

Where's the beach? Adapting to Coastal Erosion in Southern Monterey Bay



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Denver, CO
April 3, 2013



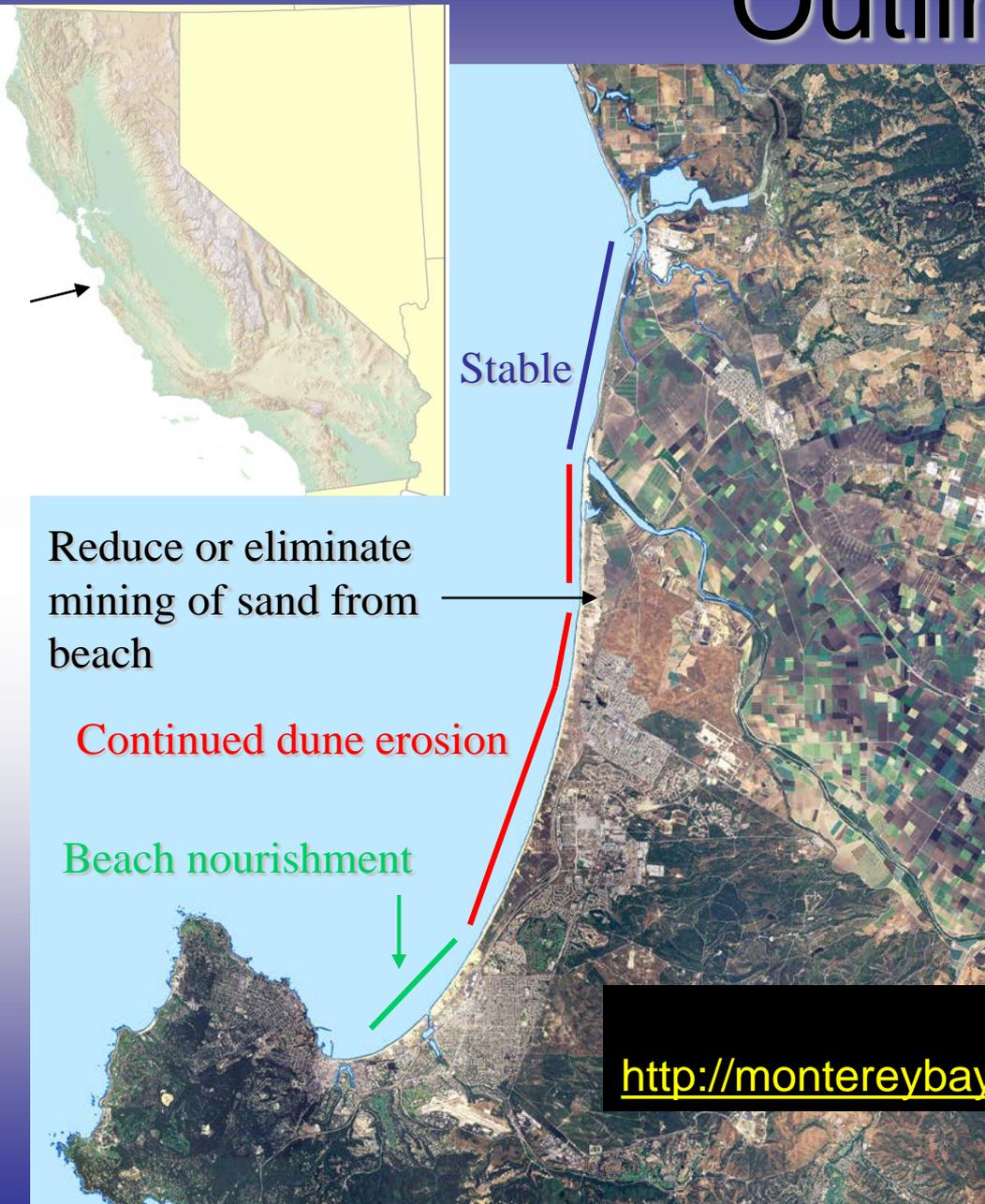
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Outline

- Erosion Issues
- Regional Sediment Mgt
- Technical Evaluation
- Cost/Benefit Analysis
- Conclusions

Final Report to Monterey Bay
National Marine Sanctuary



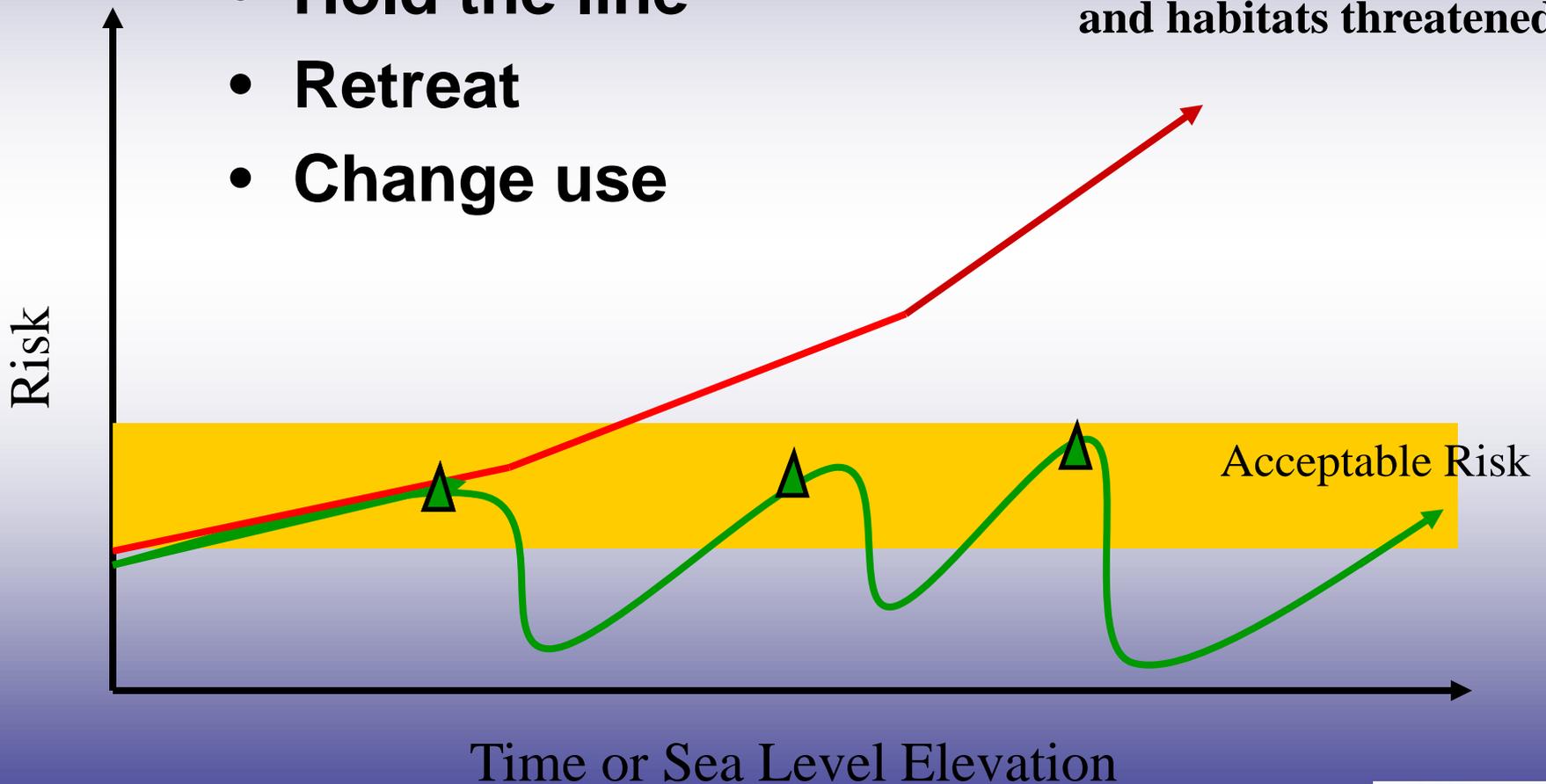
<http://montereybay.noaa.gov/new/2012/erosion.html>

