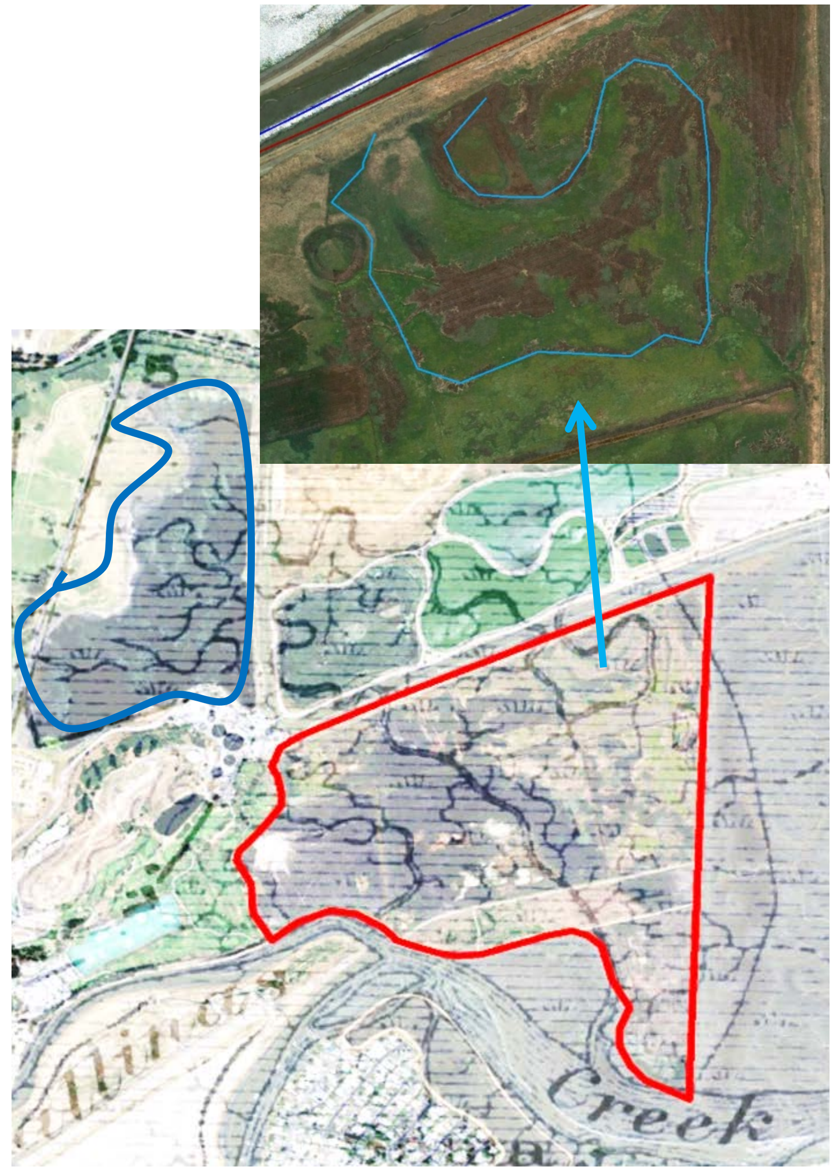
- Oro Loma – Ecotone Levee
  - Phased Construction Approach to address heave & settlement
  - Polish Treated Wastewater
  - Soils – Bay Mud vs Sandier Material
  - Plantings – Riparian vs. Wet Meadow
  - Adaptable to less irrigation supply





