Seawater Desalination – Environmental Impacts and Solutions

Tom Luster
CA Coastal Commission
45 Fremont Street, #2000
San Francisco, CA 94105
415-904-5248 / tluster@coastal.ca.gov

What I'll Cover:

- **Desal overview:** what it is and where it fits in California water planning.
- **Desal permitting:** including how to plan, site, and design for "easy" or "difficult" desal.
- **Recommendations:** what might work for Ventura?

Water Issues in California

A history of:

- Complexity
- Controversy
- Contentiousness
- Connections between water and growth, quality of life, environmental issues, etc.

– Desal is no different.

California's Involvement with Desal

- More than a dozen existing facilities and about a dozen proposed facilities.
- Research and funding for intake design, energy efficiency, corrosion studies, etc.
- Ocean Protection Council workgroup.
- Identifying desal opportunities part of Urban Water Management Plans.
- New State Water Board policy to accompany Coastal Act requirements.

Proposed Projects

From Pacific Institute, 2010.

Key Coastal Act Policies:

- **Marine Biology/Water Quality:** avoid/ mitigate effects of intake and discharge.
- **Public access:** to and along the shoreline.
- **Growth-Inducement:** will a project induce growth beyond coastal resource capacity?
- "**Least environmentally harmful feasible alternative**".
- Is a project "**coastal-dependent**"?
- **Energy use / Greenhouse Gas emissions**
- Protect coastal **scenic and visual** qualities.

Key Desal Amendment Policies:

- **Intakes :**

  Avoid marine life mortality to the extent feasible.

- **Discharge:**

  To reduce salinity effects on marine life, combine desal discharge with other discharges or use diffusers.

- **Mitigation:**

  Any expected loss of marine life to be mitigated at 95% certainty of success.

Shared Goals: Siting

Desal Amendment:

- **For Intake –** Avoid sensitive habitat (e.g., kelp, reefs)
- **For Discharge –** Keep brine away from sensitive habitat
- **For Facility –** Consider proximity to, and availability of, existing infrastructure (for example, consider co-location with WWTP or other existing discharges).

Coastal Act:

- Avoid upland sensitive habitat areas (e.g., dunes, wetlands, etc.).
- Address sea-level rise, coastal erosion, coastal and seismic hazards.
- Ensure adequate public services available to support project.

Shared Goals: Best Alternative

Key consideration: Does a proposed project represent the "least environmentally damaging and feasible alternative" to provide the needed water supply?

Coastal Commission review can include a three-part test:

- Is the facility coastal-dependent?
- Does it include all feasible mitigation measures?
- Are there no less environmentally-damaging and feasible alternatives?

Desal Policy: Evaluates the best combination of site, design, technology, and mitigation measures to minimize intake and mortality of marine life.

Shared Goals: Water Supply Considerations

Coastal Act:

- Will project induce growth beyond coastal resource or public service capacity?

Desal Amendment:

- Is the proposed water supply consistent with approved Urban Water Management Plan?

Consider:

- Other supply options – maximizing conservation? is additional recycling feasible?
- What's desal's role in overall water portfolio – reliability? baseload? growth?

Desal Amendment – Process:

Includes formal consultation among agencies to provide shared and coordinated review.

Desal Permitting: What are the hurdles?

There should be few, if any, permitting challenges for a well-planned, properly-sited, and well-designed facility. If you:

- Use the policies as the basis for your plan, site, and design.
- Coordinate with agencies early and often.
- Involve stakeholders early and often.

Key Considerations for Facility Design & Review

"Easier" review:	"More difficult" review:
Away from shoreline.	On or next to shoreline.
Subsurface intake.	Open-water intake.
Not affected by coastal/seismic hazards.	Subject to coastal/seismic hazards.
Defined service area with known level of build-out.	Unknown or extensive service area.
Part of local/regional plan in area where significant part of water portfolio is conservation.	Not part of a local/regional plan; in an area without much effective conservation.
Early, extensive coordination w/agencies & stakeholders.	Poor or little coordination.

