FLOOD CONTROL 2.0 REGIONAL FORUM

Novato Creek Flood Protection Project

November 13, 2013 • 8:30 am - 4:30 pm
## Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30</td>
<td>Welcome</td>
<td>Tracy Clay (Marin County)</td>
</tr>
<tr>
<td>8:35</td>
<td>Introductions/Overview of Meeting Goals</td>
<td>Meredith Williams (SFEI)</td>
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<tr>
<td>8:40</td>
<td>Flood Control 2.0 Project and Concepts</td>
<td>Caitlin Sweeney (SFEP) and Robin Grossinger (SFEI)</td>
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<tr>
<td>9:00</td>
<td>Novato Creek Baylands Historical Landscape</td>
<td>Micha Salomon (SFEI)</td>
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<td>9:20</td>
<td>Change Analysis</td>
<td>Robin Grossinger (SFEI)</td>
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<tr>
<td>9:40</td>
<td>Geomorphic Conceptual Model</td>
<td>Scott Dusterhoff (SFEI)</td>
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### Introductions/Overview of Meeting Goals
- To help advance conceptual design of the Novato Flood Control Project as a multi-benefit project providing flood protection, sediment transport, habitat restoration, and sea level rise resilience to lower Novato Creek and the adjacent baylands.

### Flood Control 2.0 Project and Concepts
- Overview of project goals and concepts, and the role of this forum in linking regional and local expertise.

### Novato Creek Baylands Historical Landscape
- Provide background information on historical ecological and hydrological characteristics.

### Change Analysis
- Describe landscape change since 1850, using spatial metrics representing important ecological functions.

### Geomorphic Conceptual Model
- Present initial conceptual model of drivers controlling local landscape form and function.
## Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Duration</th>
<th>Presenter/Details</th>
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<tbody>
<tr>
<td>10:00</td>
<td>Break</td>
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<tr>
<td>10:15</td>
<td><strong>Novato Flood Control Project</strong></td>
<td>10:15</td>
<td>Roger Leventhal (Marin County)</td>
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<tr>
<td></td>
<td>• <em>Provide summary of goals, constraints, status, design concepts</em></td>
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<tr>
<td>11:15</td>
<td><strong>Discussion</strong></td>
<td>11:15</td>
<td>All; Meredith Williams, facilitator</td>
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<td>• <em>Priority project questions (separate handout)</em></td>
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<td>12:00</td>
<td><strong>Lunch</strong></td>
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<tr>
<td>12:30</td>
<td><strong>Discussion</strong></td>
<td>12:30</td>
<td>All; Meredith Williams, facilitator</td>
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<td>• <em>Continue discussion with design team</em></td>
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<td>3:00</td>
<td><strong>Field Trip</strong></td>
<td>3:00</td>
<td>Roger Leventhal</td>
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<td>• <em>Visit two potential areas for project implementation</em></td>
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<td>4:30</td>
<td><strong>Adjourn</strong></td>
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Regional Science Advisory Team Members

• Peter Baye, coastal ecologist, botanist

• Letitia Grenier, wildlife ecologist, conservation biologist

• Jeff Haltiner, ESA-PWA, engineer

• Robert Leidy, EPA, fisheries and stream ecologist (not present)

• Jeremy Lowe, ESA-PWA, coastal geomorphologist
Flood Control 2.0:
Rebuilding Habitat and Shoreline Resilience through a New Generation of Flood Control Channel Design and Management
Flood Control “2.0”

• Sea Level Rise – Meeting Increasing Challenges for Flood Protection

• Sediment – Moving from Problems to Solutions

• Aging Infrastructure – Taking Advantage of Window of Opportunity

Increase Resilience
Support Multiple Benefits
Project Partners

- Funder - EPA SF Bay Water Quality Improvement Fund

- Project Team:
  - SFEP (grant recipient, project manager)
  - SFEI
  - BCDC
  - SFBJV
  - SFCJPA
  - MCFCWCD
  - CCCFCWCD