Tidal Channels & Breaches

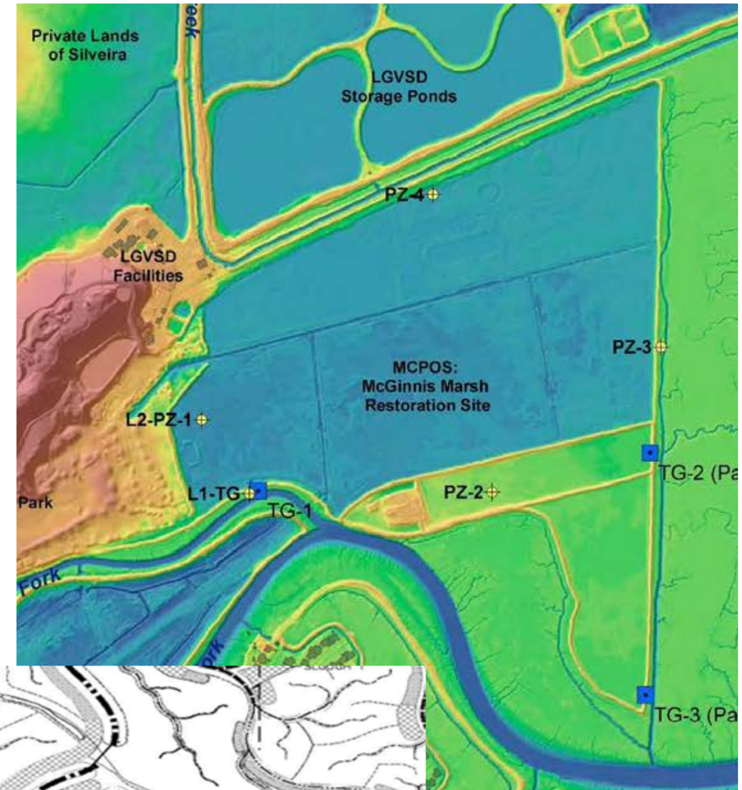
- Historic Channel Planform
  - Supports routing flows across site
  - Potential Analog for restored planform
- Future Restoration?
  - Restored Area influences Planform
  - Sinuosity, Complexity
- Breach Locations
  - Number – Gallinas & Miller Creeks
  - Utility Crossings
  - Impacts to (E) Marsh Habitat & Adjacent Levees
  - Flood Levels @ Santa Venetia