Key Requirement of State Policies: "Don't Kill Marine Life if You Can Avoid It"

Coastal Act version:

Maintain, enhance, and where feasible, restore marine life populations by minimizing the adverse effects of entrainment.

Water Code version:

Use the best available and feasible site, design, technology, and mitigation measures to minimize the intake and mortality of all forms of marine life.

Why The Concerns Over Entrainment?

Adverse Effects of Open Intakes Are Spatially and Biologically Extensive:

- Can extend along dozens of miles of nearshore waters.
- Can affect hundreds of species.

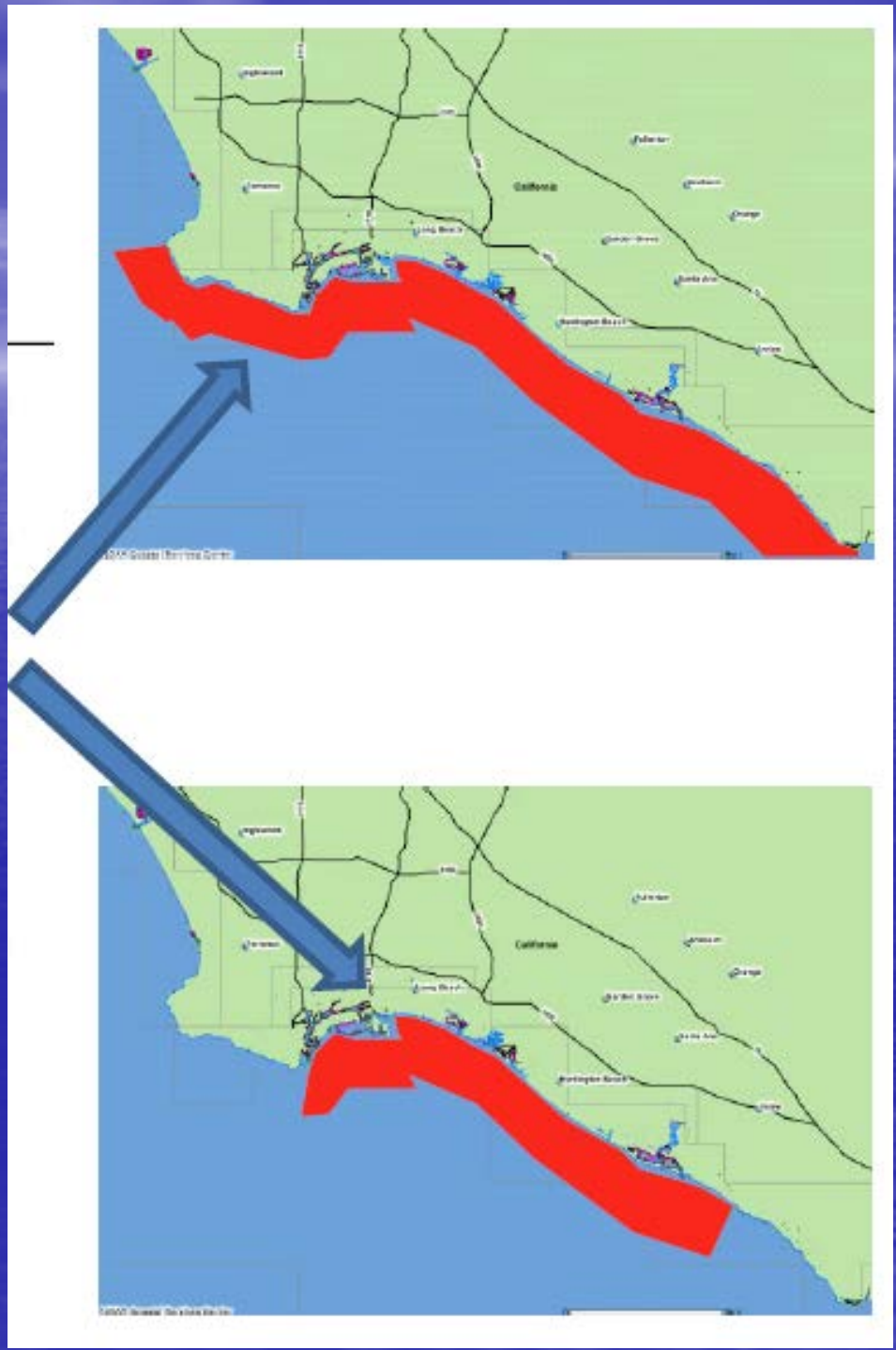
However, these Adverse Effects Are Largely Avoidable:

- By selecting the best site, design, and technology.
- By using subsurface methods where feasible.