Adaptation

Choices

- Hold the line
- Retreat
- Change use

More people, property
and habitats threatened



Erosion Mitigation Options

1. Fee Simple Acquisition:
2. Conservation Easements:
3. Present Use Tax:
4. Transfer of Development Credit
5. Rolling Easements
6. Removal/Relocation
7. Managed Retreat
7. Structural or Habitat Adaption
8. Bluff top Development (setback)
9. Beach Level Development (setback)
10. Controlling Surface Run-off
11. Controlling Groundwater
12. Reservoir and
13. Sand Mining
14. Harbor By-Passing
15. Back-Passing
16. Subaerial Placement
17. Artificial Seaweed
18. Native Plants
19. Geotextile Core
20. Nearshore Placement
21. Dredge Sand from Deep or Offshore Deposits
22. Added Courser Sand than Native
23. Opportunistic Sand
24. SCOUP Efforts
25. Canyon Interception
26. Rip-Current Interruption
27. Inter-littoral Cell Transfers
28. Berms/Beach Scraping
29. Perched Beaches
30. Groins
31. Breakwaters
32. Dune Nourishment
33. Delta Enhancement
34. Headland Enhancement
35. Geotextile Groins
36. Branch Box Breakwaters
37. Floating Breakwaters
38. Coir Logs
39. Submerged Breakwaters
40. Restoration
41. Beach Dewatering
42. Pressure Equalizing Modules
43. Seawalls
44. Revetments
45. Cave Fills
46. Gabions
47. Mixed Structures
48. Cobble Nourishment
49. Dynamic Revetments
50. Geotextile Revetment
51. Floating Reefs
52. Rubber Dams
53. Visually Treated Walls or Revetments
54. Cessation of Sand Mining
55. Sand Fencing/Dune Guard Fencing

Categories of Alternatives

- Land Use Planning
- Non-structural
- Structural

- Time Horizons –
 - Immediate 0-5 years
 - Short 5-25 years
 - Medium 25-50 years
 - Long 50-100+

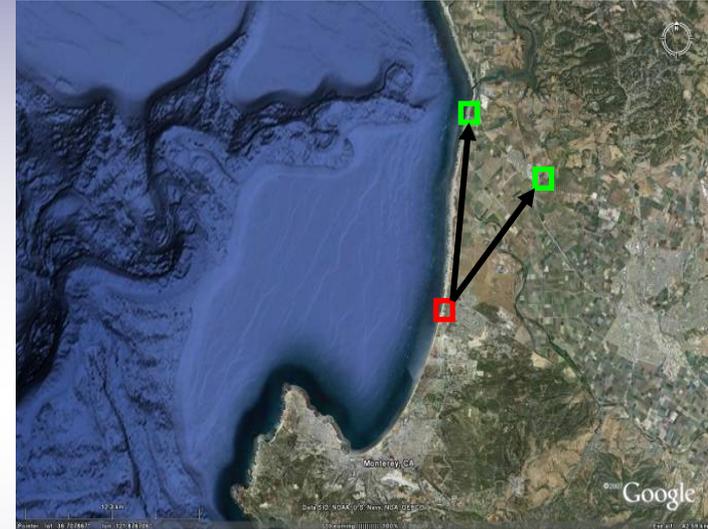


Evaluation Criteria

- **Effectiveness** – reduce threat to structures
- **Effectiveness** – maintain beach width
- **Environmental** – impacts +/- to ecosystem
- **Recreation** – impacts +/- to rec. opps.
- **Safety/Access** – impacts +/- lateral access
- **Aesthetics** – judgment*
- **Cumulative** –if all oceanfront parcels treated
- **Resiliency** – adaptability to future conditions
- **Certainty of success** –scientific certainty

Land Use Planning Tools

- Rolling easements
- Managed Retreat
- Transfer of development credit
- Conservation Easements
- Present use tax
- Fee Simple Acquisition
- Structural or Habitat Adaptation
- Setbacks for Bluff top Development
- Setbacks + Elevation for Beach Level Development



Generally issues are: high upfront costs, long implementation timelines, limited application, or put off the problem until a later date

Regulatory Risk Analysis

| | | HYPOTHETICAL PROPERTY TYPE | | |
|---------------|--|--|--|--|
| | | Undeveloped property with proposed development | Developed property with "no future armoring" permit condition in place | Residential development predominate the Coastal Zone |
| LAND USE TOOL | Transfer of development rights (TDR) credits | No Development Allowed; Partial Diminution in Property Value—1 | N/A, although TDRs can be used in combination with easements and setbacks to reduce regulatory risk. | Exactions or Dedication—4 |
| | Lateral conservation easement condition to CDP | Exactions or Dedication—3 | Exactions or Dedication—5 | Exactions or Dedication—6 |
| | Transfer of development rights (TDR) credits | Partial Diminution in Property Value—7 | Partial Diminution in Property Value—8 | Partial Diminution in Property Value—9 |
| | Lateral conservation easement condition to CDP | Exactions or Dedication—10 | Exactions or Dedication—11 | Exactions or Dedication—12 |
| | Setback regulation | Denial of All Economically Beneficial Use; Partial Diminution in Property Value—13 | Denial of All Economically Beneficial Use; Partial Diminution in Property Value—14 | Denial of All Economically Beneficial Use; Partial Diminution in Property Value—15 |
| | Setback regulation | Denial of All Economically Beneficial Use; Partial Diminution in Property Value—13 | Denial of All Economically Beneficial Use; Partial Diminution in Property Value—14 | Denial of All Economically Beneficial Use; Partial Diminution in Property Value—15 |

NOT TO BE USED IN LIEU OF LEGAL COUNSEL

Non Structural

- Sand Mining cessation
- Opportunistic Nourishment
- Beach Dewatering
 - Active Pumping
 - Passive – PEMs
 - Desalination wells
- Beach Nourishment



General approach is: increase natural sand supply, accelerate natural accretion processes, or augment sand volumes