- Regional Partner – BAFPAA

- Project Oversight – Regional and National Science Forums

- Regulatory Partners – RWQCB, USACE, NMFS, CDFW, Etc.
Project Components

- Conceptual Models
  - Regional Historical Ecology Synthesis
  - Regional Coarse Sediment Supply Synthesis

- Regulatory and Economic Guidance

- Implementation Projects

- Public Outreach and Education

- Regional Implementation Toolbox
Project Overview

- 4 year project, $3 million (½ grant, ½ match)
Regional Science Advisory Team

- sponsored by SFBJV Design Review Program and FC2.0, coordinated by SFEI
- multidisciplinary background
- provide expert advice/review to help achieve resilient, multi-benefit, landscape-scale restoration projects
- synthesize existing knowledge and experience to identify opportunities and constraints
- not expected to develop project restoration/engineering designs
- work collaboratively with project proponents to shape broadly-supported, landscape-scale conceptual designs
- Potential team products: conceptual landscape designs/visions, ecological or geomorphic targets, narrative principles, and/or recommended research priorities.
Workshop Goal

To help advance conceptual design of the Novato Flood Control Project as a multi-benefit project providing flood protection, sediment transport, habitat restoration, and sea level rise resilience to lower Novato Creek and the adjacent baylands.

• Not a goal of perfection – not necessarily a perfect option out there

• Learning how to do this together – exploring what's possible, identifying opportunities and challenges, both short-term and long-term

• Trying to actually do multi-benefit planning: not flood control versus ecosystem-- all on the same team here

• Learning from the region and drawing regional resources to local challenges

• Will likely be a complex and challenging process – but expect benefits from more integrated and inclusive process
  -- local and regional support
  -- funding avenues
  -- permitting process
Circa 1900 Design Principle:
Minimize tidal and fluvial hydrologic footprint to maximize dry land.
Now recognize limitations and unintended consequences.

And changing drivers: subsidence, climate change, environmental values, economics.

Potential new design principles?

Maximize tidal prism for sediment transport to the Bay

Support marsh-building processes to maintain wave energy buffers

Create larger, well-connected populations of native species to support ecosystem functions and reduce regulatory conflicts.
Geographic Setting
Ca 1850 Landscape
Changes in Major Habitat Types
Ecological Functions Past and Present
Baylands Ecosystem Goals
Geomorphemic Setting
Geographic Setting
Tidal marshes of northeast Marin (BAARI 2011)
ca 1850 Landscape
Novato Creek
Baylands ca. 1850

DRAFT
Possible Southern route of Novato mainstem
High channel density within historical marsh
Large pannes in interior marsh
Broad tidal flats along the Bay margin
Changes in Major Habitat Types
Habitat Overview

Tidal Habitats

circa 1850

2009

Legend:
- Bay Tidal Flat
- Channel Tidal Flat
- Channel Open Water
- Panne
- Tidal Marsh

0 0.5 1 Miles
Habitat Overview

Tidal Habitats

circa 1850

2009

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Bay Tidal Flat
Channel Tidal Flat
Channel Open Water
Panne
Tidal Marsh

Historical_Shoreline

Bay Tidal Flat
Channel Tidal Flat
Channel Open Water
Panne
Tidal Marsh

0 0.5 1 Miles
Habitat Overview

Tidal Habitats

circa 1850

Habitat Area (ha)

-77%

-87%

-99%

Historical

Modern

Habitat Type

Bay Tidal Flat
Channel Tidal Flat
Channel Open Water
Panne
Tidal Marsh
Habitat Overview
including nontidal & anthropogenic wetlands
Habitat Overview
including nontidal & anthropogenic wetlands

![Bar chart and map with habitat type distribution]

- Nontidal Vegetated Wetland
- Nontidal Open Water
- Bay Tidal Flat
- Channel Tidal Flat
- Channel Open Water
- Panne
- Tidal Marsh

DRAFT
Tidal Channel Length
Historical Tidal Channel Density

Channel connecting to Simmons Slough = 64,419 m
Simmons Slough Tidalshed = 468 ha
Channel Density = 135 m/ha
Marsh Zone