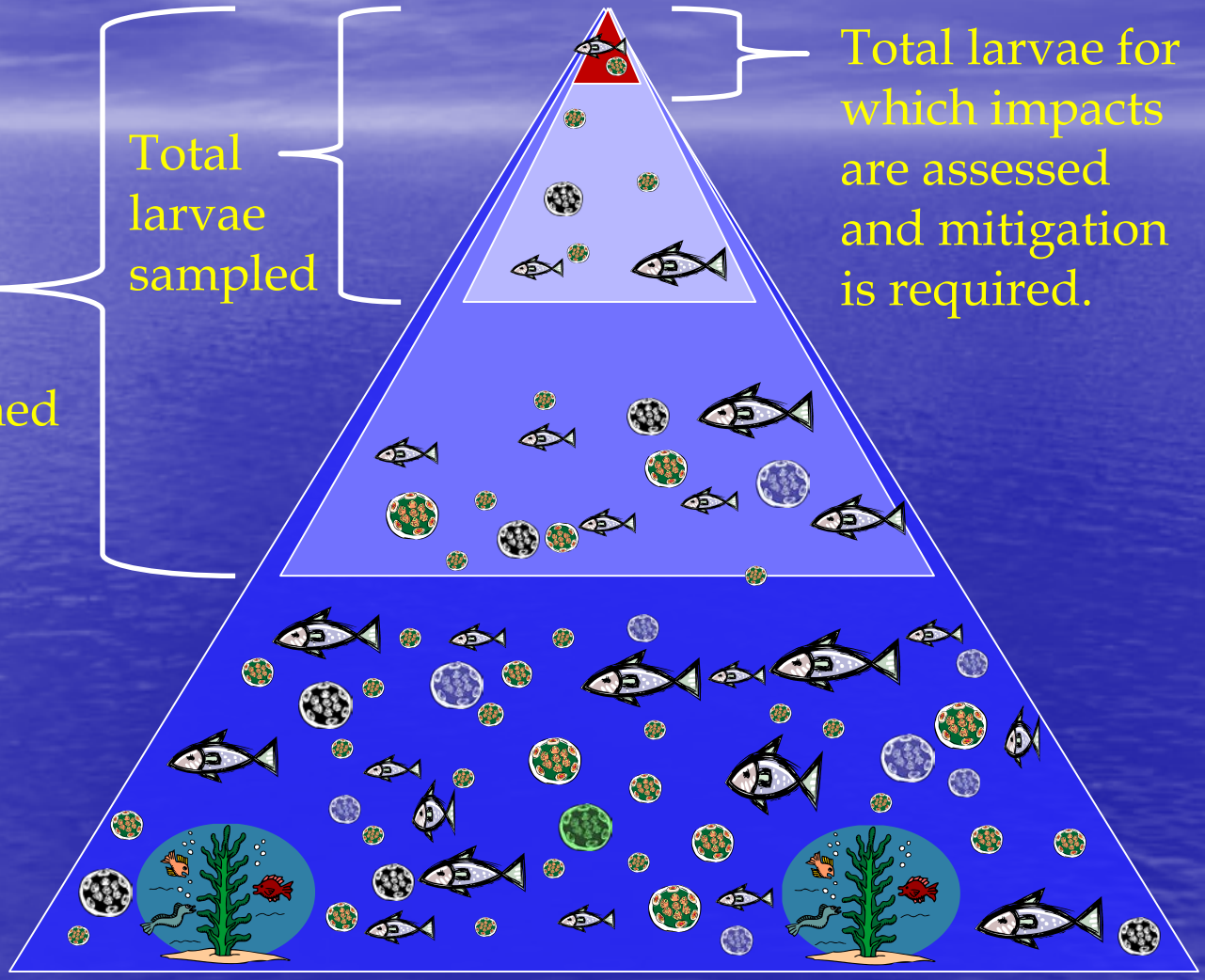
Examples of Source Water Areas

Queenfish

White Croaker

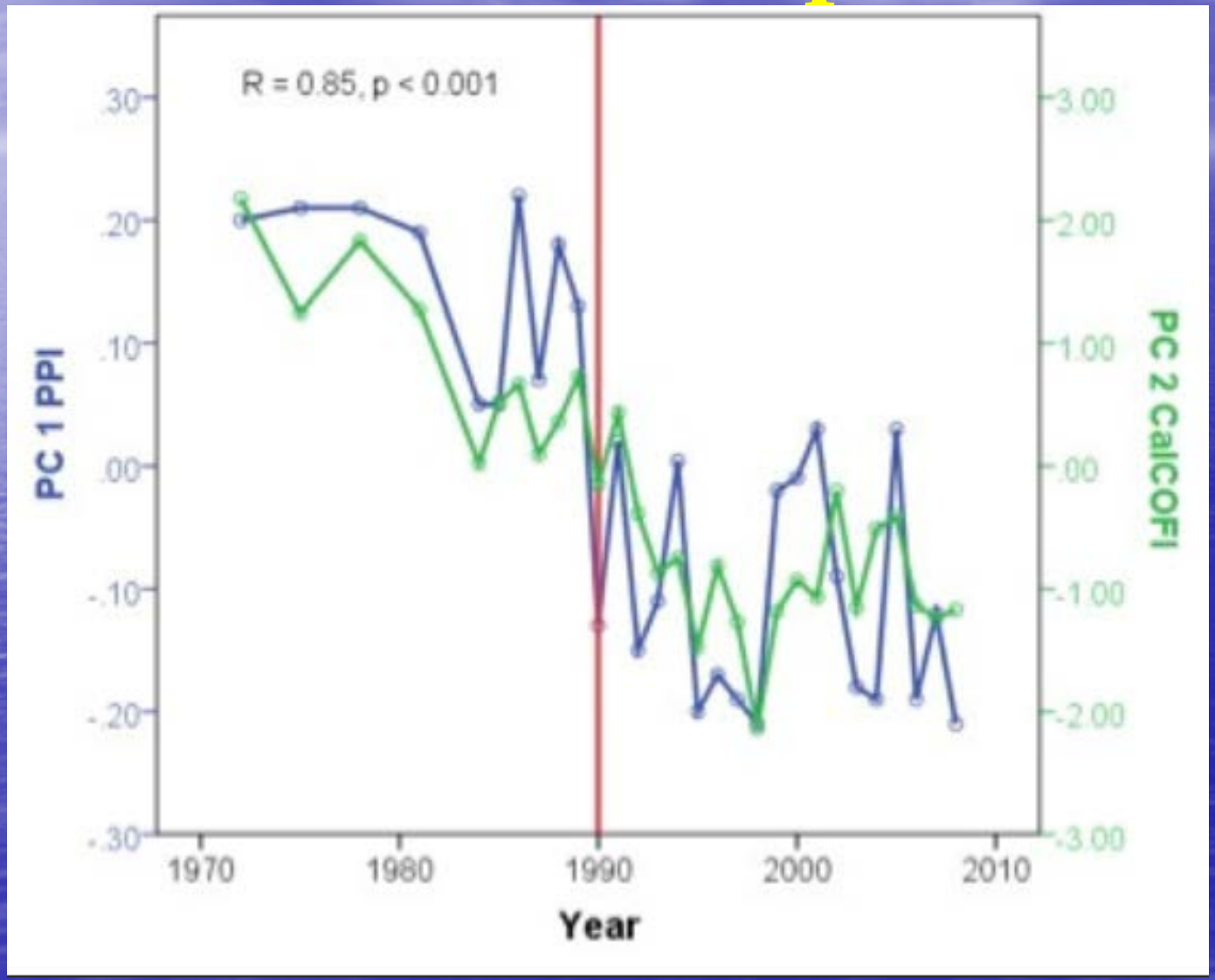


Biological Extent of Impacts



From Raimondi, *Variation in Entrainment Impact Estimations Based on Different Measures of Acceptable Uncertainty*, 2011.

