Suisun Marsh Levee Breach Modeling

CALFED Suisun Marsh Levee Subteam

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www.iep.ca.gov/suisun

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Background

- CALFED has designated Suisun Marsh Levees an "optional strategy" for meeting the levee integrity, water quality, and ecosystem restoration goals of the program.
- CALFED is gathering information on the costs, benefits, and linkages to other CALFED programs of including all or part of the remaining Suisun Marsh levees in the program.
- The CALFED Suisun Marsh Levee Subteam is using hydrodynamics and water quality models as an information gathering tool for screening impacts and linkages.
- The modeling analysis design is consistent with CALFED Shallow Water Habitat (SWH) and Tidal Marsh restoration goals.

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Two Levels of Analysis:

- The "what", "when", "where", and "why" results (reconnaissance modeling analysis).

- The "so what", or linkages and relevance to CALFED's decision on including Suisun Marsh levees in the program.

Today we address the first level. The group should collaborate on addressing the second level.

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Modeling Approach

- *Base Case*: Historical simulation of water years 1991 - 1992 (drought period).

- Compare *Base Case* water levels and salinity to:
  - 6 Shallow Water Habitat breach scenarios
  - 4 Tidal Marsh breach scenarios

- Each scenario was run with two breach sizes:
  - 100 Feet wide, by 20 Feet deep (MLLW)
  - 5000 Feet wide, by 3 Feet deep (MLLW)

- Shallow Water Habitat area target is ~ 2000 acres
- Tidal Marsh area target is ~ 5000 acres

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Modeling Output

- All results are being posted on a www site:

  www.iep.ca.gov/suisun

- Four graphical output type examples in packet:

  1) WY1992 salinity time-series at various Suisun Bay and Delta locations (Example Plot 1).

  2) Spatial salinity change from base condition on July 29, 1992 (Example Plots 2A, 2B).

  3) Suisun Bay/Delta axis salinity change from base case on July 29, 1992 (Example Plots 3A, 3B).

  4) Tidal prism plots: Average July 1992 maximum, minimum and mean water levels (Example Plot 4).

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Mechanisms for Observed Water Level and Salinity Response

- Two "competing" mechanisms are at work:

  1) Inundation of formerly dry areas dissipates tidal energy and reduces tidal range everywhere else. This reduces tidal excursion which is proportional to dispersion of salt. ***Salinity tends to be reduced.***

  2) When there is asymmetry between tidal flows inside and outside levee breaches, salinity can be held upstream. ***Salinity tends to be increased.***

These mechanisms exert differential influence depending on location and breach geometry.

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Observations/Conclusions

- Results should be considered provisional until verified independently.
- If verified, results are significant.
- Salinity response is sensitive to breach size and location.
- Regional salinity increases when breaches are adjacent to deep, energetic channel.
- Wide SWH breaches increase salinity everywhere.
- Tidal range is always reduced.

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Further Research

- Verify water level and salinity trends with RMA model results.

- Coordinate with DWR Delta Modeling group to reproduce their short term Delta island salinity impact analysis and conduct long term salinity impact analysis.

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Focused Analysis:

- What is the effect of breach location on salinity and water level response?
- What is the effect of breach size on salinity and water level response?
- What is the effect of inundated area size?
- What is the effect of inundated area roughness (vegetation)?
- How quickly does salinity respond to seasonal hydrology changes in the presence of levee breaches?
- Further mechanisms analysis.

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So What?

- How do these results inform CALFED's decision on including Suisun Marsh levees in the program?

- What are the linkages to the other CALFED programs (water quality, water supply reliability, ERP)?

Based on the modeling output, further collaborative Sub-Team effort should be applied to these questions.