- high marsh berm: NO channels or pannes
- poorly drained marsh: FEW channels, MANY pannes
- well drained marsh: MANY channels, FEW pannes
- zones of freshwater influence: NEAR where creeks enter the marsh
Ecological Functions Past and Present
Known T&E species at the site

Tidewater goby (*not seen since 1950s*)
Steelhead
Chinook (*likely strays from Petaluma River*)
Northwestern pond turtle
California black rail
California clapper rail
Western burrowing owl
Salt marsh common yellow throat
San Pablo song sparrow
Salt marsh harvest mouse
Sacramento Splittail

Soft bird's beak
Pt Reyes bird's beak
• The highest modeled habitat densities for Clapper Rails are along the western edge of San Pablo Bay, from Petaluma River to China Camp (Liu et al. 2012)
Historical Steelhead Status
(Leidy et al., CEMAR)
Novato Creek was one of the last places tidewater goby was found in the Bay before it was extirpated (Leidy 2007)
Shorebirds
Marsh Birds
Estuarine Fish
Transition Zone (Biodiversity)

Based on Delta Landscapes and BEHGU
Landscape Ecology Analyses
Shorebirds

including sandpipers, dowitchers, curlews, avocets, stilts, godwits
Overview: Shorebirds

• Shorebirds forage on intertidal mudflats and pannes

• Historical mudflats included most of the tidal channel network
Shorebird foraging: Flats

circa 1850

2009

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- **Channel Flat**
- **Bay Flat**
- **Panne**
Area by Type

<table>
<thead>
<tr>
<th>Habitat Class</th>
<th>Historical area (ha)</th>
<th>Modern area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bay Flat</td>
<td>1143</td>
<td>289</td>
</tr>
<tr>
<td>Channel Flat</td>
<td>128</td>
<td>15</td>
</tr>
<tr>
<td>Panne</td>
<td>95</td>
<td>2</td>
</tr>
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</table>

[Graph showing area by type with historical and modern data for different habitat classes]
Marsh Birds

California clapper rail, black rail
Tidal Marsh for Rails
Including Low Marsh, and Channels/Flats < 200ft wide. Excluding Pannes

circa 1850

2009
Marsh Core Area
(50m internal buffer)

Historical: 1 large patch

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Total area = 1,523 ha

Modern: 7 smaller patches

Total area = 102 ha

circa 1850

2009

0 0.5 1 Miles
Core area size distribution

more core patches today, but much smaller

- Size classes of core area patches (ha):
  - 0 - 1
  - 1 - 10
  - 10 - 100
  - 100 - 1000
  - 1000 - 10K

- # of historical core patches
- # of modern core patches
Estuarine Fish

rainbow trout/steelhead
three-spined stickleback
California roach
Sacramento pikeminnow
prickly sculpin
tidewater goby (now extirpated)
(Leidy 2007)
Shoreline Length by Adjacent Marsh polygon size

• Shoreline length (channel edges) provides important functions for estuarine fish:
  – Hiding places
  – Shelter from strong currents
  – Adjacent marshes provide food

• Larger adjacent marshes provide more

• Metric: shoreline length by adjacent marsh polygon size
  – reflects both services
Shoreline Length

circa 1850

2009

Channel Shoreline

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0 0.5 1 Miles
Adjacent Marsh polygon sizes

Marsh Polygons by area
- 0-1 ha
- 1-10 ha
- 10-100 ha
- 100-1000 ha

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Shoreline Length by Adjacent Marsh polygon size

- Historical Channel Shoreline
- Modern Channel Shoreline

Marsh Polygons by area:
- 0-1 ha
- 1-10 ha
- 10-100 ha
- 100-1000 ha
Transition Zone

Tidal – Terrestrial interface
Salt Marsh Harvest Mice and other small mammals use the Tidal-Terrestrial interfaces as refugia during high and extreme high tides

Link to terrestrial species

In the Bay, interfaces between fluvial systems and tidal marshes were often historically broad (100s or 1000s of meters) and have largely been developed