Structural Tools

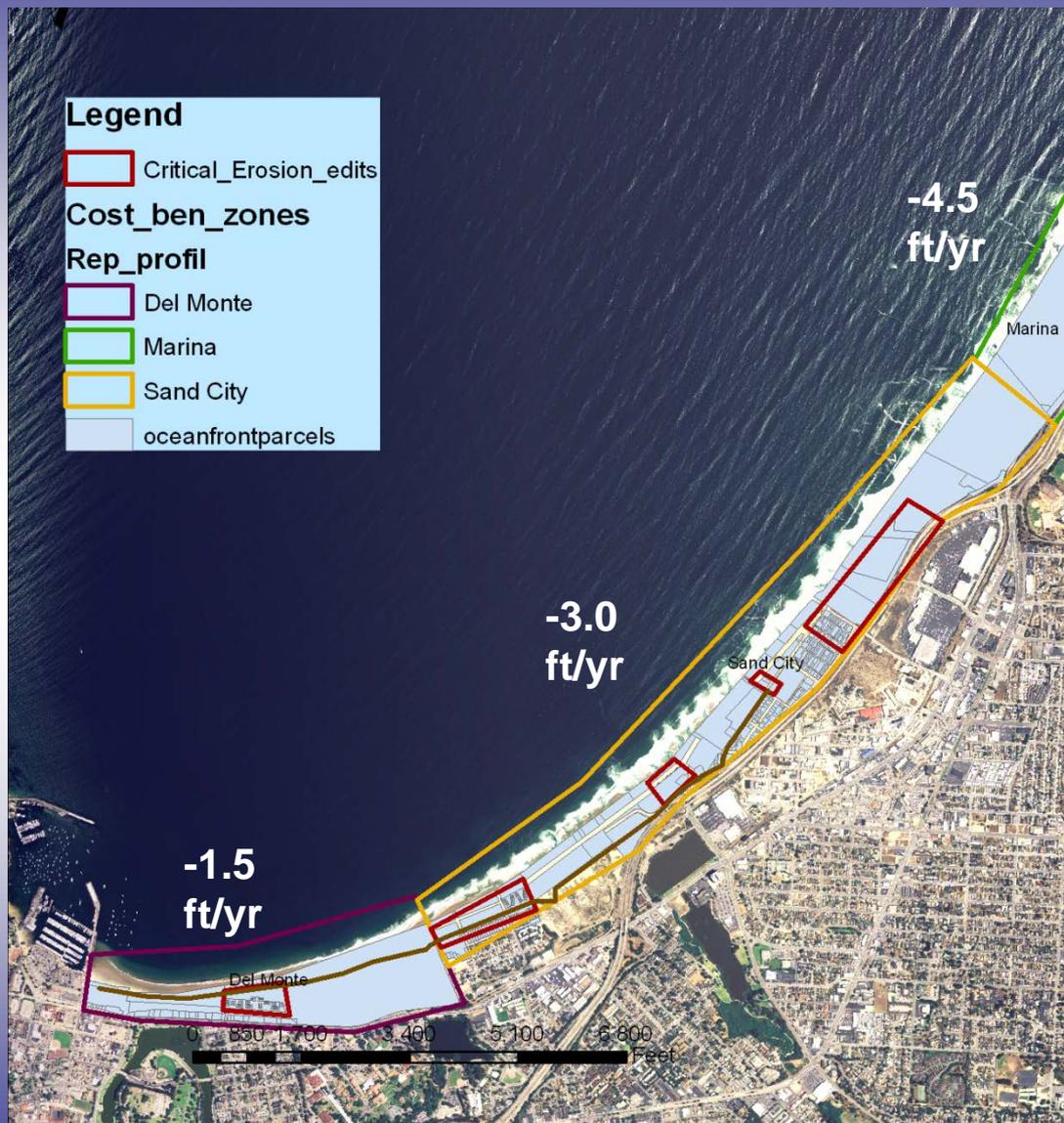
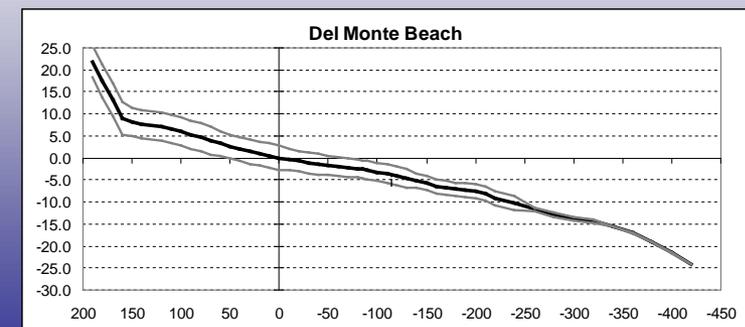
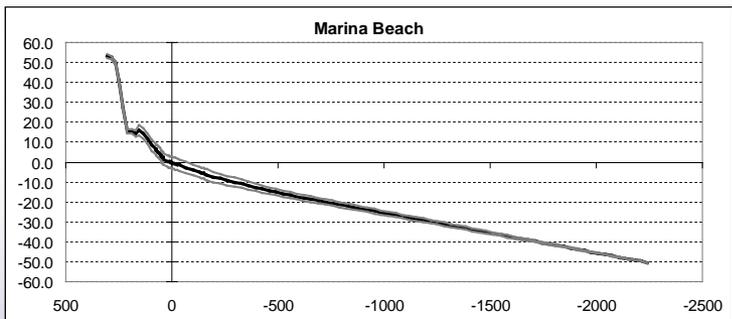
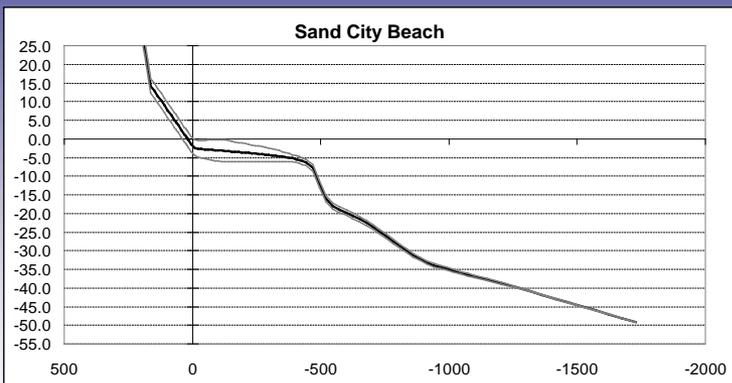
- Revetments
- Seawalls
- Perched Beaches
- Groins
- Breakwaters
- Artificial Reefs/
Submergent
Breakwaters/ Low
Crested Structures



