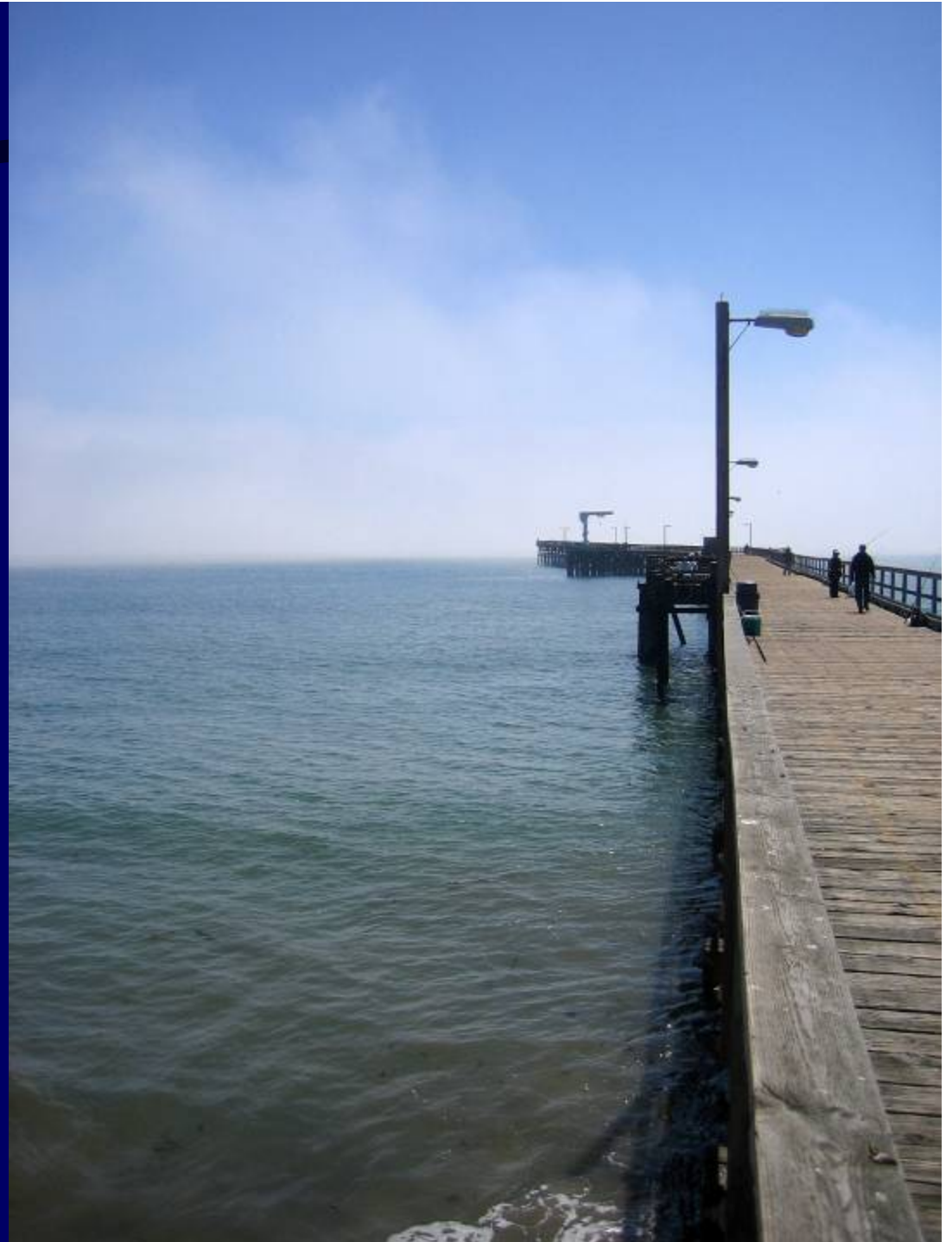


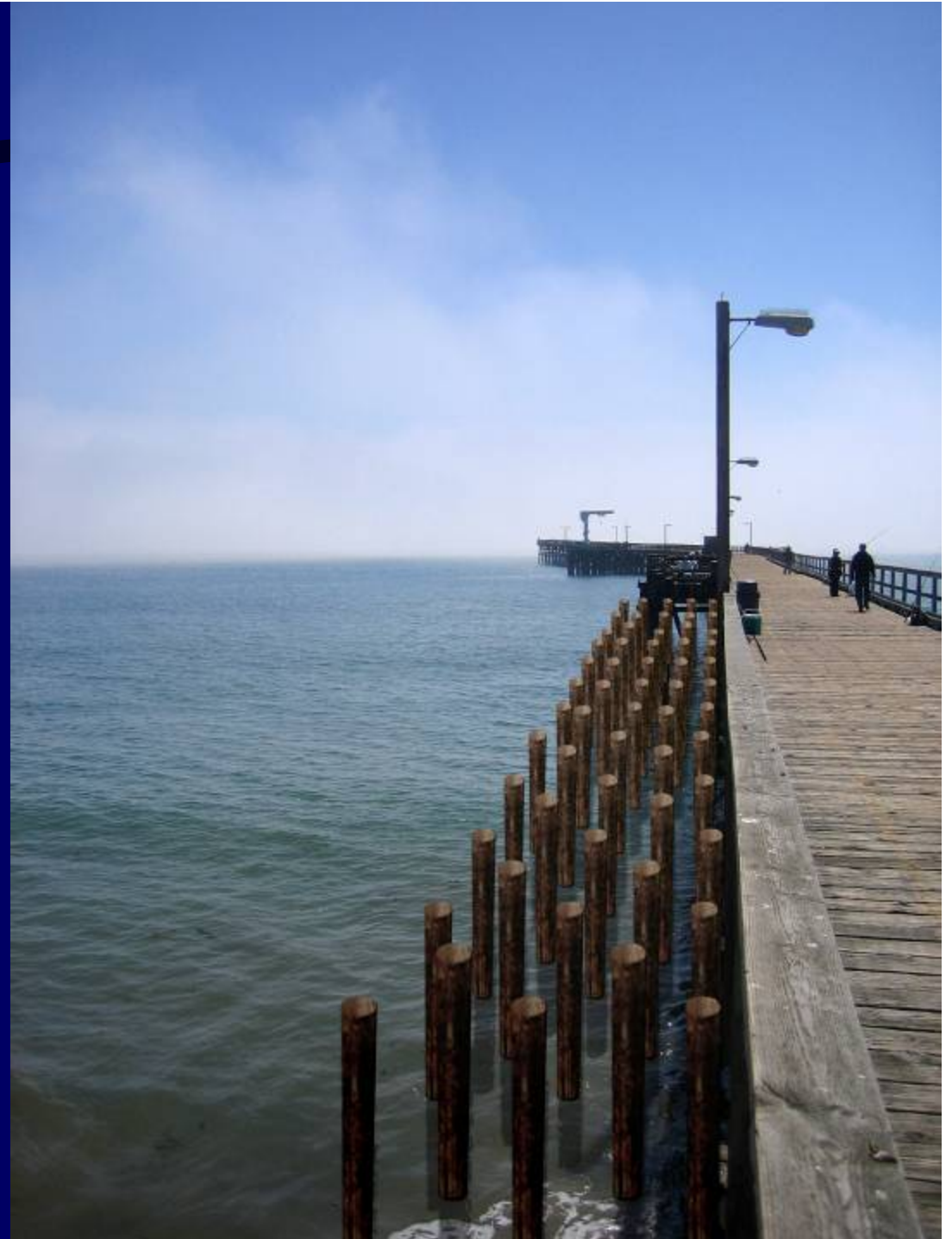
# Beach Stabilization/Permeable Pier

- Maintains wider beach upcoast
- Does not cause downcoast retreat
  - Requires 500,000 cy of sand pre-fill as preventive
- Provides continued access over and around it
- Removable and able to be “tuned” for optimization
- Slough mouth will be unaffected
- Mid-park revetment to be removed immediately, and the west end revetment soon after (in the first 2 to 5 years)