The large number of bedrock islands within Tidal Marsh is typical for eastern Marin, but somewhat rare in other parts of the Bay
Tidal-Terrestrial Interface

circa 1850

2009

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- Tidal-Terrestrial interface
- Shallow Bay
- Tidal Flat
- Shallow Subtidal Channel
- Tidal Flat - Intertidal Channel
- Low Tidal Marsh
- Tidal Marsh
- Salt Pond or Panne

[Scale: 0 0.5 1 Miles]
About the Interfaces

• **Low-gradient transition zone**: bottom/alluvial land<->tidal marsh
  – Broad lowland interface
  – herbaceous vegetation
  – potential freshwater wetlands

• **Steeper transition zone**: hillslope<->tidal marsh
  – steep vegetated slopes, oaks, grassland

• **Levees**: artificial levee/dike-tidal marsh
  – dry, upland vegetation including non-natives and invasives typical
  – may be topped by roads
  – Normally steep-sloped (narrow T-zone)
  – Could be constructed with gentle slopes (broader T-zone)
T-zone types

Interface type
- Broad ecotone: lowland interface
- Narrow ecotone: hillslope interface

Interface type
- Levee (narrow) ecotone
- Narrow ecotone: hillslope interface

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Potential Baylands Landscape Ecology Design Elements

Freshwater-brackish tidal marsh
Tidal marsh with high density channel networks
Poorly drained tidal marsh with large pannes
Wave-built high marsh terrace

Bay flats
Channel flats

Core marsh areas
Tidal marsh channels adjacent to large marsh patches
Low gradient and steeper tidal-terrestrial transition zones
Goals Project (1999):
Unique restoration opportunities

• major expansion of California clapper rail into very wide marshes
• enhance tidal marsh in areas where natural marsh/upland transitions can be restored
• expand and reintroduce populations of rare plant species (e.g. Point Reyes bird’s-beak and johnny-nip)
• enhance flood protection in the Novato Creek area by expanding tidal prism
• treated wastewater: opportunity to develop freshwater managed wetlands for waterfowl
Goals Project (1999): Recommendations

• between Black Point and Gallinas Creek, and along Gallinas Creek and Novato Creek.
  – Restore a wide, continuous band of tidal marsh along the bayfront
  – Ensure a natural transition to uplands throughout
  – provide an upland buffer outside the baylands boundary.

• Establish managed marsh or enhanced seasonal pond habitat on agricultural baylands that are not restored to tidal marsh.
Geomorphic Conceptual Understanding
Conceptual Framework for Marshland Establishment & Evolution

Drivers
- Watershed area
- Land use
- Climate
- Geology
- Topography/Bathymetry
- Tide range
- Fetch
- Wind speed
- Water power
- Tidal prism
- Wave power
- Sediment delivery
- Fine sediment supply
- Flow resistance
- Sediment trapping

Key processes
- \( Q_w \) (surf. & gw)
- Stream power
- \( Q_s \) (fine & coarse)
- Wave power
- Tidal prism
- Fine sediment delivery
- Sediment trapping

Expression (landscape response)
- Marshplain characteristics
  - Size, elevation, position, type
  - Vegetation distribution
  - Key physical features (e.g., salt pannes and lagoons)
- Marsh channel characteristics
  - Hydr. geom., drain. dens, sinuos.
  - Connectivity
  - Key physical features (e.g., natural levees and berms)
Historical Watershed Processes: $Q_{sed}$ & $Q_{water}$

Source: Marin History Museum

Historical Habitats
- Historical channels
- Shallow Bay
- Tidal Flat
- Shallow Subtidal Channel
- Tidal Flat - Intertidal Channel
- Low Tidal Marsh
- Tidal Marsh
- Salt Pond or Panne
- Island; Upland

Legend:
- Blue: Historical channels
- Light Green: Shallow Bay
- Dark Green: Tidal Flat
- Dark Blue: Shallow Subtidal Channel
- Light Brown: Tidal Flat - Intertidal Channel
- Light Green: Low Tidal Marsh
- Green: Tidal Marsh
- Red: Salt Pond or Panne
- Gray: Island; Upland