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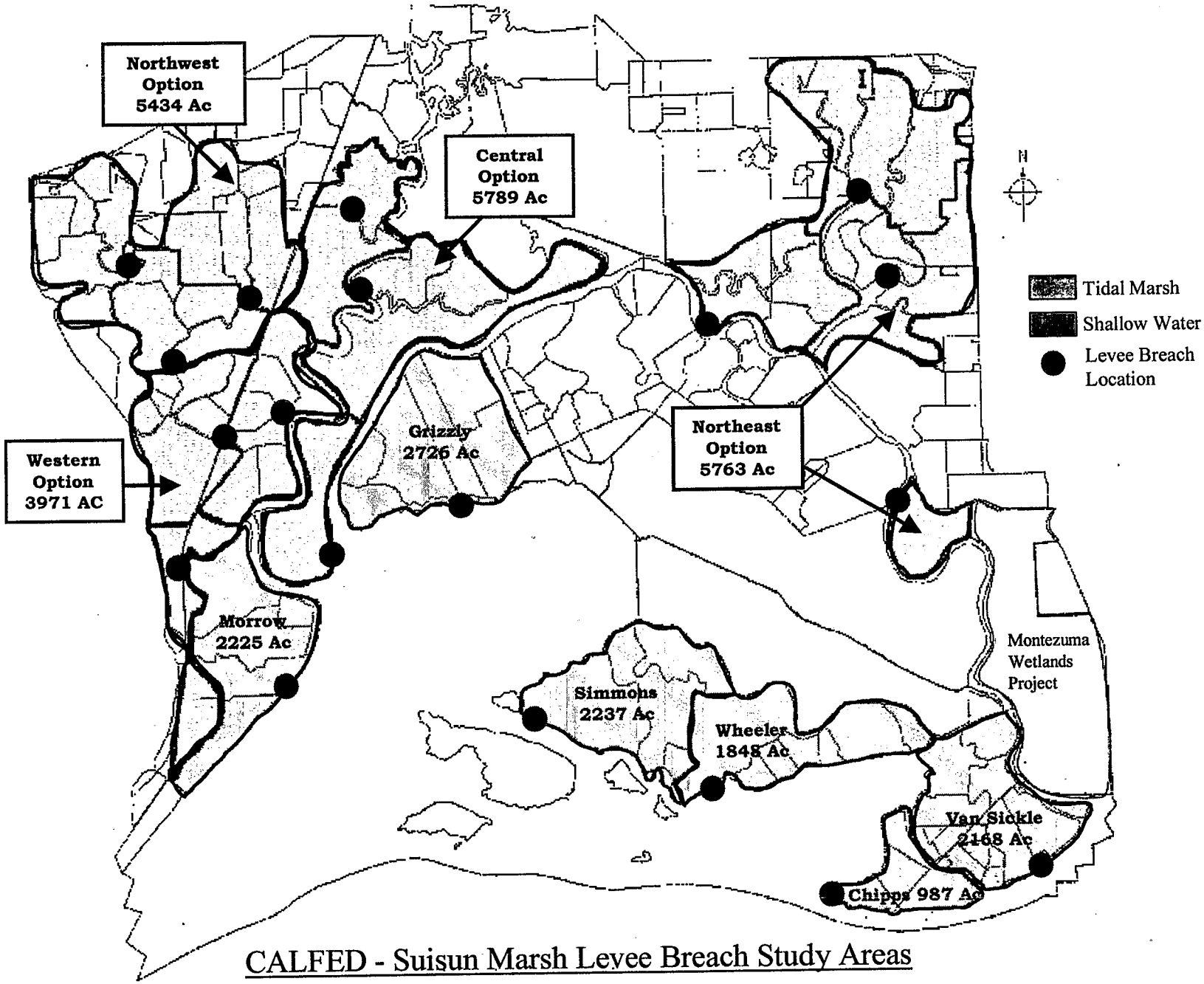

CALFED - Suisun Marsh Levee Breach Study Areas

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Example Plot 1

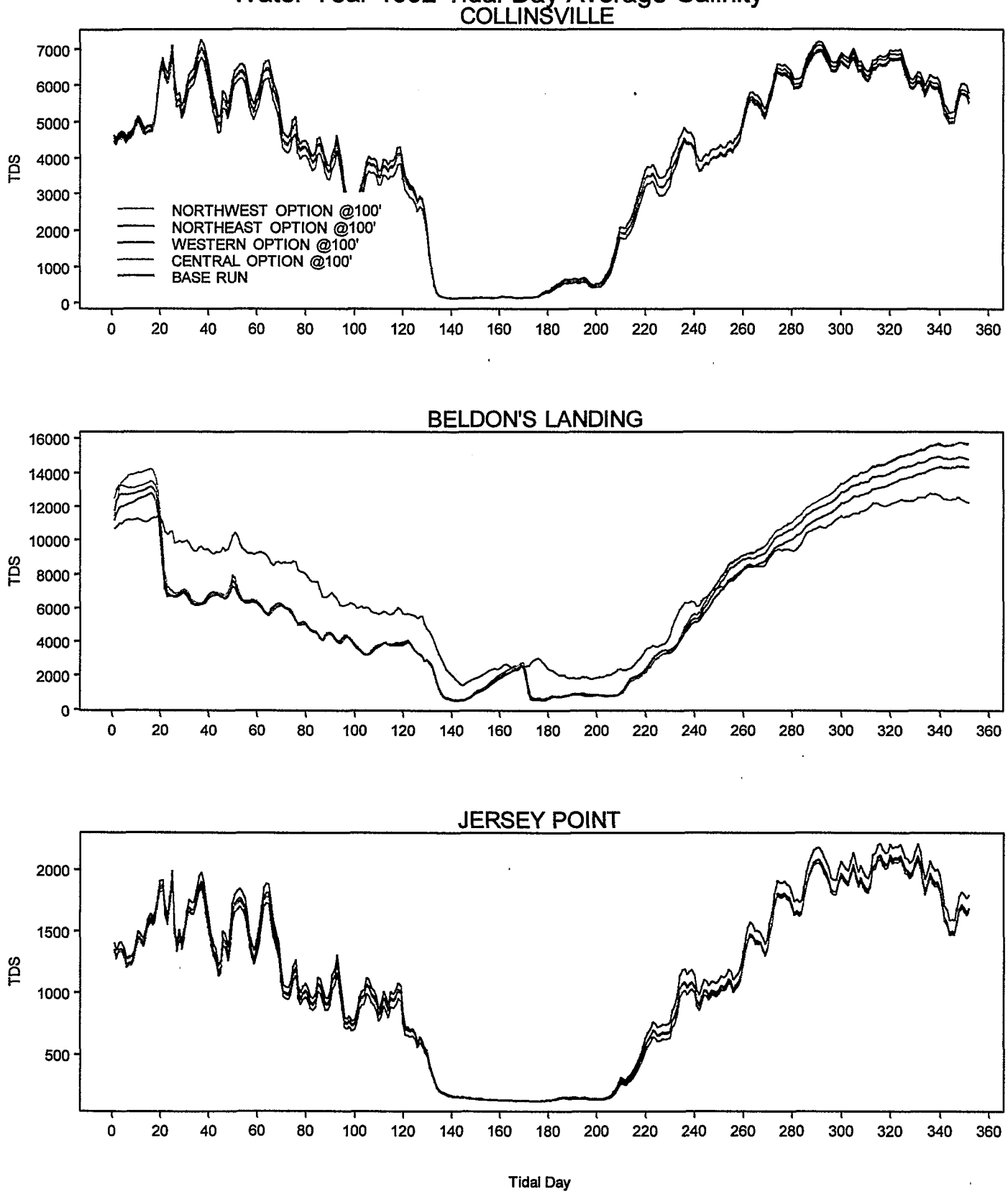
Time Series Salinity for Water Year 1992