# The Existing Pier

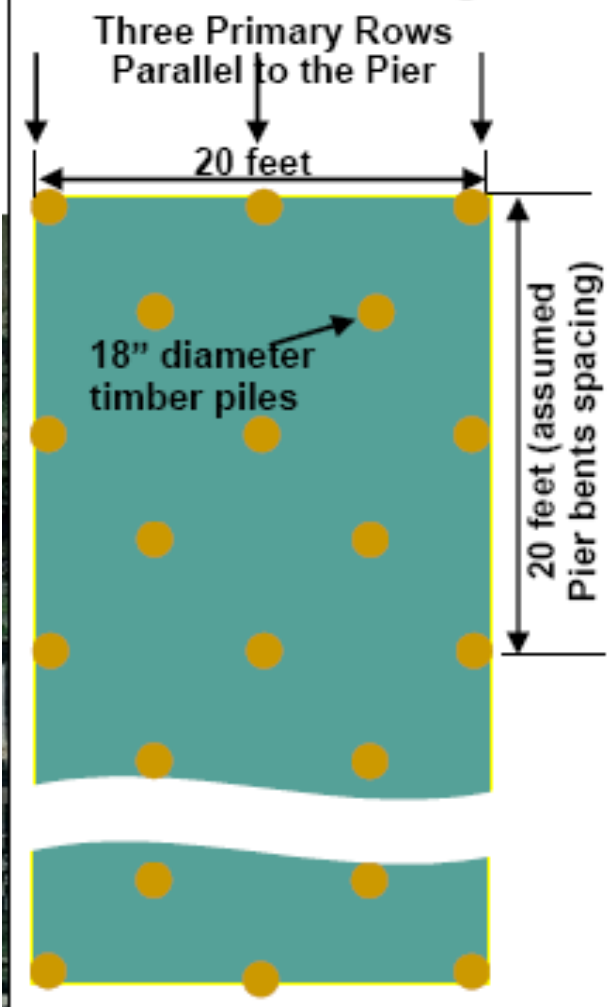


# The Permeable Pier

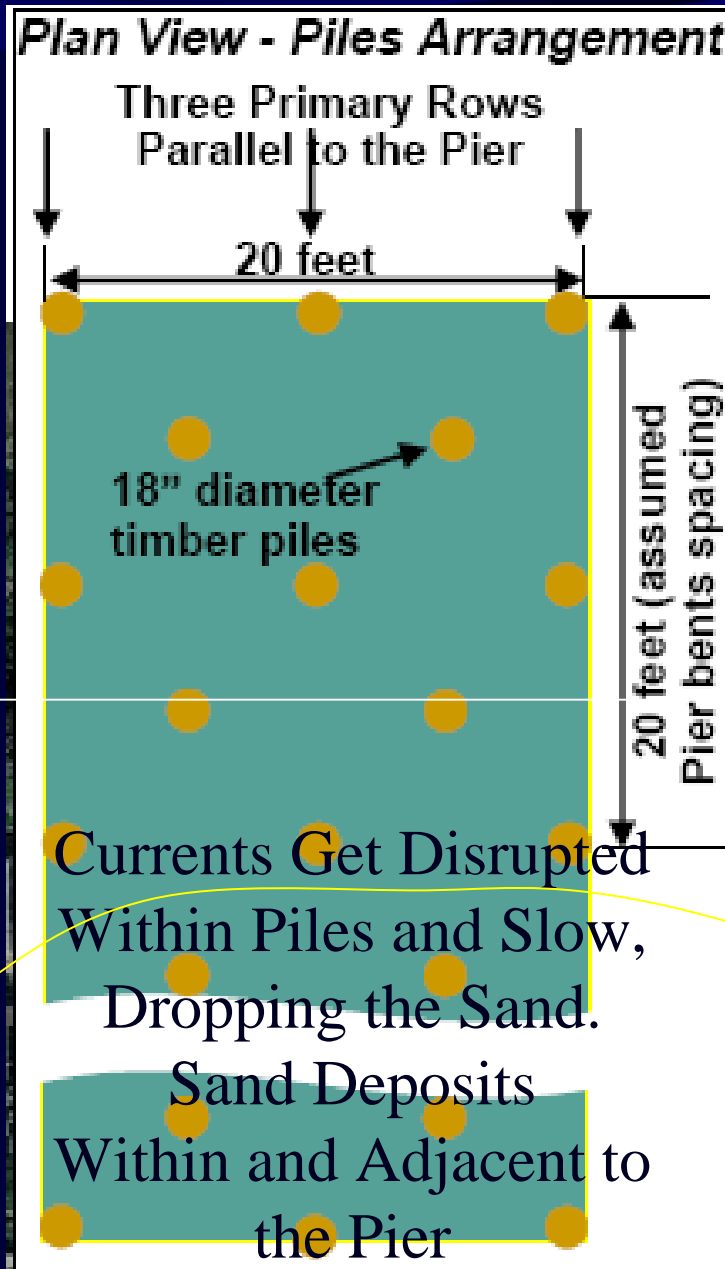


# Beach Stabilization/Permeable Pier

**Plan View - Piles Arrangement**



# Function



Currents Move Sand Toward Piles

Sand Gets Partially Blocked From Moving Past Deposit; Some Remains Upcoast and The Rest Continues Downcoast