Photo courtesy G. Griggs

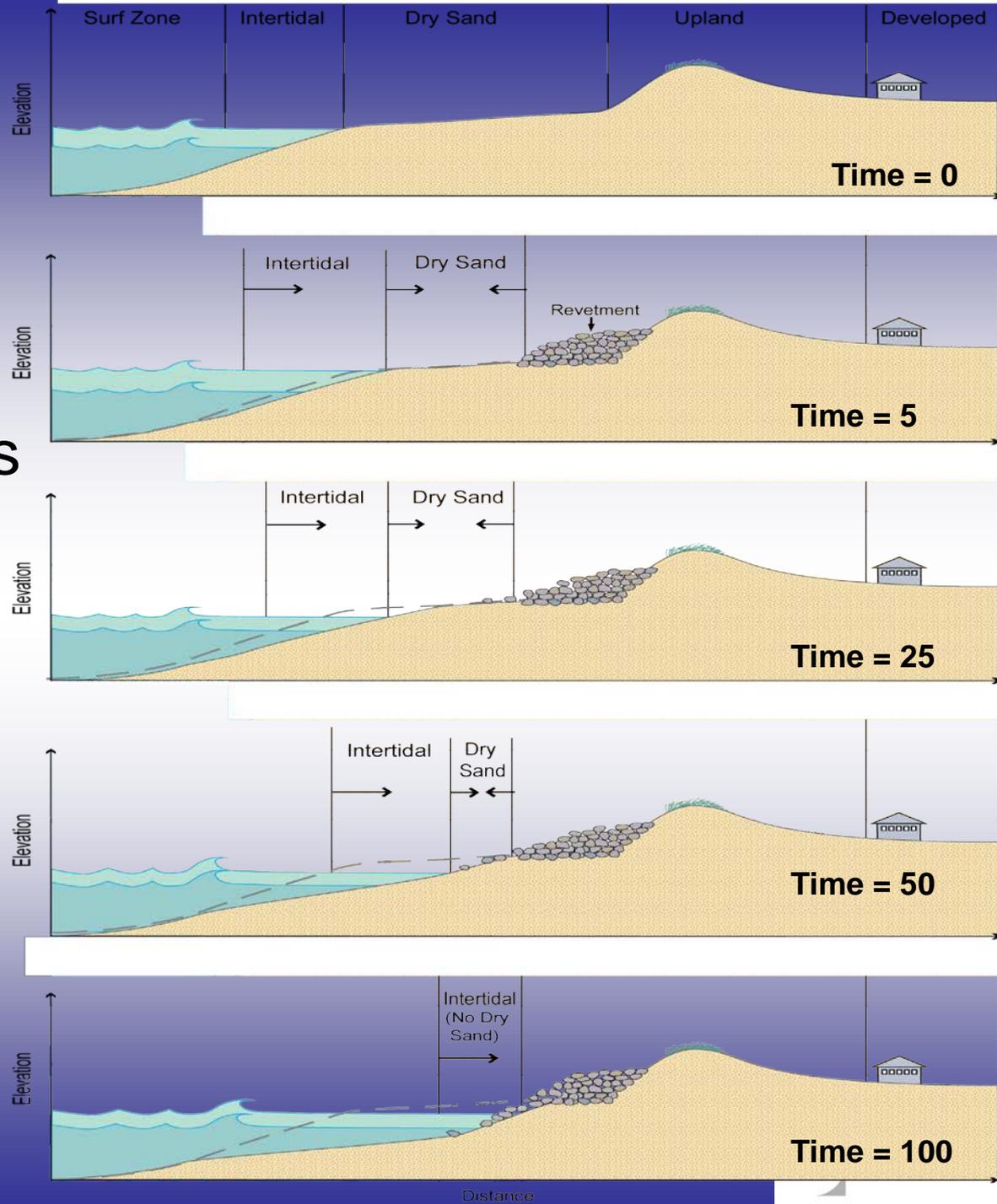
\$3.6 million sand mitigation fee for lost recreational beach over the life of the seawall

Representative Profiles location



Cost Benefit Accounting

- Account for storm impacts, taxes, recreation, ecosystem services
- Multiple recreational and habitat zones
- Multiple time horizons
- Generally tie data inputs to CRSMP



Cost Benefit Methodology

- Construction/Nourishment Costs Estimated
- Assessors Parcel data modified to Fair Market Value
- Structures/Infrastructure values based on damages and replacement cost
- Benefits:
 - Recreational Benefits (CSBAT)
 - Ecological Benefits (NJ)
 - Economic Impacts
 - Tax Revenue Impacts



Photo D. Hubbard



Managed Retreat – Ford Ord

- *getting out of the way gracefully*
- Various mechanisms
- Abandonment
- Phasing, relocate critical infrastructure, remove expendable structures as needed,
- realign transportation corridors, adaptively manage
- purchase



2002

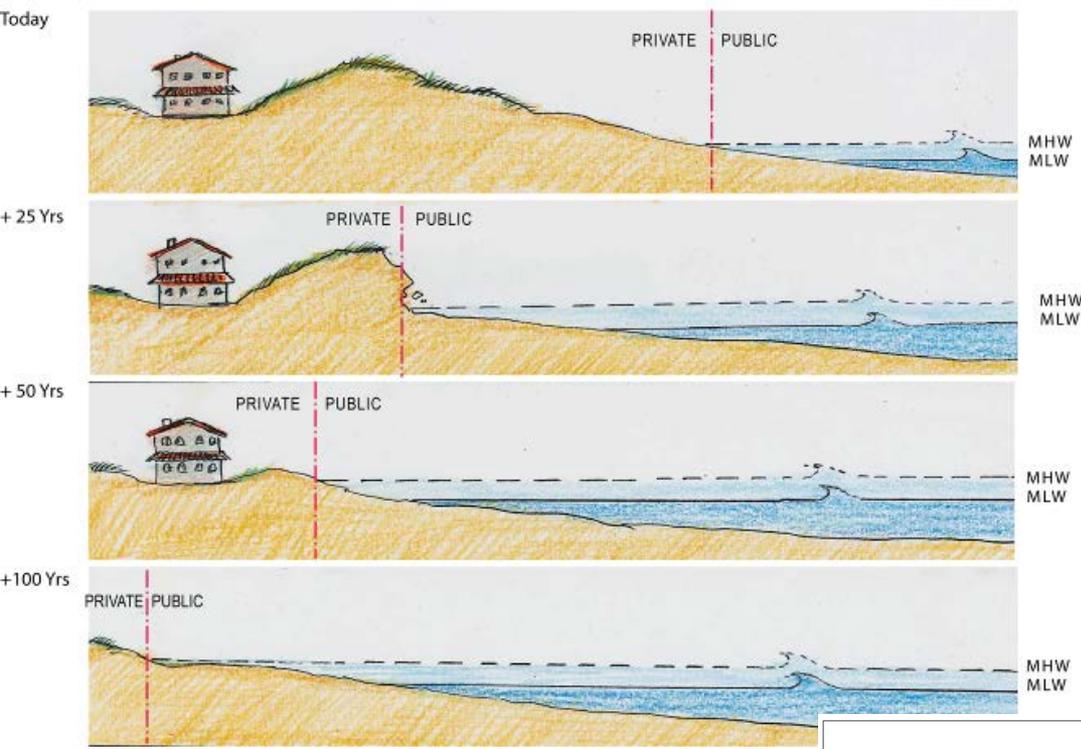
Source: California Coastal Records Project