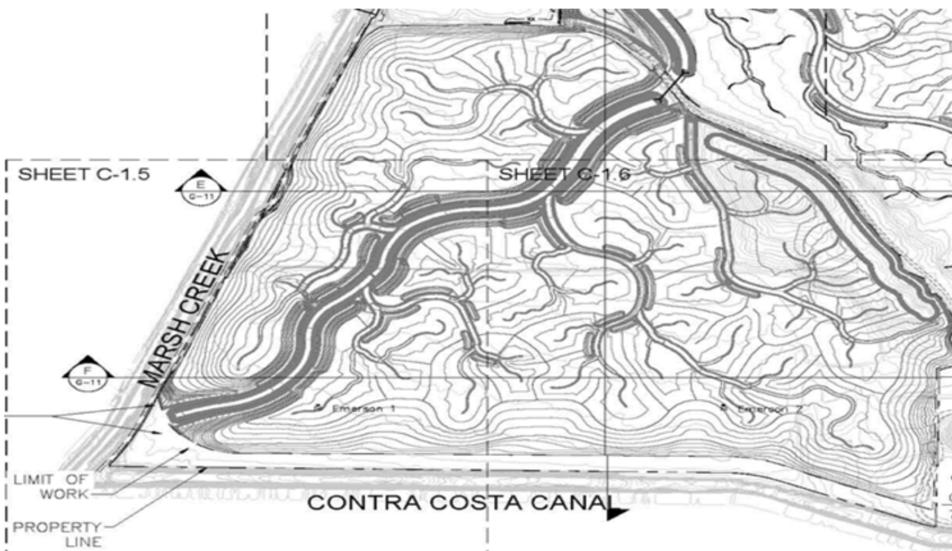


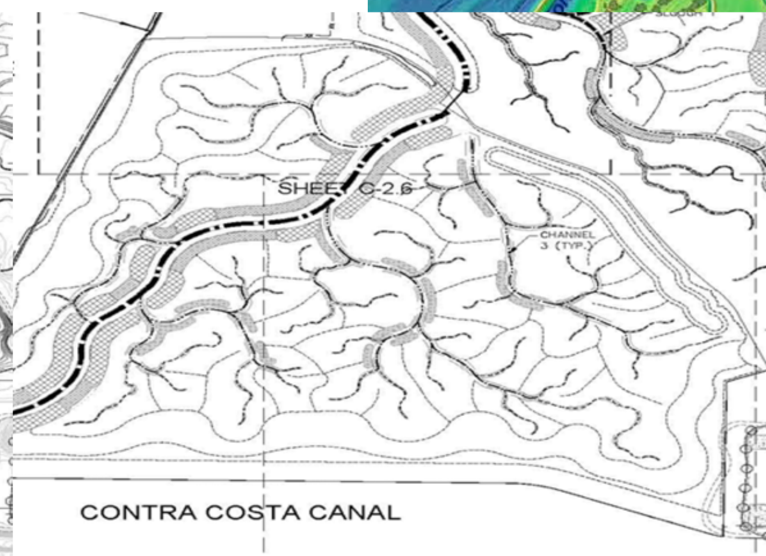
CLIENT NAME

Topographic Complexity

- Create Habitat at Marsh Elevations
- Berms along Channels
  - Mimic Natural Levees
  - Provide Vegetated Habitat – Near Term
  - Reduce Wind Waves
  - Create Smaller Quiescent Areas for Deposition
- Elevation Capital
  - South Dredge Disposal Sites @ Marsh Elevations
  - Needs Channels for Marsh Function
  - Lowered Levees – Transitional Slopes







Restoration Ecology

- Restore ecological connectivity from subtidal baylands across estuarine transition zone to alluvial creek channel
  - Restore sediment transport processes and remove fish barriers
  - Create upslope migration corridors for fish and native wetland plant and animal communities
  - Take advantage of 'elevation capital' to provide high tide refuge, marsh transgression space
  - Create habitat diversity with topographic variability in restoration area
  - Design for dynamic conditions – target habitats and ecological benefits in near term and facilitate succession with climate change and SLR

Resilient Habitat Restoration

Implementing Regional Resilience Strategies

The habitat restoration approach will incorporate guidance from the Baylands Ecosystem Goals (Goals Project 2015), and will be specifically designed for resiliency with sea-level rise.