Decline in SoCal plankton



From Scripps Institute of Oceanography, October 2015

Two Main Intake Types:

Subsurface –

Pros:

- Fewer marine life impacts.
- May reduce desal operating costs.
- Needs little, if any mitigation.

Cons:

- Requires extensive geotechnical analysis.
- Only feasible at certain locations.

Open Water –

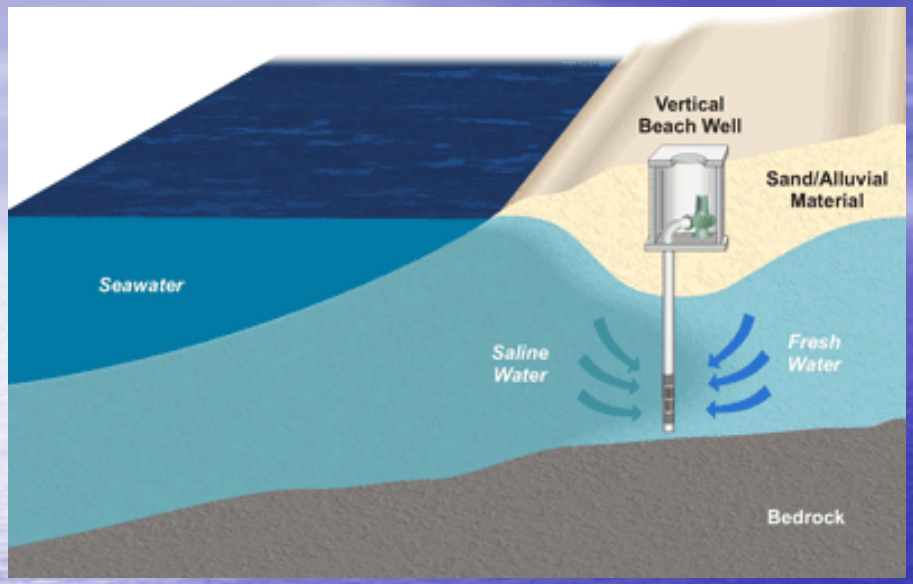
Pros:

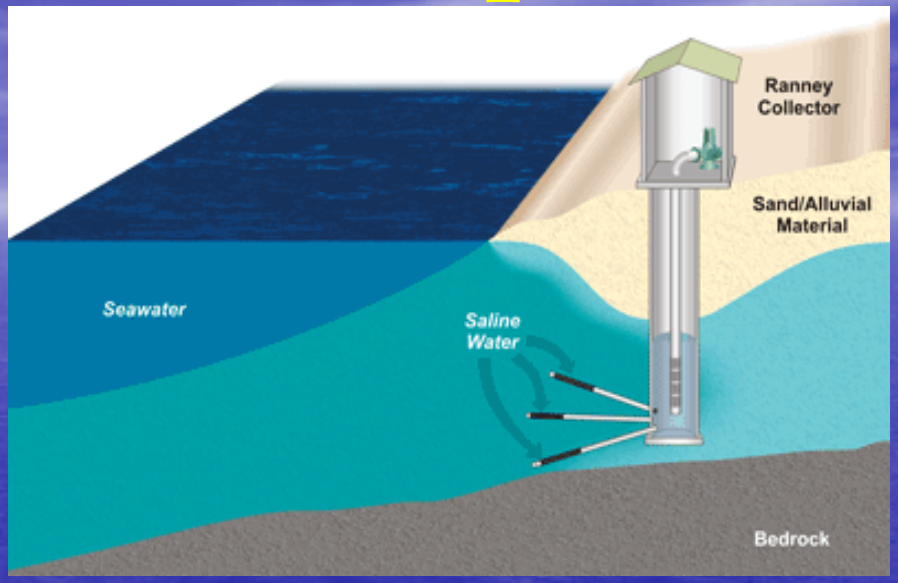
- Uses existing structures.