Tidal Marsh Options

100 FT Breaches

EXAMPLE PLOT 1 (See www.iep.ca.gov/suisun for complete results)

CALFED Suisun Marsh Levee Breach Investigation 100 FT Wide Breaches; Water Year 1992 Tidal Day Average Salinity



DWRDSM1 Suisun Marsh Version.
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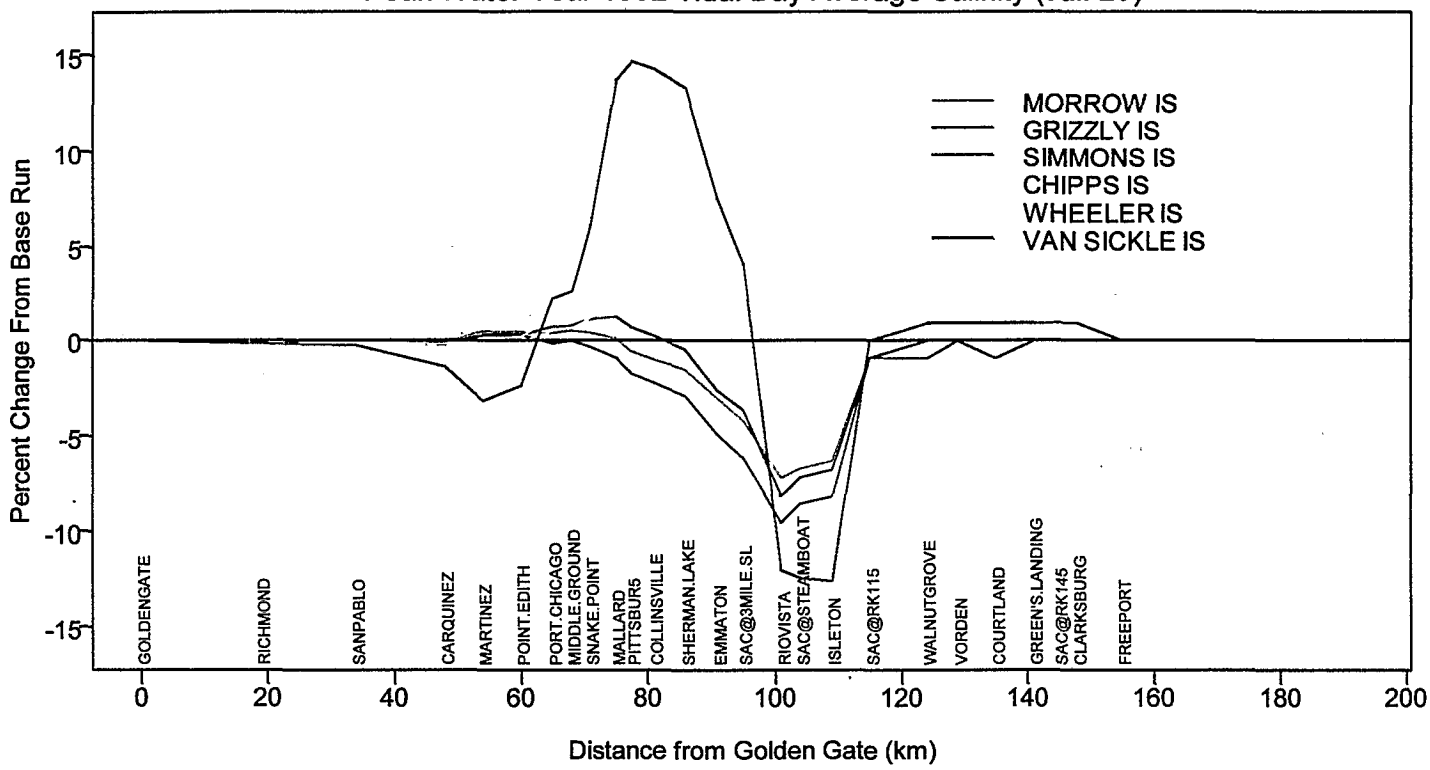
Example Plots 2A, 2B