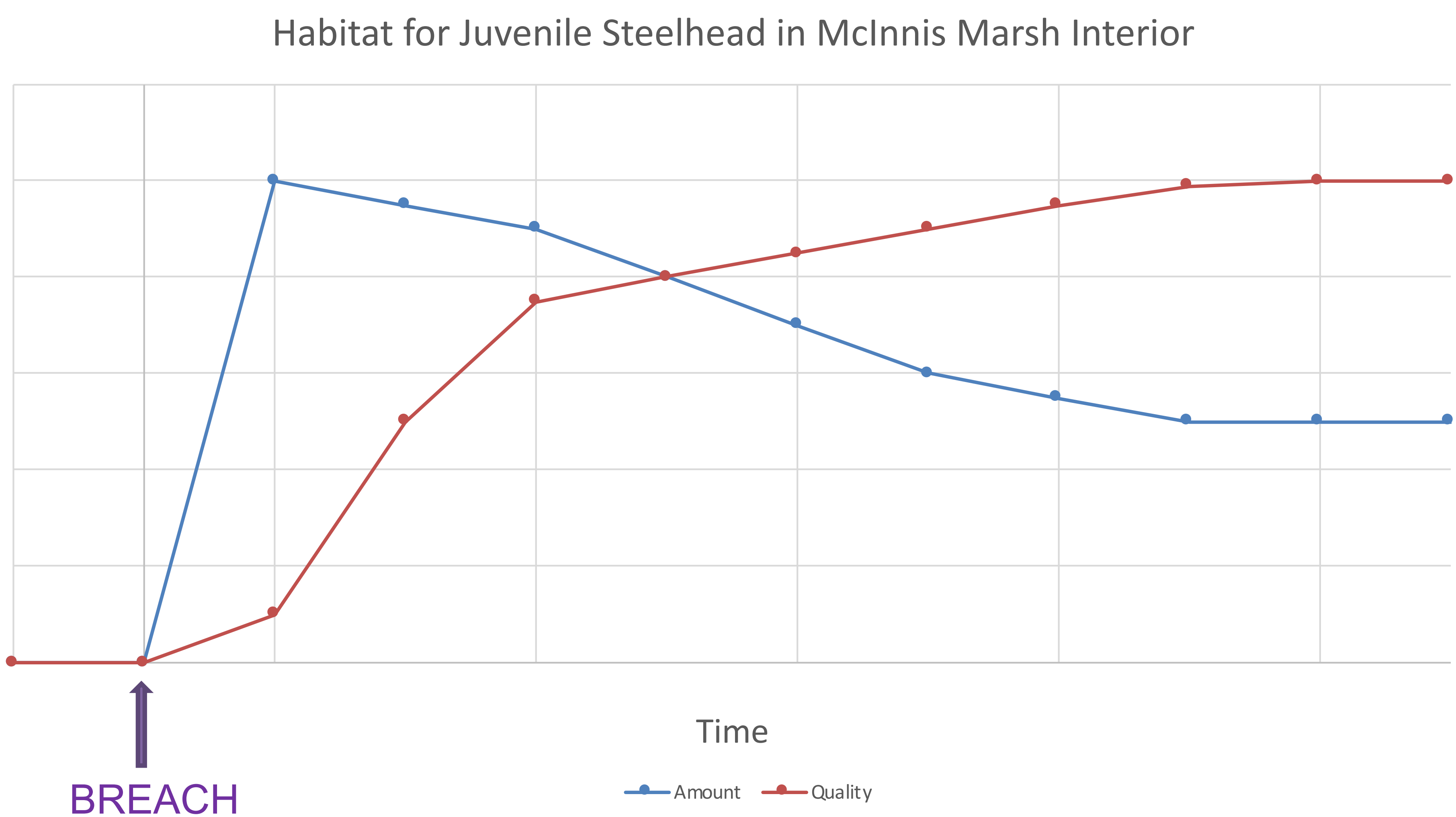
1. **Restore estuary-watershed connections**
   - Re-establish tidal connections to roughly 120 acres of historic marsh, promoting marsh growth through sediment deposition and providing migration corridors for wildlife.
2. **Design complexity and connectivity into the Baylands**
   - Restore and enhance a diverse range of Baylands habitats, extending from subtidal channels, tidal marsh areas, and into adjacent lowland and upland terrestrial habitats.
   - Create a variety of micro-topographic treatments within each habitat to promote habitat diversity, including tidal channels, marsh ponds and berms, seasonal wetlands
   - Breach and lower existing levees which currently limit ecological and hydrological connectivity between the creek channels and historic marsh areas.
3. **Restore and protect complete tidal wetlands systems**
   - Preserve and enhance existing terrestrial habitats in areas adjacent to existing and restored tidal wetlands, to restoration of complete tidal marsh-to-upland ecotones.
4. **Restore the Baylands to full tidal action before 2030**
   - Implementation planned in 2020, which will allow time for sediment deposition and marsh plain accretion within the restored marsh areas before the site experiences the accelerated rates of sea-level rise projected to occur in the second half of the century.
5. **Plan for the Baylands to migrate**
   - Preserve existing high marsh and upland terrestrial habitats in areas adjacent to existing or restored tidal marsh. Design will anticipate gradual succession of these terrestrial habitats to tidal marsh habitats over time as sea-levels rise and these areas experience more frequent tidal inundation

Expected Marsh and Stream Evolution

MOVE to POCKET

- Subsided areas on the diked wetland would take some years to accrete sediment and begin forming marshes
- That during initial post construction period, there would be some tidal lagoons; some of those areas (particularly the lowest areas, unless more earth is moved) would persist indefinitely
- Some existing seasonal wetlands would be lost via conversion to tidal marshes
- Rails and several other species and guilds would benefit in different ways as the different portions of the marsh developed over time; forage, nesting, refugia, etc. would all be increased for some species in some parts of the project area, but that not all species would benefit equally or from the same stages of marsh development
- Steelhead and other native fish species would benefit in the early years from the newly available aquatic habitat; habitat for fish in the restored marsh would evolve in nature over time – initially broad areas of shallow inundated (former) marsh plain would provide rearing habitat – with marsh plain aggradation and incision-development of tidal channels, primarily habitat would be limited to the channels (passage, food web support functions)
- Upland and transitional ecotone(s) would be planted with native vegetation that would need maintenance/replanting and these and other areas of the site would need invasive plant management until a mature native vegetation community is established

Conceptual Trajectory of Species Benefits



Conceptual Trajectory of Species Benefits