# Santa Monica Breakwater Salient



# Santa Monica Bay



# Coastline Impacts

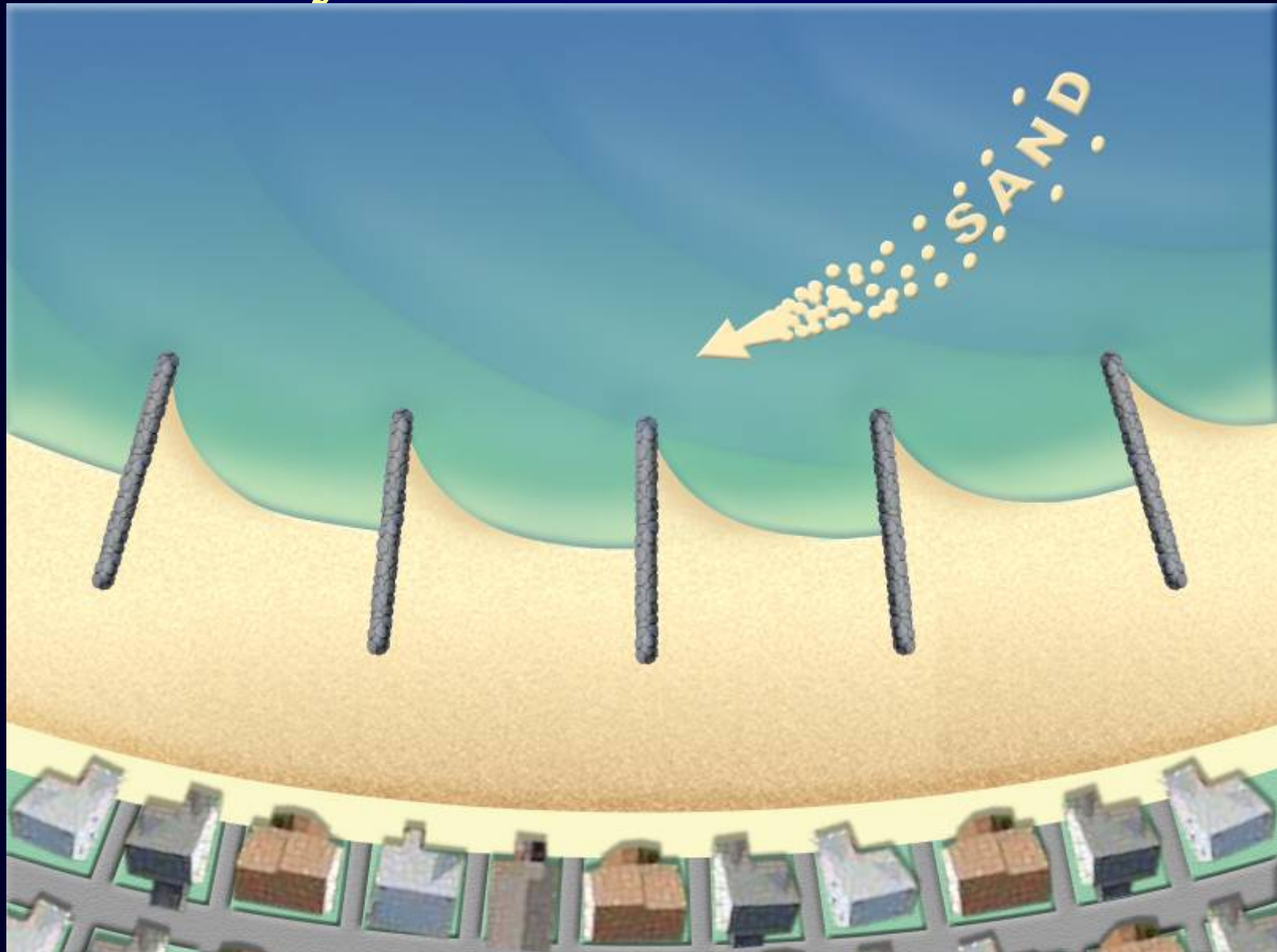
1. Sand builds in the salient and fillet until an equilibrium form is achieved relative to the shoreline orientation and waves.
2. Once achieved, sand resumes full bypassing downcoast for no net long-term effect.
3. Short-term impacts can be eliminated by “pre-filling” the salient and fillet.