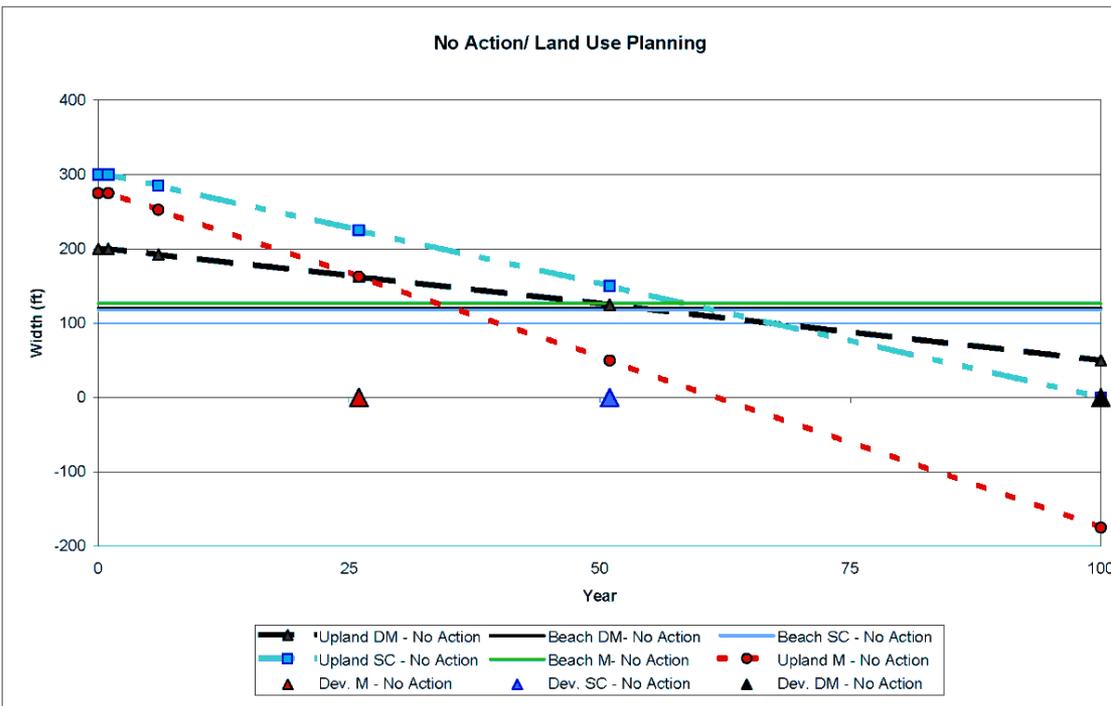
2005

Rolling Easements

Public lands migrate with the "ambulatory shore"



Maintains beach recreation and ecosystem services while upland erosion continues



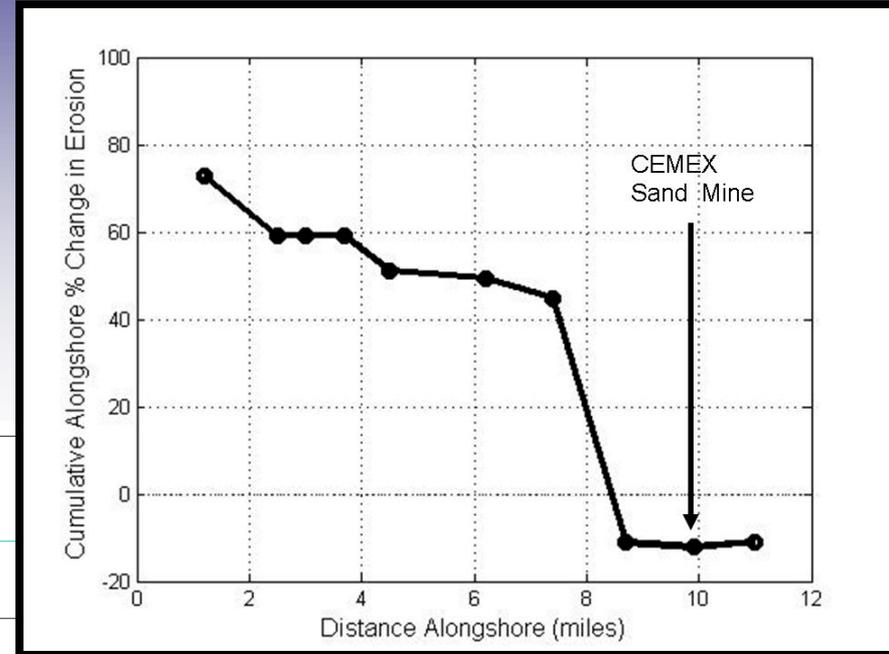
Sand Mining Cessation



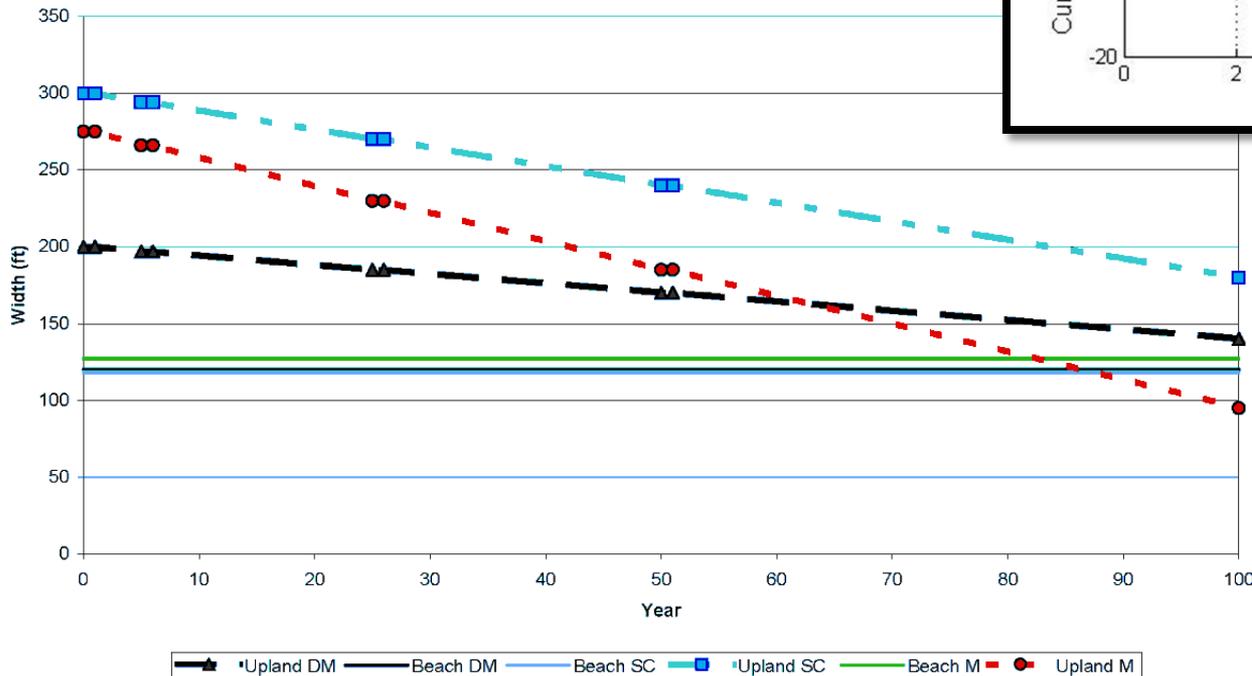
Source: California Coastal Records Project

- Currently ONLY active sand mine from beach in CA
- A regulatory authority exertion over the sand mine
- Buy out of the sand mine
- Lawsuit by an affected party – Public Trust?