- System Axis Salinity Plots
- Shallow Water Habitat Options
- 100 FT Breaches

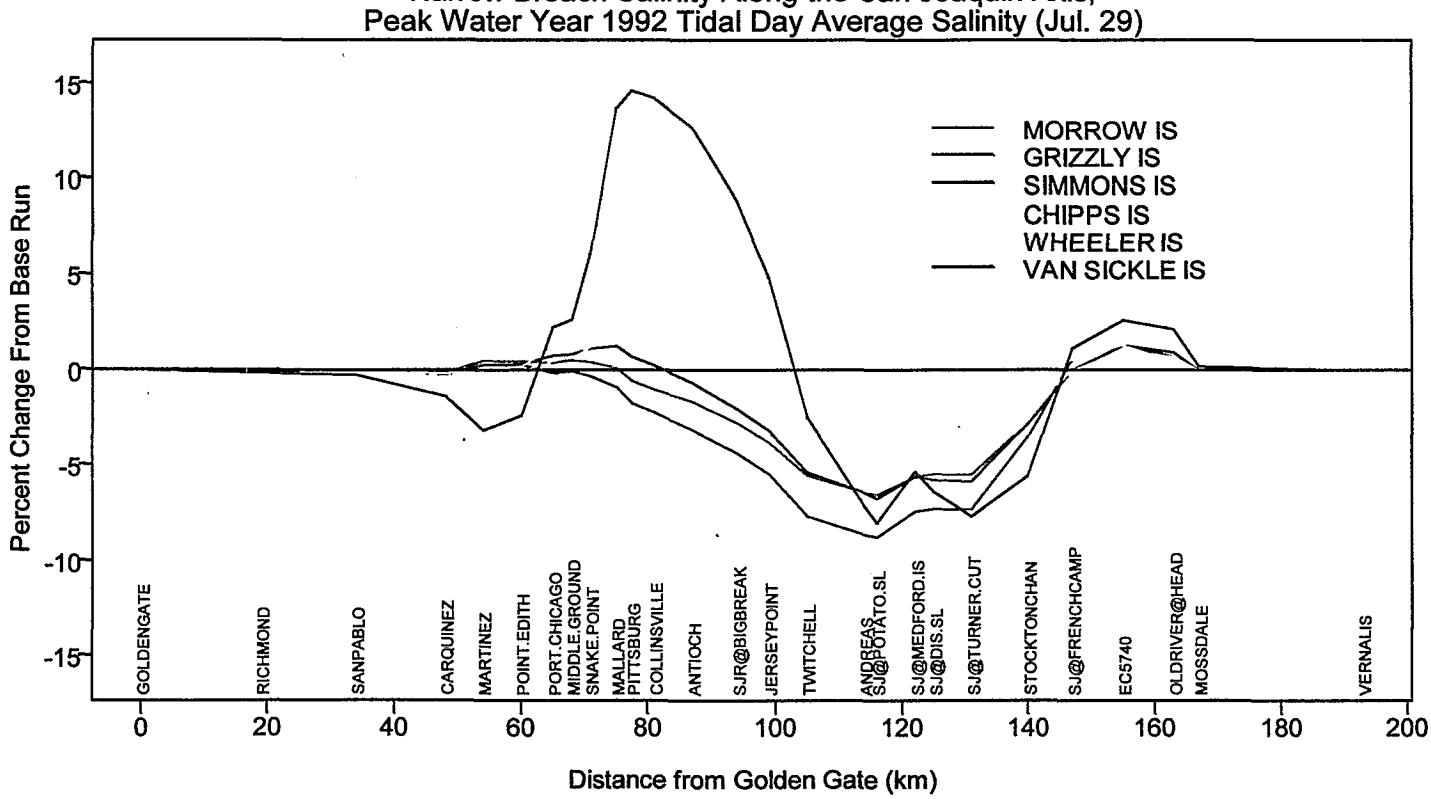
Example Plot 2A (See www.iep.ca.gov/suisun for complete results)

CALFED Suisun Marsh Levee Breach Investigation

Narrow Breach Salinity Along the Sacramento Axis:
Peak Water Year 1992 Tidal Day Average Salinity (Jul. 29)



Narrow Breach Salinity Along the San Joaquin Axis;
Peak Water Year 1992 Tidal Day Average Salinity (Jul. 29)



