Intake Approaches and Technology for Seawater Desalination

California Ocean Protection Council Desalination Panel

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Presentation Outline

- **Review of open-water intakes**
- **Review of subsurface intakes**
- **Studies to support intake evaluations**
- **Questions**

The primary objective of an intake is to supply seawater to the desalination facility

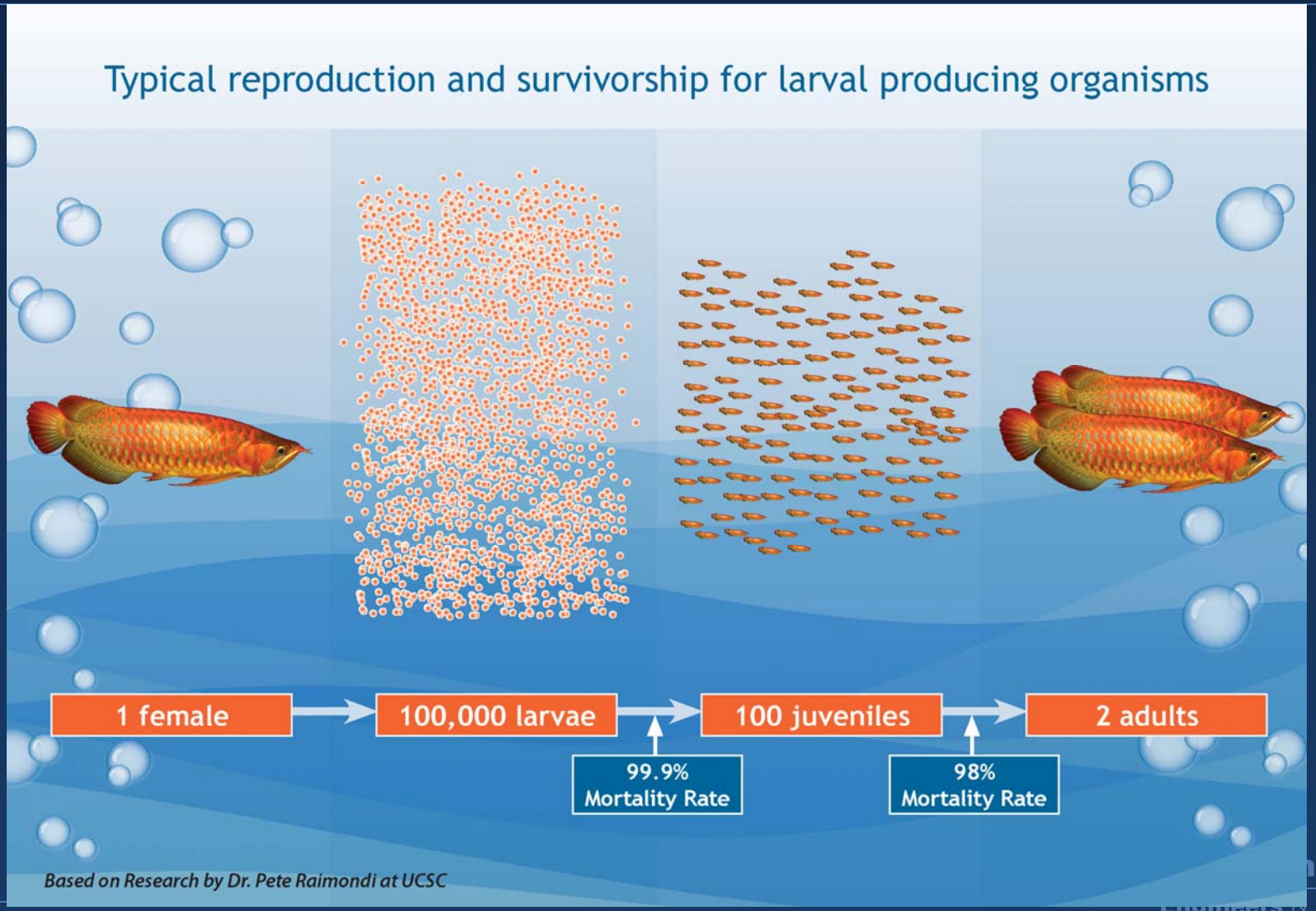
Important Considerations:

- Source water quantity and quality
- Construction impacts to marine environment
- Operational impacts to marine environment
- Regulatory Permitting
- Capital and Maintenance Costs

Explanation of the terms “Entrapment”, “Impingement” and “Entrainment”

- **Entrapment:** **Adult and juvenile fish cannot swim out of intake system**
- **Impingement:** **Adult and juvenile fish get stuck to intake screen due to high intake velocity**
- **Entrainment:** **Fish larvae that are smaller than the screen slots are drawn into the intake**