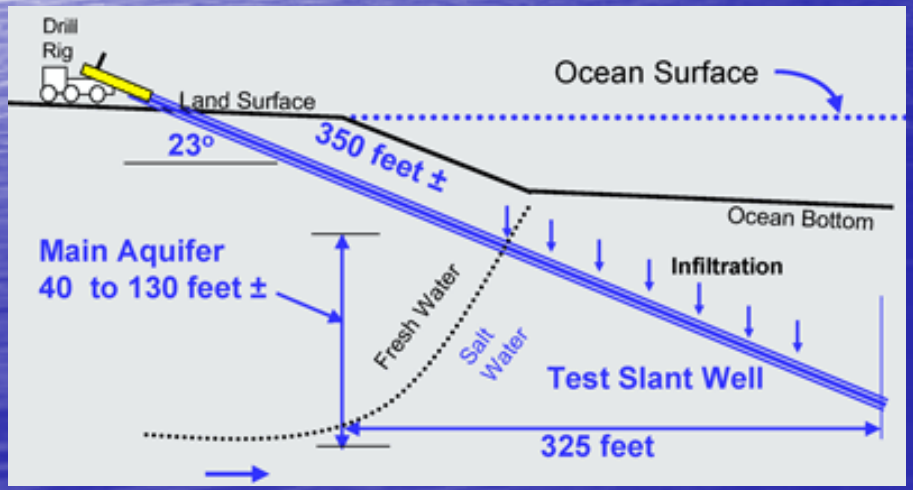
Cons:

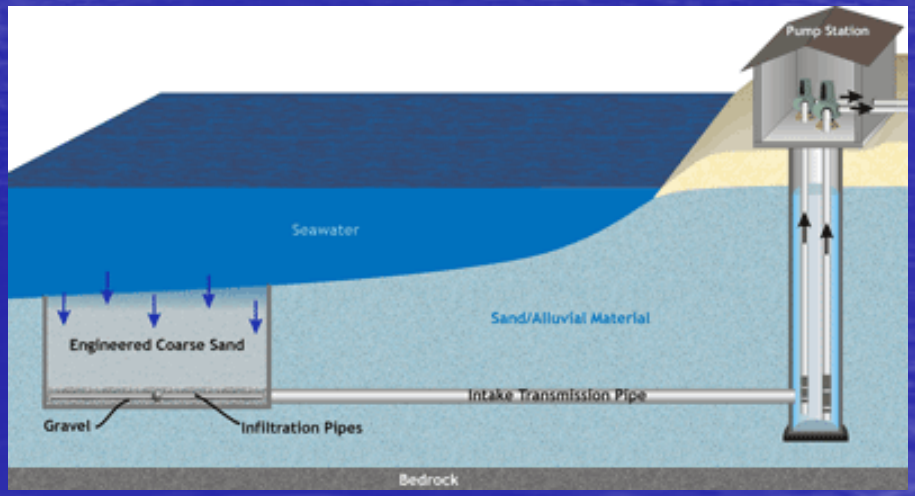
- Requires extensive sampling/analysis of marine life effects.
- Requires alternatives analysis.
- Requires modification – screens, lower velocity, etc.
- Requires marine life mitigation.

Subsurface Intake Examples









Seawater Desalination – Environmental Impacts and Solutions

Photograph 15. Beach drilling site following demobilization.

Tom Luster
CA Coastal Commission
45 Fremont Street, #2000
San Francisco, CA 94105
415-904-5248
tluster@coastal.ca.gov

Screened open water intakes

From Kennedy-Jenks Consultants, 2012.

From West Basin Water District, 2012.

What might work for Ventura?

- **Need:** Would like increased water reliability, but no specific identified need for seawater desal.
- **Hazards:** Existing/predicted coastal hazards and sea level rise limit use of existing infrastructure.
- **Presence of seawater intrusion.**
- **Elevation:** ~1000-foot elevation gain between ocean and main water users.

Desal Amendment: Need for water?