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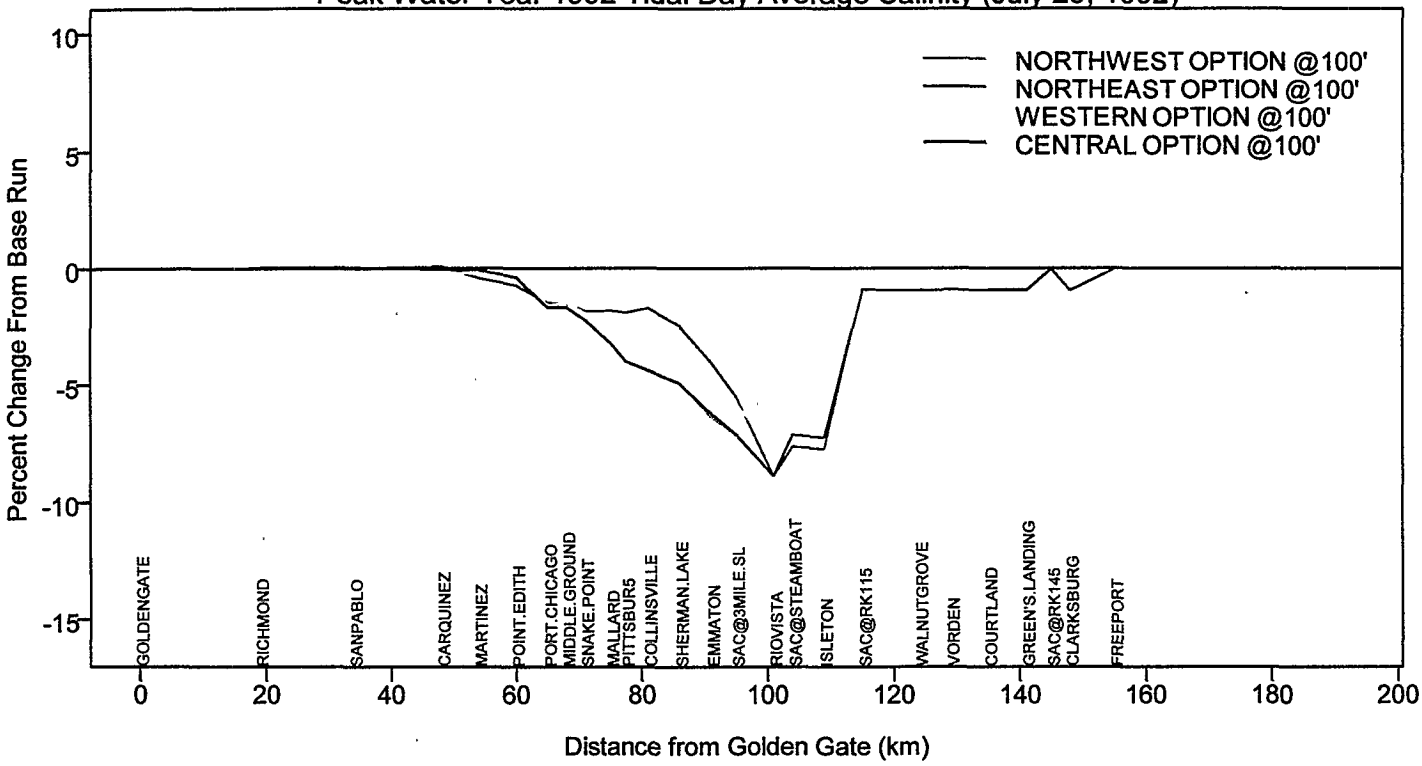
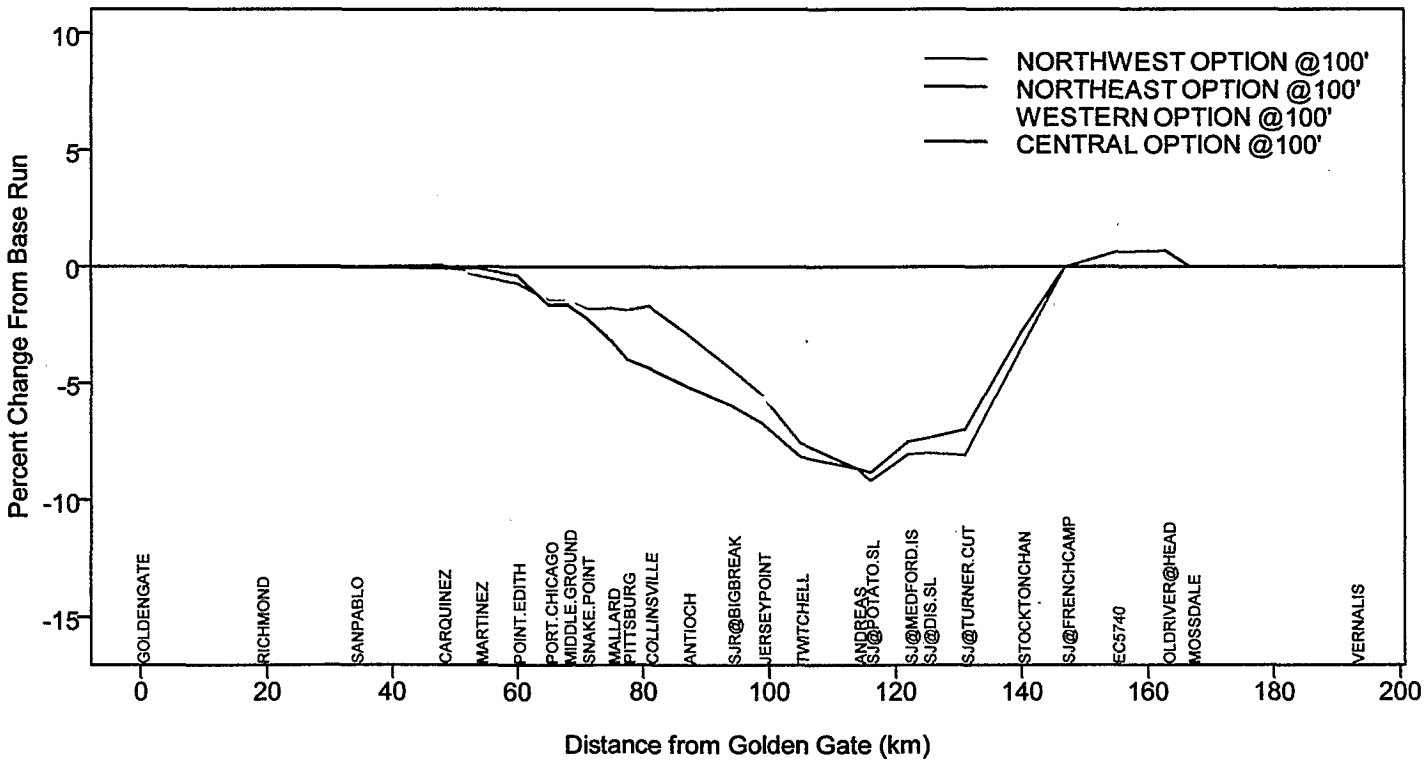
Example Plot 2B (See www.iep.ca.gov/suisun for complete results)