Cessation of Sand Mining



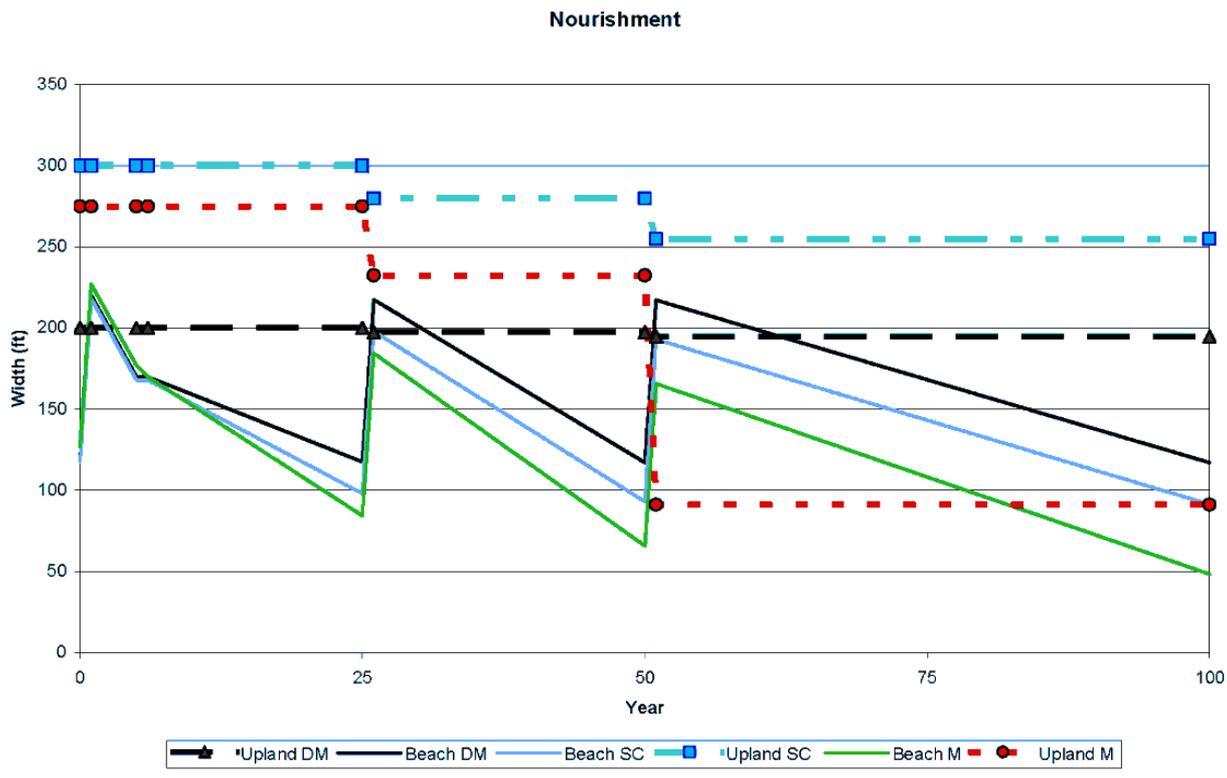
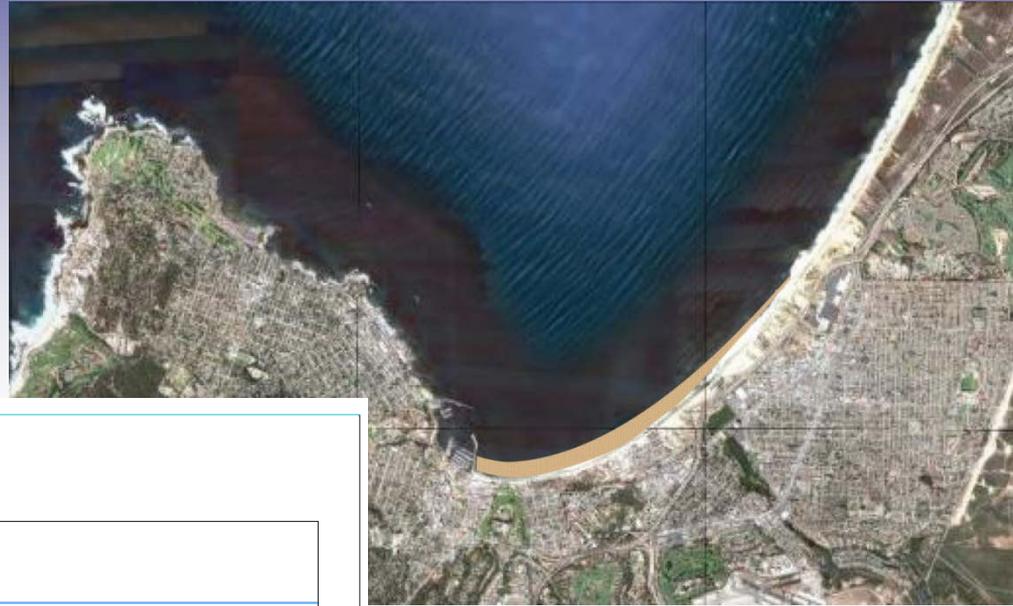
Cessation of Sand Mining from the Beach