From 2015 Urban Water Management Plan:

Calleguas Municipal Water District

Multi Dry-Year

(Repeat of 1990-1992 Hydrology)

Local Supplies	2020	2025	2030	2035	2040
Total Local Supplies	48,616	50,106	51,553	52,983	54,187
Groundwater Production	27,700	27,700	27,700	27,700	27,700
Surface Production	0	0	0	0	0
Los Angeles Aqueduct	0	0	0	0	0
Seawater Desalination	0	0	0	0	0
Groundwater Recovery	1,504	1,869	2,152	2,420	2,445
Recycling	6,312	7,437	8,600	9,763	10,942
M&I and Agricultural	6,312	7,437	8,600	9,763	10,942
Groundwater Replenishment	0	0	0	0	0
Seawater Barrier	0	0	0	0	0
Other Non-Metropolitan Imports	13,100	13,100	13,100	13,100	13,100

Ventura Coastal Hazards

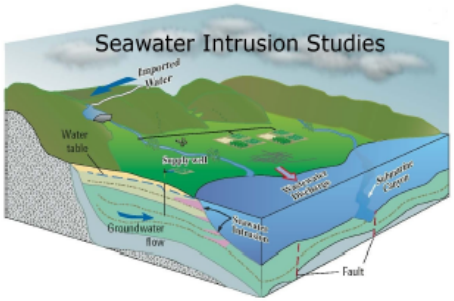
Figure 2-1: 2030 Moderate SLR Combined Hazards Map

Coastal Zone Boundary
City Boundary
City of Oxnard LCP Planning Area
Adjacent Jurisdictions
2030 Moderate SLR Combined Hazards

Modeling results from Coastal Resilience Ventura (ESA PWA, 2013)

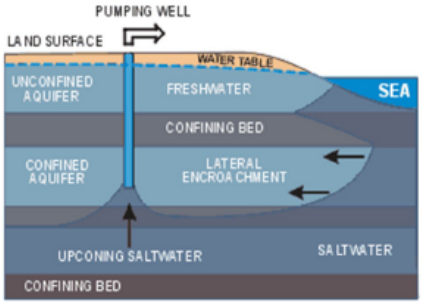
Saline Water Intrusion on South Oxnard Plain: 2011 Update

Groundwater Department— United Water Conservation District



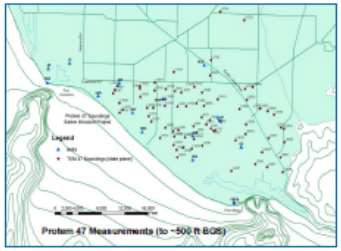
The Problem

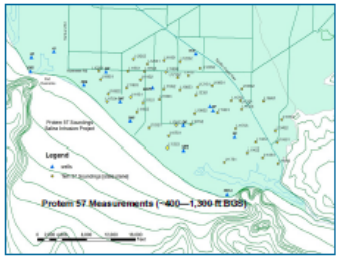
- Seawater intrusion reported as early as 1930s
- Overdraft causes sea water to move inland
- Many wells pump from multiple aquifers
- Saline water focused at Hueneme and Mugu canyons
- Aquifers exposed to sea water in canyons
- Saline water intrusion varies laterally & with depth
- Variability must be understood prior to designing a program to control intrusion

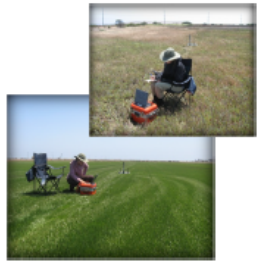


Investigation

- Use surface geophysical technique to estimate lateral and vertical extent of saline water
- Geophysical technique—Time Domain ElectroMagnetic Induction (TDEM) often used to investigate seawater intrusion in coastal areas
- Large wire loop used as transmitter—small loop used as receiver antenna
- Protem 47 and 57 (Geonics Ltd) equipment used to collect 122 measurements on South Oxnard Plain in summer of 2010