CALFED Suisun Marsh Levee Breach Investigation

NARROW Breach Salinity, Golden Gate -> Vernalis along SACRAMENTO RIVER Axis:
Peak Water Year 1992 Tidal Day Average Salinity (July 29, 1992)



NARROW Breach Salinity, Golden Gate -> Vernalis along SAN JOAQUIN RIVER Axis;
Peak Water Year 1992 Tidal Day Average Salinity (July 29, 1992)



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Example Plots 3A, 3B

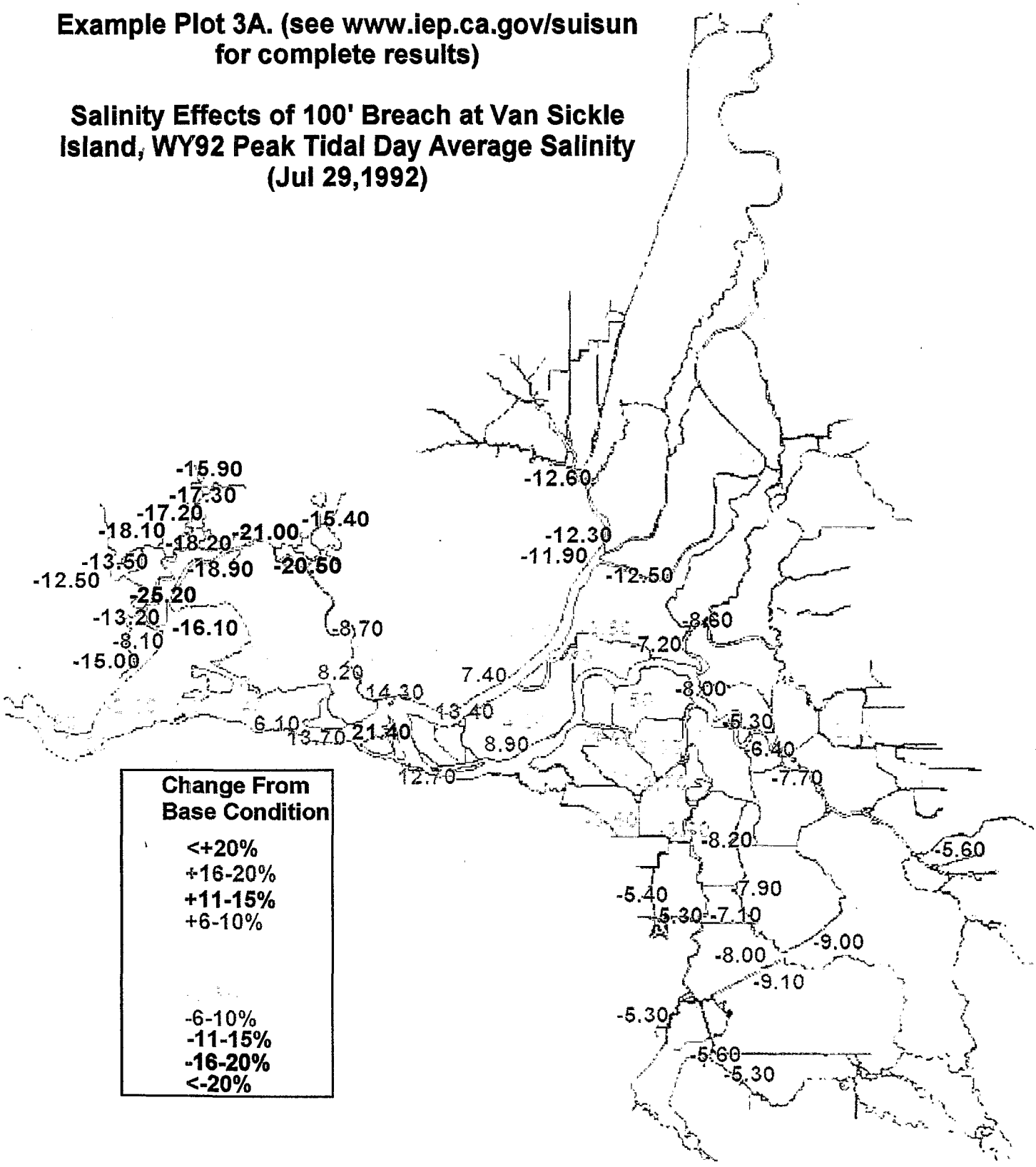
System-Wide Salinity Plots (July 29, 1999)