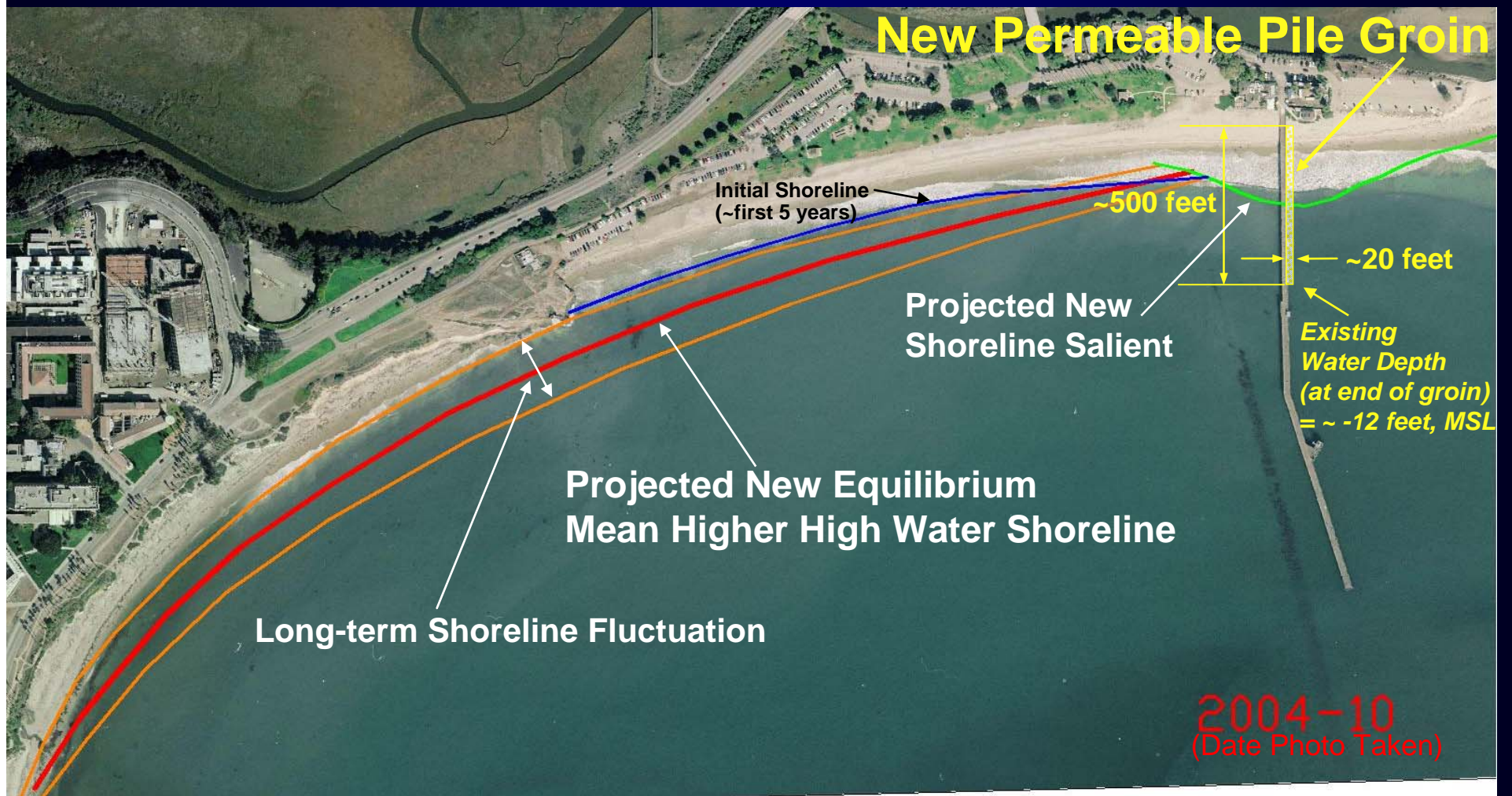
# No Downcoast Erosion

- Short-term impacts can be eliminated.
- Long-term impacts will not occur because full sand by-passing will continue.
- No downcoast erosional embayment will form adjacent to the pier because it will not function like a typical groin; groins deflect sand offshore and then it has to