Thornton 2010

Nourishment

- 25 year renourishment cycle
- 2M CY for 100' of beach
- 3 miles of shoreline





BREAKING NEWS

OCTOBER 2013

Fair & Balanced

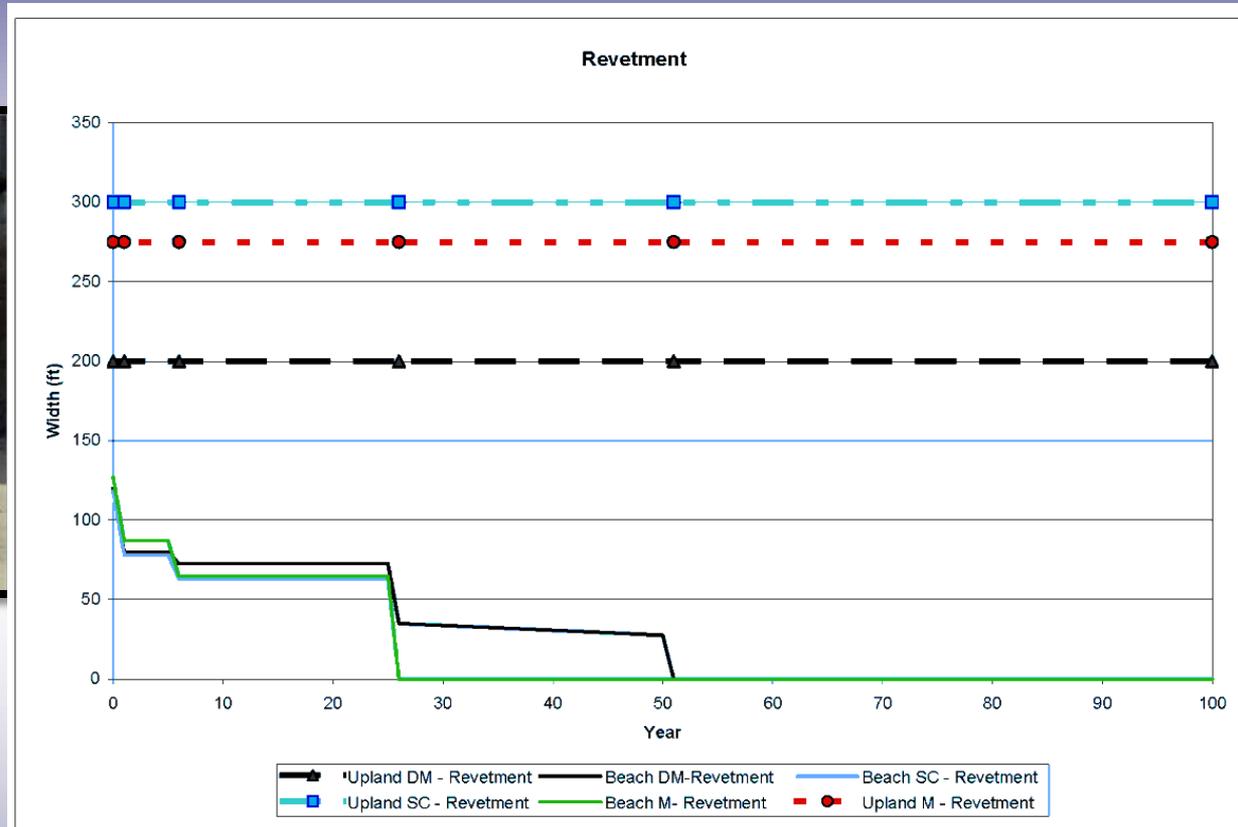
U.S. GOVERNMENT PAYS MEXICAN COMPANY TO TAKE A 5-YEAR VACATION

MONTEREY, CALIFORNIA - In a surprising turn of events in that liberal cash strapped state of California, the federal government is found paying off CEMEX, a Mexican mining company, to take a five year vacation and to stop operations at its sand plant near Monterey which harvest an estimated 200,000 cy of sand. State officials swear that is to minimize the impact of coastal erosion to the beaches by not mining sand, but Fox news has found evidence that....

Note this is not really the news headline, YET!

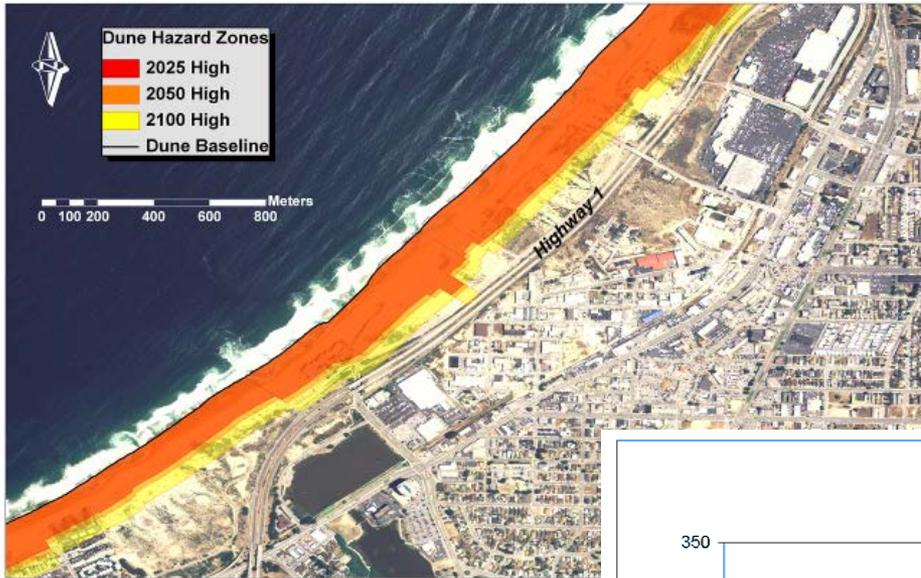


Revetments

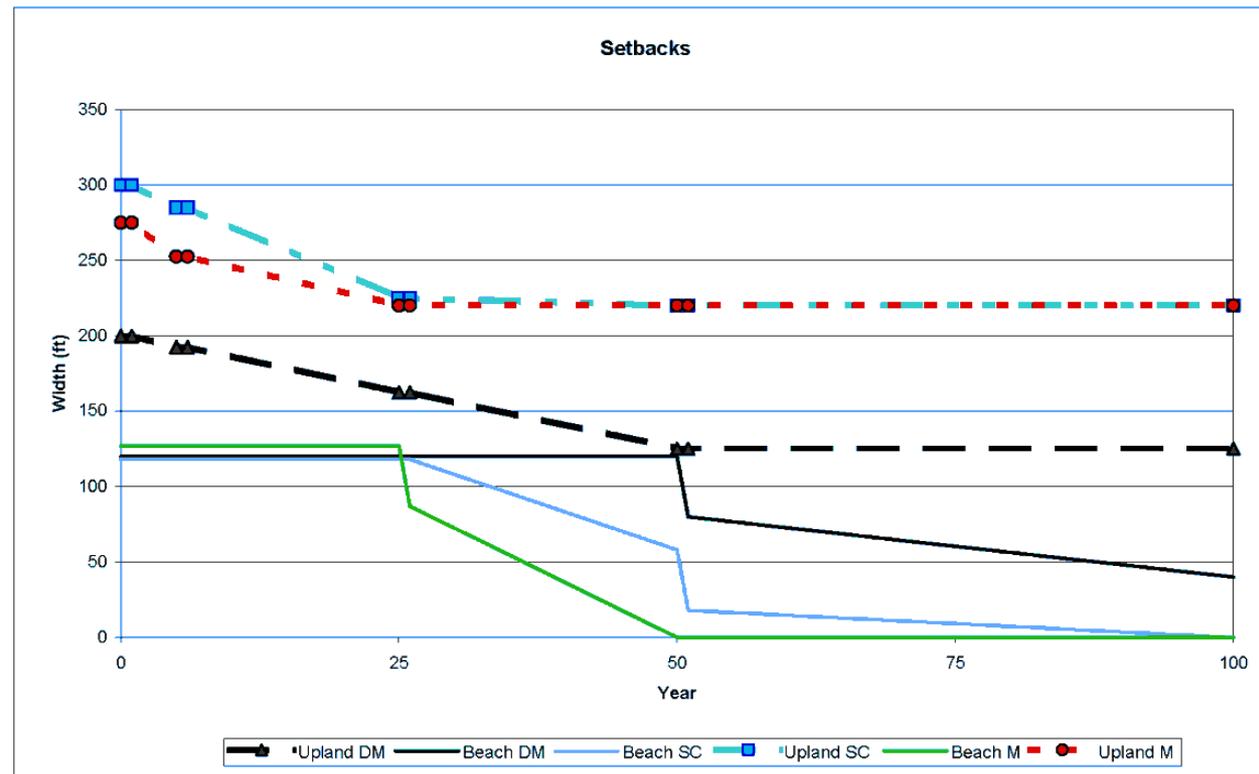


- Economic Baseline for comparison

Setbacks



- **Marina** – 50 year or east of tsunami
- **Sand City** – 50 year
- **Seaside** – 75 year
- **Monterey** – 100 year (Del Monte)