Van Sickle Is. Shallow Water Habitat Option

100 FT Breaches

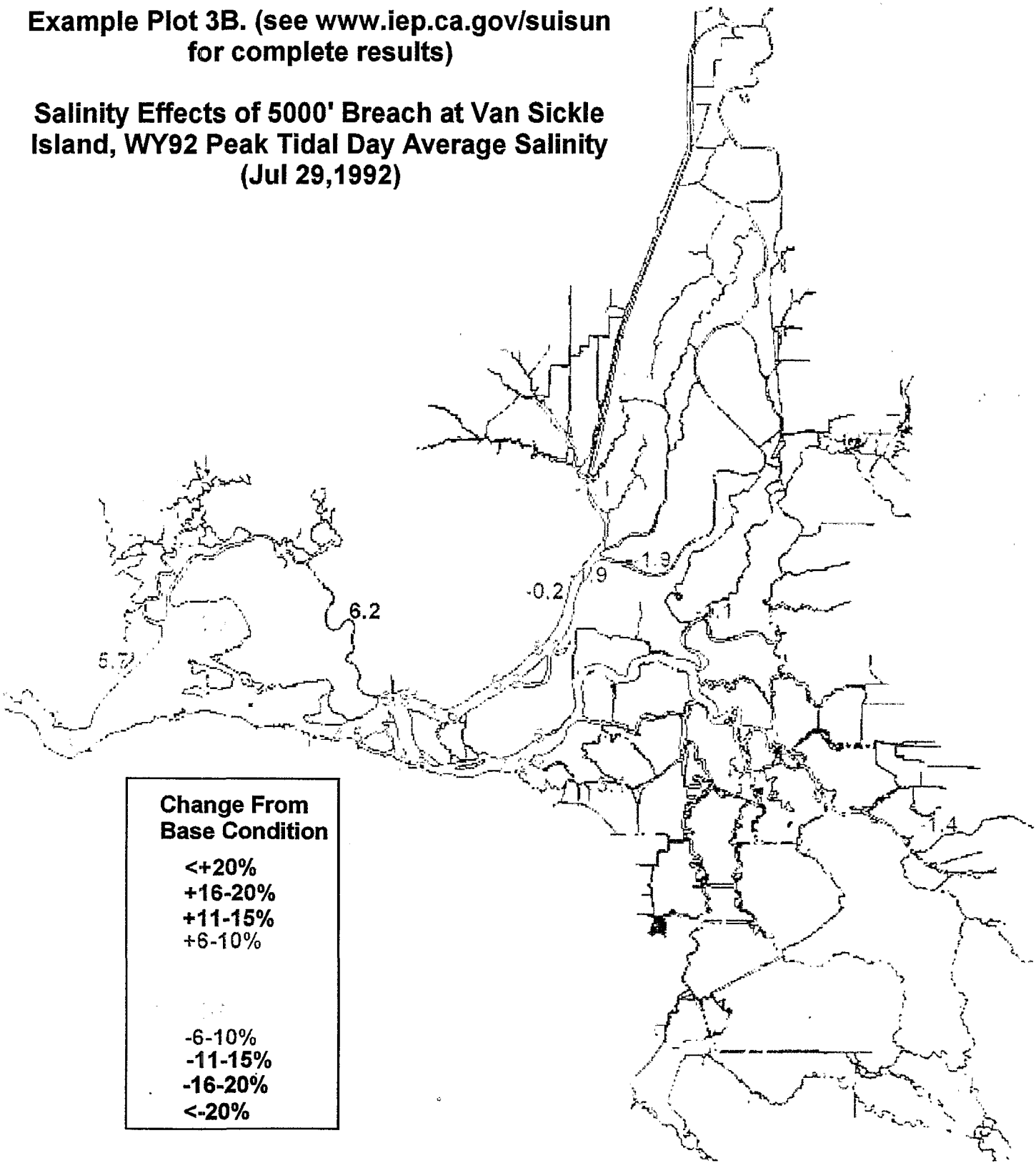
Example Plot 3A. (see www.iep.ca.gov/suisun for complete results)

Salinity Effects of 100' Breach at Van Sickle Island, WY92 Peak Tidal Day Average Salinity (Jul 29,1992)



Example Plot 3B. (see www.iep.ca.gov/suisun for complete results)

Salinity Effects of 5000' Breach at Van Sickle Island, WY92 Peak Tidal Day Average Salinity (Jul 29,1992)



Example Plot 4

28-Day Average Tidal Amplitude (July 1999)

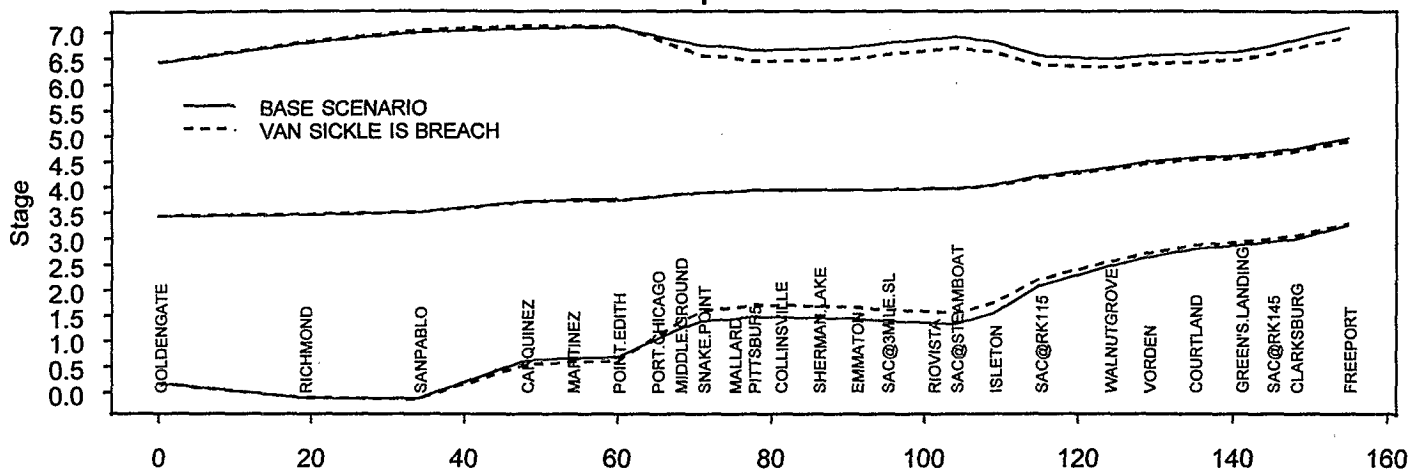
Van Sickle Is. Shallow Water Habitat Option