return over some distance, while salients do not deflect sand offshore allowing sand to remain close to shore.
- Shoreline monitoring of the effects can lead to “tuning” or adjustment of the piles & arrangement to optimize the pier’s performance.

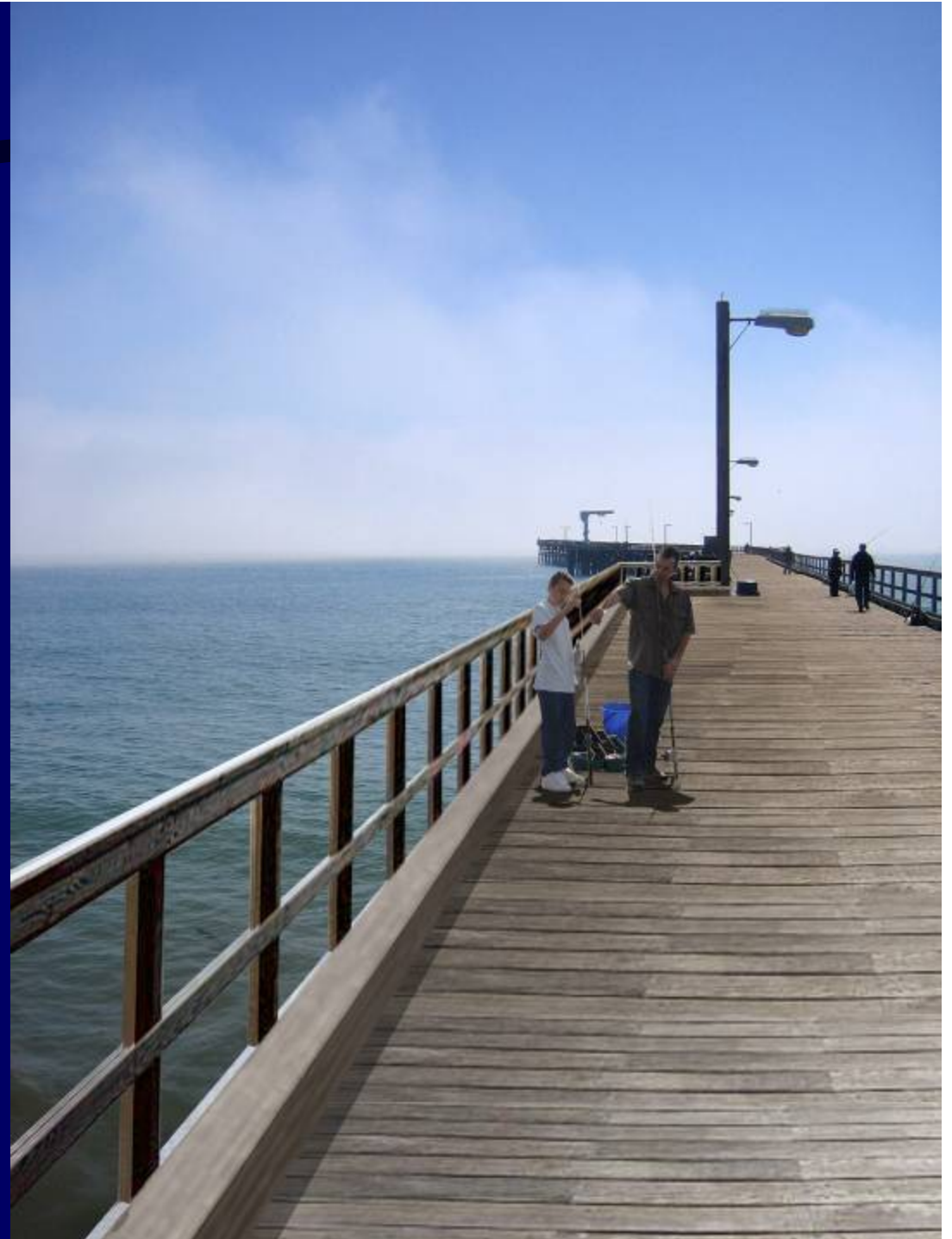
# Downcoast Impacts from Groins – Embayments Form Downcoast