Scale:
- 0 0.5 1 2 Miles
- 0 0.5 1 2 Kilometers
Historical Tidal Processes: Wave Power & Tidal Prism

**Historical Habitats**
- Historical channels
- Shallow Bay
- Tidal Flat
- Shallow Subtidal Channel
- Tidal Flat - Intertidal Channel
- Low Tidal Marsh
- Tidal Marsh
- Salt Pond or Panne
- Island; Upland

[North Arrow] 0 0.5 1 2 Miles

[North Arrow] 0 0.5 1 2 Kilometers
Historical Tidal Processes: Wave Power & Tidal Prism

Channel Area vs. Marsh Area (Williams et al. 2002)

\[
y = 2.40 x^{0.772} \\
R^2 = 0.94
\]
Historical Littoral Processes: Circulation & Sediment Deposition
Historical Littoral Processes: Circulation & Sediment Deposition

Residual sediment transport rate (van der Wegen & Jaffe 2013)

(a) 1856 wet season
(b) 1856 dry season
Historical Marsh Landscape

Fine & coarse watershed sediment supplied to expansive marsh

High elevation, poor drainage, low channel density, salt pannes

Fine tidal sediment supplied to expansive marsh, scoured mainstem channel, extensive tidal channel network

Expansive, depositional mudflat

Historical Habitats
- Historical channels
- Shallow Bay
- Tidal Flat
- Shallow Subtidal Channel
- Tidal Flat - Intertidal Channel
- Low Tidal Marsh
- Tidal Marsh
- Salt Pond or Panne
- Island; Upland

N 0 0.5 1 2 Miles
0 0.5 1 2 Kilometers
Current Watershed Processes: $Q_{sed}$ & $Q_{water}$

Stafford Lake

Modern Baylands
- Shallow Bay/Channel
- Lagoon
- Tidal Flat/Channel
- Tidal Vegetated
- Marsh Panne
- Modern channels (BAARI)

Photo: Laurel Collins
Current Watershed Processes: $Q_{\text{sed}}$ & $Q_{\text{water}}$

Relative distance (parallel to first levee) (m)

Elevation (m NAVD88)

Source: Collins 1998

Topography source: Kamman Hydrology & Engineering
Current Tidal Processes: Wave Power & Tidal Prism
Current Tidal Processes: Wave Power & Tidal Prism

Channel Area vs. Marsh Area (Williams et al. 2002)

\[ y = 2.40 \times 0.772 \]
\[ R^2 = 0.94 \]
Current Marsh and Mudflat Elevations

Marin County 2013

Elevation (ft NAVD88)

- < -1
- -1 - 0
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- 8 - 9
- 9 - 10
- 10 - 11
Current Marsh Elevations Below MLLW

MLLW @ Hamilton = 0.2 ft NAVD88
Current Littoral Processes: Circulation & Sediment Deposition

Residual sediment transport rate (van der Wegen & Jaffe 2013)
Current Marsh Landscape

Constrained flood flows, high fine watershed sediment load

Subsided reclaimed marsh area

Constrained tidal flows, decreased sediment supply, aggrading mainstem channel, in-filled tidal channel network

Eroding, supply-limited mudflat

Modern Baylands
- Shallow Bay/Channel
- Lagoon
- Tidal Flat/Channel
- Tidal Vegetated
- Marsh Panne
- Modern channels (BAARI)
Looking towards the future...

Excess watershed fine sed. + confined channel + hardened shoreline
- Aggrading channel that required frequent dredging
- Subsiding reclaimed lands
- Locally eroding marsh and mudflat areas

Climate change impacts
- Rising sea level = increased channel aggradation
- Potential increased ‘storminess’ = increased watershed fine sediment loading & increased wave power and localized mudflat erosion
THANK YOU

Questions?

Contact
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Micha Salomon  Micha@sfei.org