100 FT Breaches

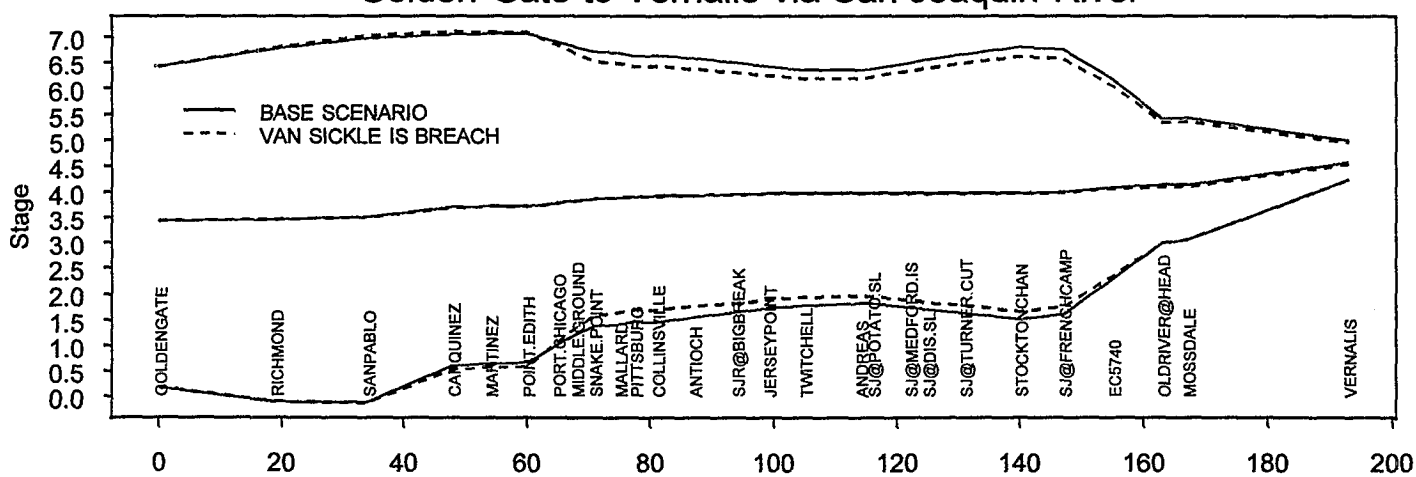
Example Plot 4 (See www.iep.ca.gov/suisun for complete results)

CALFED Suisun Marsh Levee Breach Investigation
28 Day Average Tidal Amplitude (July, 1992); 100' VAN SICKLE IS Breach

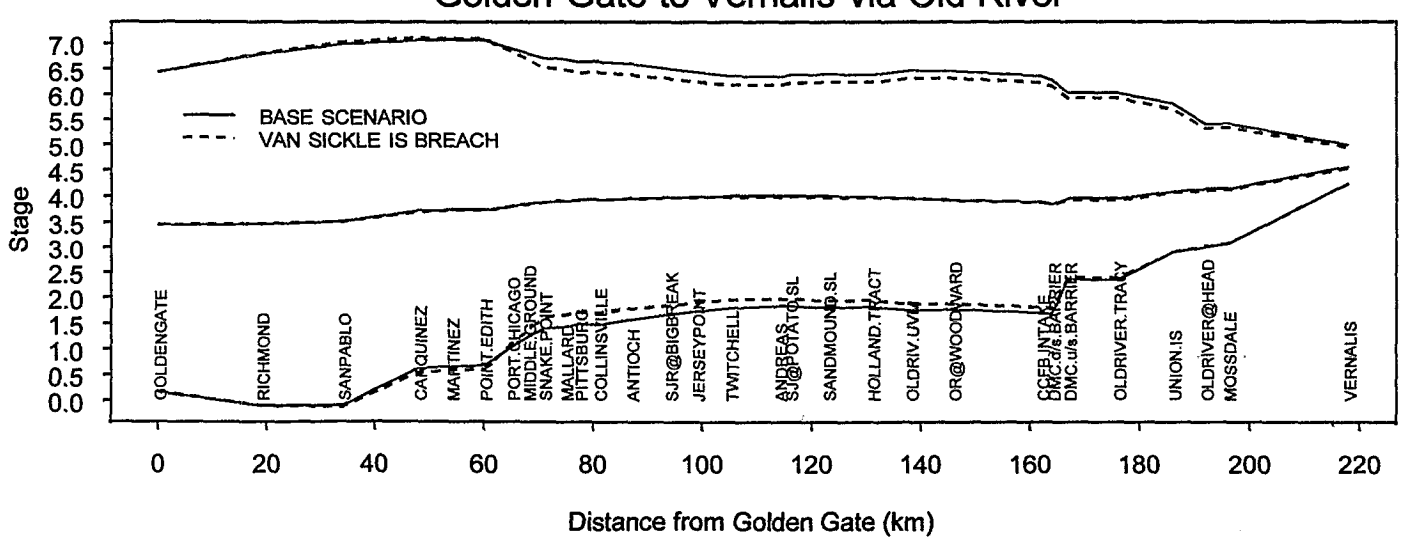
Golden Gate to Freeport via Sacramento River



Golden Gate to Vernalis via San Joaquin River



Golden Gate to Vernalis via Old River



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