Sand City Reach Results

7

2

8

11

9

10

1

6

4

5

3

| | Baseline:Rock Revetment | Nourishment | Nourishment with Groins | Nourishment with Reefs | Nourishment with Breakwaters | Seawall | Cease Sand Mining | Setbacks | Conservation Easement | Fee Simple | Rolling Easement |
|--|----------------------------|-----------------------|----------------------------|---------------------------|---------------------------------|-------------------------|-----------------------|-----------------------|--------------------------|-----------------------|-----------------------|
| Total Recreational Value Above Baseline | \$ - | \$29,638,702 | \$33,440,691 | \$35,261,963 | \$37,421,939 | \$ 7,486,130.27 | \$ 18,754,661 | \$ 10,441,369.80 | \$ 24,592,108.45 | \$ 24,592,108.45 | \$ 24,592,108.45 |
| Total Habitat Value Above Baseline | \$ - | \$32,349,846 | \$42,326,191 | \$44,988,441 | \$48,228,602 | \$ 6,688,794.32 | \$ 15,916,615 | \$ 10,297,740.90 | \$ 11,203,976.59 | \$ 11,203,976.59 | \$ 11,203,976.59 |
| Sum Benefits | \$ - | \$ 61,988,547 | \$ 75,766,881 | \$ 80,250,404 | \$ 85,650,541 | \$ 14,174,925 | \$ 34,671,276 | \$ 20,739,111 | \$ 35,796,085 | \$ 35,796,085 | \$ 35,796,085 |
| Structural Adjustment Costs | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ 23,642,591 | \$ 23,642,591 | \$ 23,642,591 | \$ 23,642,591 | \$ 23,642,591 |
| MRWPCA | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ 11,309,061 | \$ 25,970,041 | \$ 25,970,041 | \$ 25,970,041 | \$ 25,970,041 |
| Cost of Private Property Compensation | | \$ 376,589 | \$ 2,203 | \$ - | \$ - | \$ 112,670 | \$ 665,723 | \$ 2,424,907 | \$ 1,747,023 | \$ 3,494,046 | |
| Cost of Pubic Property Compensation | | \$ 352,209 | \$ 1,942 | \$ - | \$ - | \$ 109,517 | \$ 543,436 | \$ 1,436,205 | \$ 718,103 | \$ 1,436,205 | |
| Construction/Nourishment Cost | \$ (253,486,440) | \$ 70,412,900 | \$ 366,147,080 | \$ 549,220,620 | \$ 549,220,620 | \$ 464,725,140 | \$ - | \$ 20,331,941 | \$ - | \$ - | \$ - |
| Revetment Cost | \$ (253,486,440) | \$ (253,486,440) | \$ (253,486,440) | \$ (253,486,440) | \$ (253,486,440) | \$ (253,486,440) | \$ (253,486,440) | \$ (253,486,440) | \$ (253,486,440) | \$ (253,486,440) | \$ (253,486,440) |
| Cost over Baseline | 0 | \$ (182,344,742) | \$ 112,664,785 | \$ 295,734,180 | \$ 295,734,180 | \$ 211,460,887 | \$ (217,325,630) | \$ (179,680,755) | \$ (201,408,682) | \$ (198,943,557) | \$ (203,873,808) |
| Net Benefits | \$0 | \$ 244,333,290 | \$ (36,897,903) | \$ (215,483,776) | \$ (210,083,639) | \$ (197,285,962) | \$ 251,996,905 | \$ 200,419,865 | \$ 237,204,767 | \$ 234,739,642 | \$ 239,669,893 |
| Benefit/Cost Ratio | | NA | 0.67 | 0.27 | 0.29 | NA | NA | NA | NA | NA | NA |

Ranked Results

Over 100 years in
2010 dollars

Positive \$

Negative \$

| | <u>Del Monte</u> | <u>Sand City</u> | <u>Marina</u> |
|------------------------|------------------|------------------|---------------|
| Cease Sand Mining | 1 | 1 | 2 |
| Nourishment | 2 | 2 | 5 |
| <hr/> | | | |
| Rolling Easements | 3 | 3 | 1 |
| Conservation Easements | 4 | 4 | 3 |
| Fee Simple Acquisition | 5 | 5 | 4 |
| Setbacks | 6 | 6 | 6 |
| <hr/> | | | |
| Groins | 7 | 8 | 8 |
| Revetment | 8 | 7 | 7 |
| Seawall | 11 | 10 | 9 |
| Artificial Reefs | 10 | 11 | 10 |
| Breakwaters | 9 | 9 | 11 |

Conclusions

- New economic analysis includes traditional storm damages as well as ecosystem and recreational benefits and can support adaptation planning
- Beach recreation and habitat values have higher long term value than private property
- Ceasing Sand Mining is the most important erosion mitigation strategy
 - Provides ~\$718 M over 100 years including \$116M in recreation and ecosystem benefits
- Rolling easement, conservation easement and fee simple are all superior to armoring and structural alternatives across all time horizons
- Comparison of Rolling Easements with Seawalls show a net benefit to the region of \$1.25 Billion dollars over the next 100 years
- Non-standardized setbacks policies do not maintain beaches after 25-50 years if armoring allowed.

<http://montereybay.noaa.gov/new/2012/erosion.html>

Conclusions Continued

- Armoring results in loss of beaches within ~5-50 year planning horizon
- Nourishment effective as a medium term solution but erosion of upland occurs within 25 year nourishment cycles under existing erosion rates
- Retention structures (groins, reefs and breakwaters) increases effectiveness of nourishment but high costs to maintain with eroding region and most still show signs of upland erosion under high erosion rates
- Groins in Del Monte show net benefits over the 100 year time horizon (\$9M)
- Opportunistic Sand Placement has high incremental benefit under all erosion rates (>5 B/C -)
- Passive dewatering uncertain but low cost experiment with monitoring
- Develop a storm response strategy to reduce damages of high wave events

<http://montereybay.noaa.gov/new/2012/erosion.html>

Acknowledgements

Southern Monterey Bay Coastal Erosion Workgroup

- Lesley Ewing, Charles Lester, Bruce Richmond, Tom Reeves, Kim Cole, Steve Matarazzo, Mark Johnsson, John Kasunich, Mark Foxx, Sarah Damron, Ed Thornton, John Kiliany, Anthony Tersol, Jennifer Gonzales, Ken Gray, Clif Davenport, Kim Sterrett, Chris Potter, Tom Kendall, John Dingler, Doug Smith, Les Strnad
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- Karen Grimmer, Paul Michel, John Hunt, Mike Eng

Monterey Bay Sanctuary Foundation

- Dennis Long

In Memory of John “Snowy Plover” Fischer

Construction Cost Estimates

| Item | Cost (\$M/km) | |
|--|---------------|-------|
| | Low | High |
| Rock revetment | \$15 | \$18 |
| Seawall | \$20 | \$33 |
| Groins (with sand placement) | \$17 | \$26 |
| Reefs (with sand placement) | \$26 | \$39 |
| Breakwaters (with sand placement) | \$26 | \$39 |
| Sand Placement Large (about 2,000,000 cy) | \$3.3 | \$5.0 |
| Sand Placement Opportunistic (about 75,000 cy) | \$0.4 | \$0.8 |

Replacement cost for MRWPCA - \$135 Million

*Does not include all costs, including:
design, environmental review, permitting, construction administration, monitoring,
sand mitigation fees for armoring, and/or property purchase.*