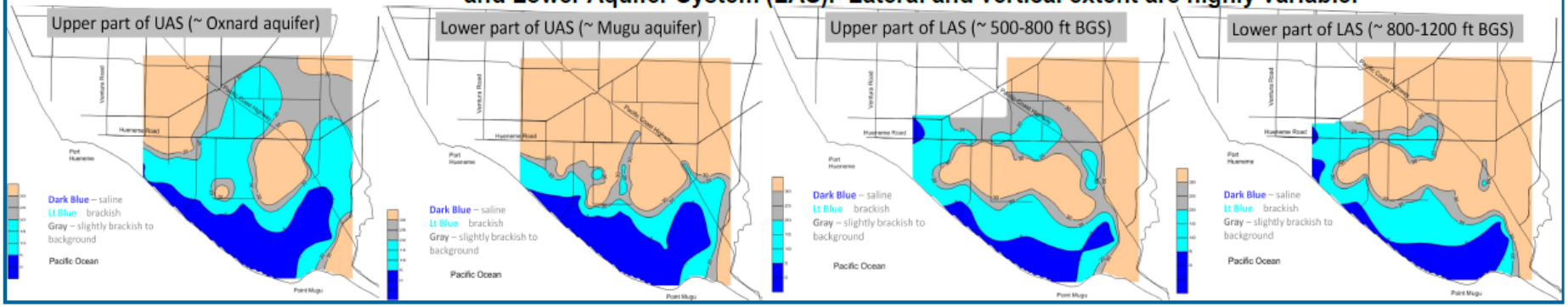






Results

Saline and brackish waters prevalent in the South Oxnard Plain in both Upper Aquifer System (UAS) and Lower Aquifer System (LAS). Lateral and vertical extent are highly variable.



Solution!

If you're going to do seawater desal:

- Small- to moderate-sized coastal facility that serves local area, not inland.
- Sited to use subsurface intakes to draw in brackish water or intruded seawater.
- Intakes located seaward of facility to allow adaptation to coastal hazards.

Example: Sand City

- Produces 300 acre-feet per year.
- Capital cost ~$12 million.
- Uses a series of wells over seawater/brackish water.
- Uses a subsurface discharge.
- Includes a managed retreat plan for resiliancy.

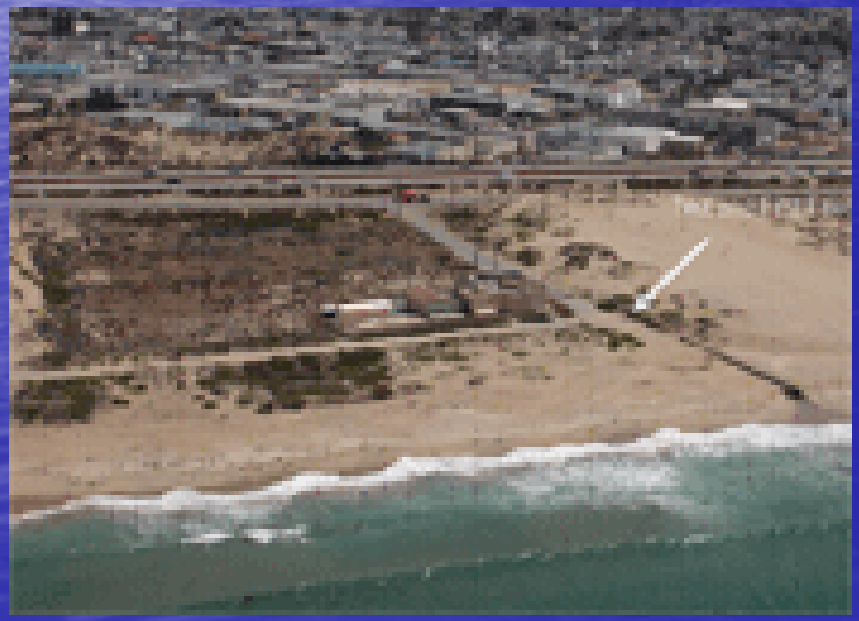


Image courtesy of CDM Constructors

What does it take to do desal?

- It must really be needed.
- It must address all environmental issues.
- It must make economic sense.
- There must be a transparent decision-making process.
- There are no shortcuts.

From Tom Pankratz, Water Desal Report, 2011

Questions?