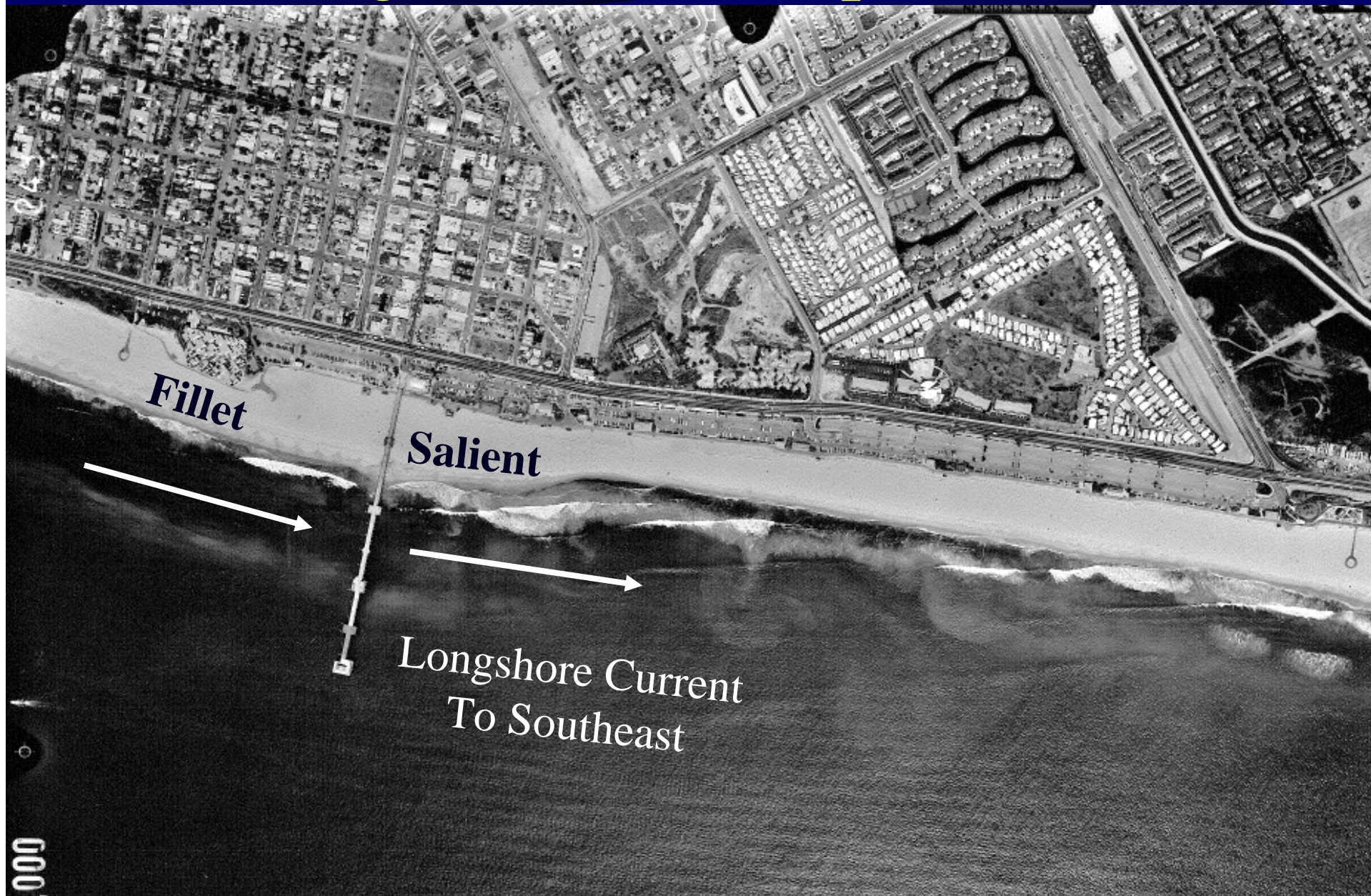
# Beach Stabilization/Permeable Pier



# The Ultimate Permeable Pier/Expanded Pier Deck



# Huntington Pier Example - Winter



# HB Pier Winter Salient



# Huntington Pier Example - Summer



# HB Pier Remnant Summer Salient



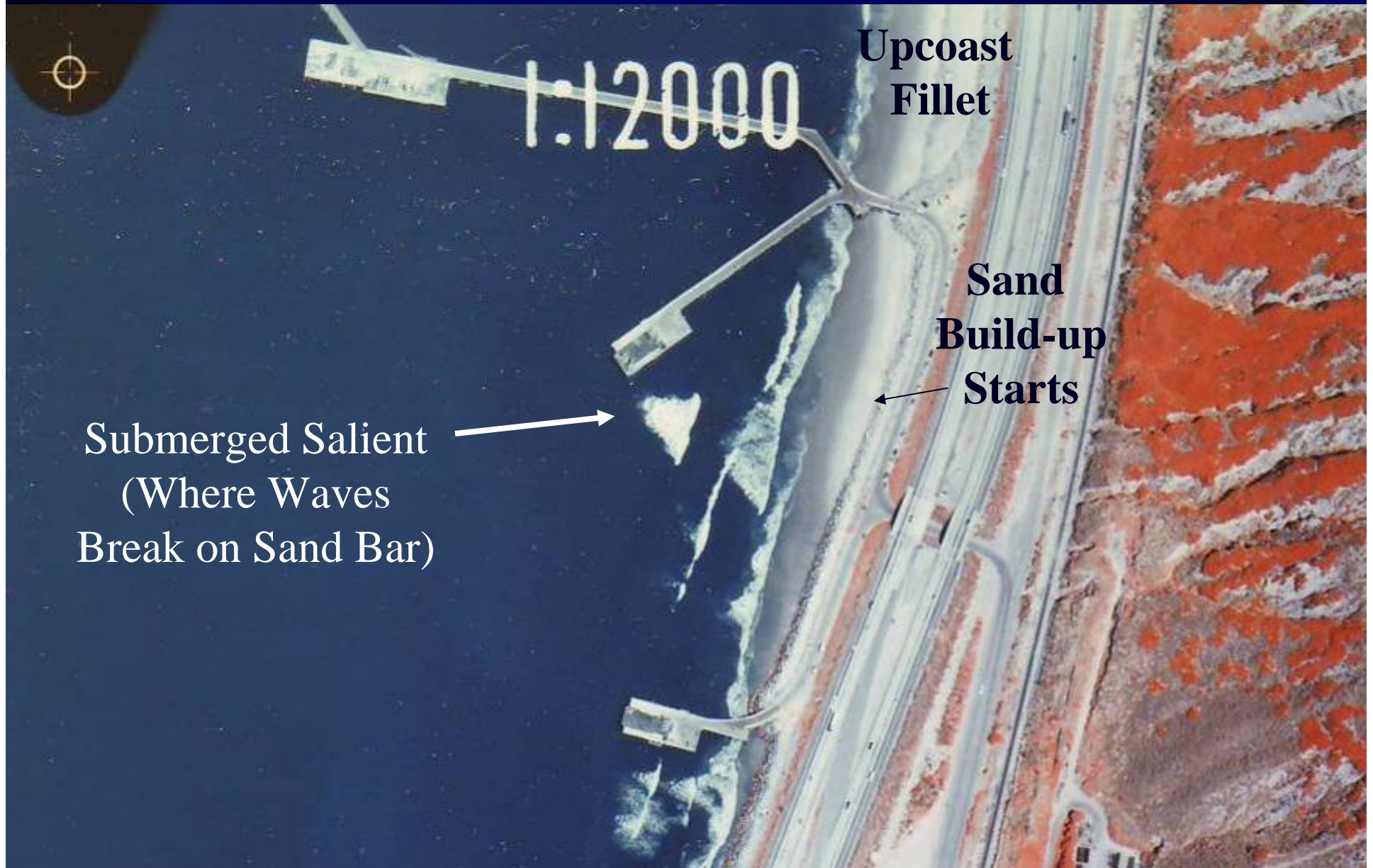




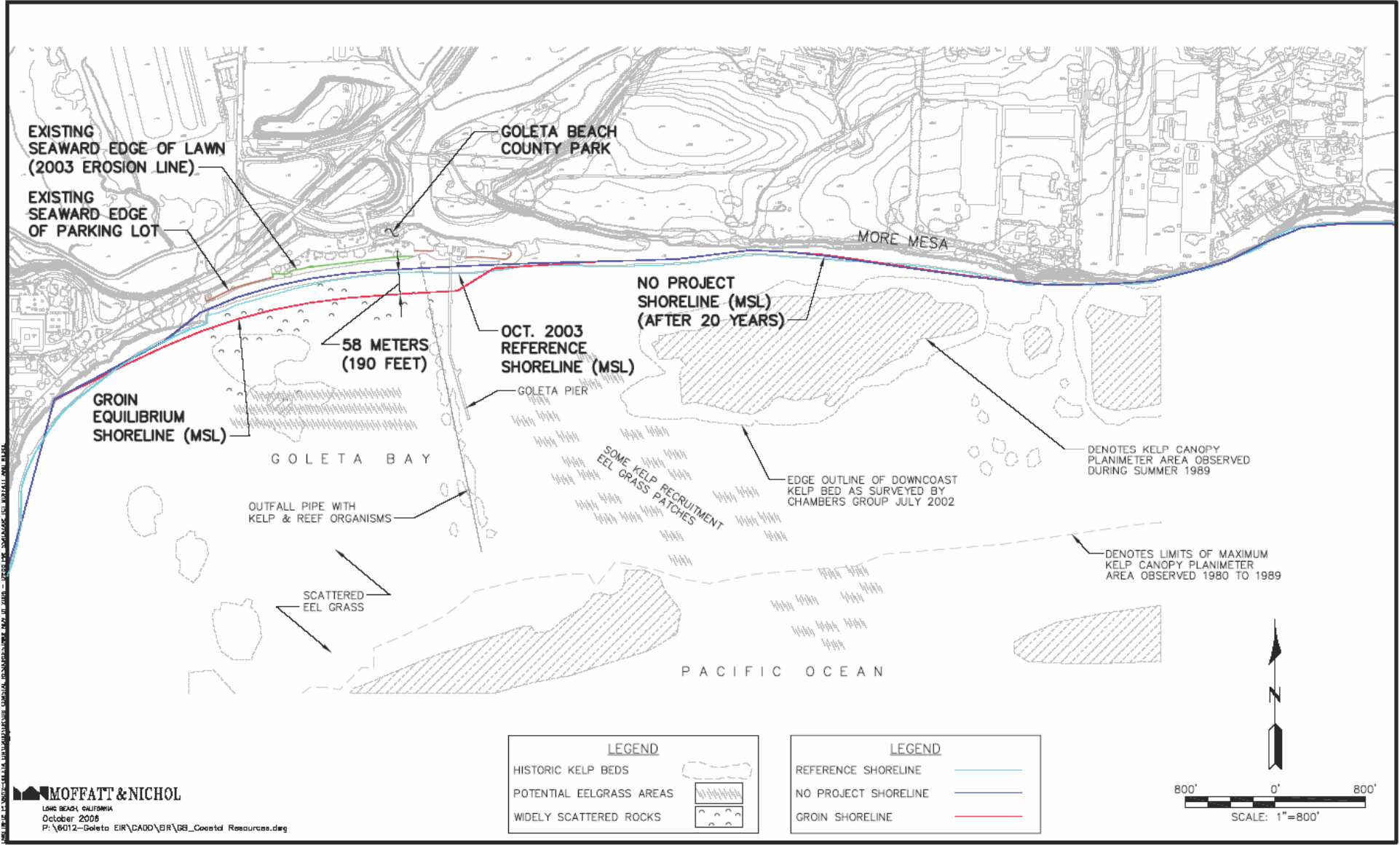




# Oil Piers Beach Example



# Shoreline Evolution for the Beach Stabilization/Permeable Groin Alternative



# Additional Considerations

- Sand deposits form and stabilize over 10 years
- Pre-fill beach nourishment of 500,000 cubic yards of sand dredged from offshore
- Piles can be added, removed, and/or reconfigured to optimize the effects
- Requires further analyses in a physical model laboratory to set design parameters
- Requires long-term monitoring

# Designers

- Everts Coastal – Dr. Craig Everts
  - Researcher and Former USACE R&D Leader
  - Leading Expert in Sand Retention Research
  - Authored State Studies, Local Studies, Independent Studies on the Subject
- Moffatt & Nichol – Coastal Engineers
  - Leading in So. Cal. Coastal Engineering
  - 60+ Years Experience With Sand Transport, Ocean Structures, Wetlands Restoration, Modeling; Broad Experience for Staff

# M&N Experience

- Sand Retention Strategy for the San Diego Region (2002);
- Treasure Island Sand Retention Structure Design for Construction (2004);
- Coney Island Sand Retention Program (1995);
- Sand Nourishment Studies and Designs
  - BEACON Region      - Newport Beach
  - San Diego Region    - San Clemente
  - Seal Beach            - Carlsbad