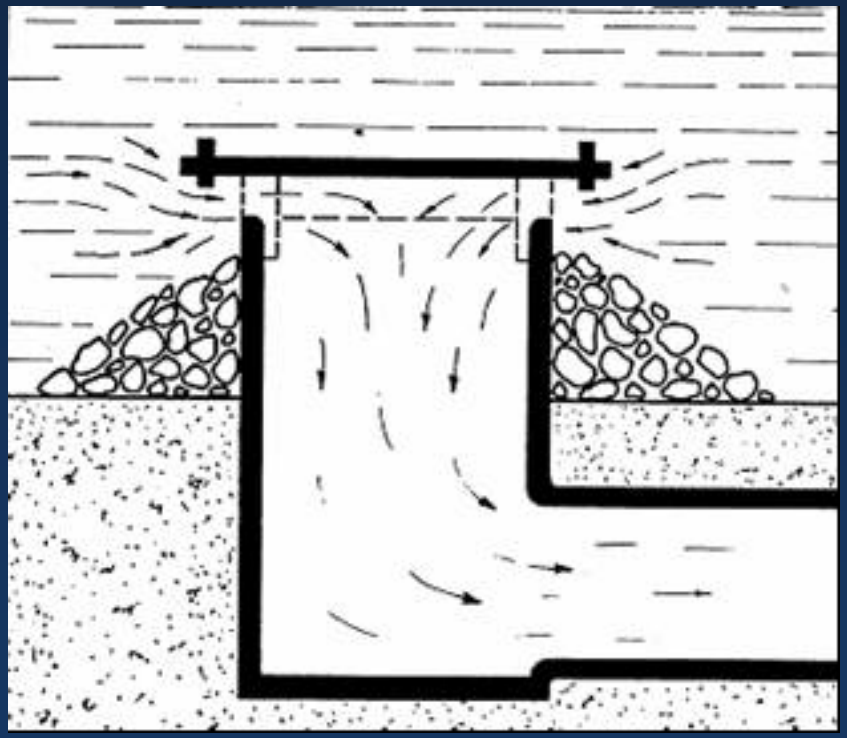
Open-water intakes use technologies to protect adult and juvenile fish and minimize entrainment of larval size organisms



Major types of open-water intakes

- **Velocity Caps**
- **Traveling Water Screens**
- **Vertical and Cylindrical Wedgewire Screens**
- **Aquatic Filter Barriers**

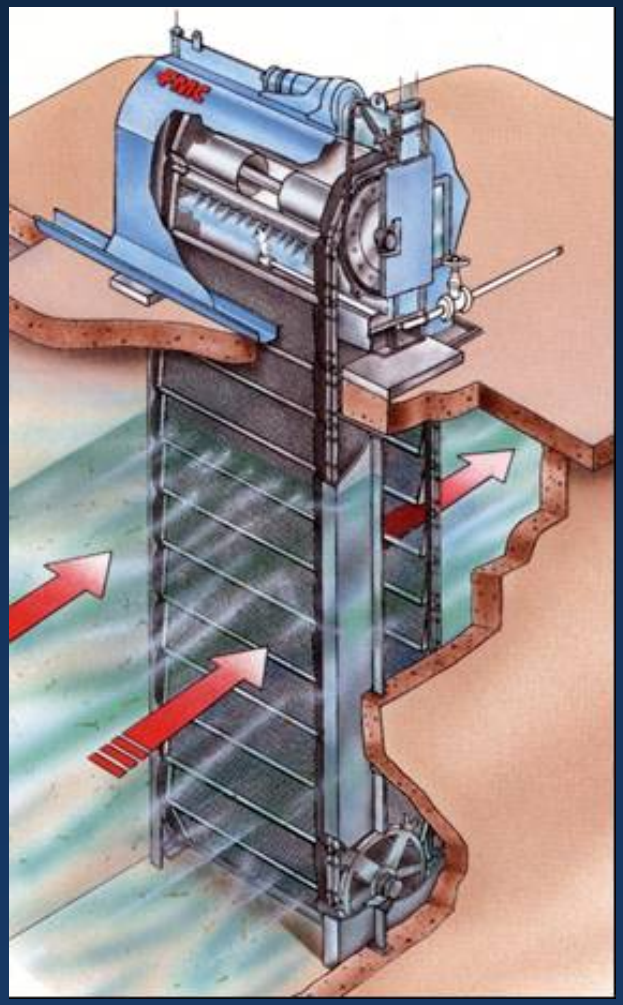
Velocity caps minimize the velocity at the intake to prevent impingement

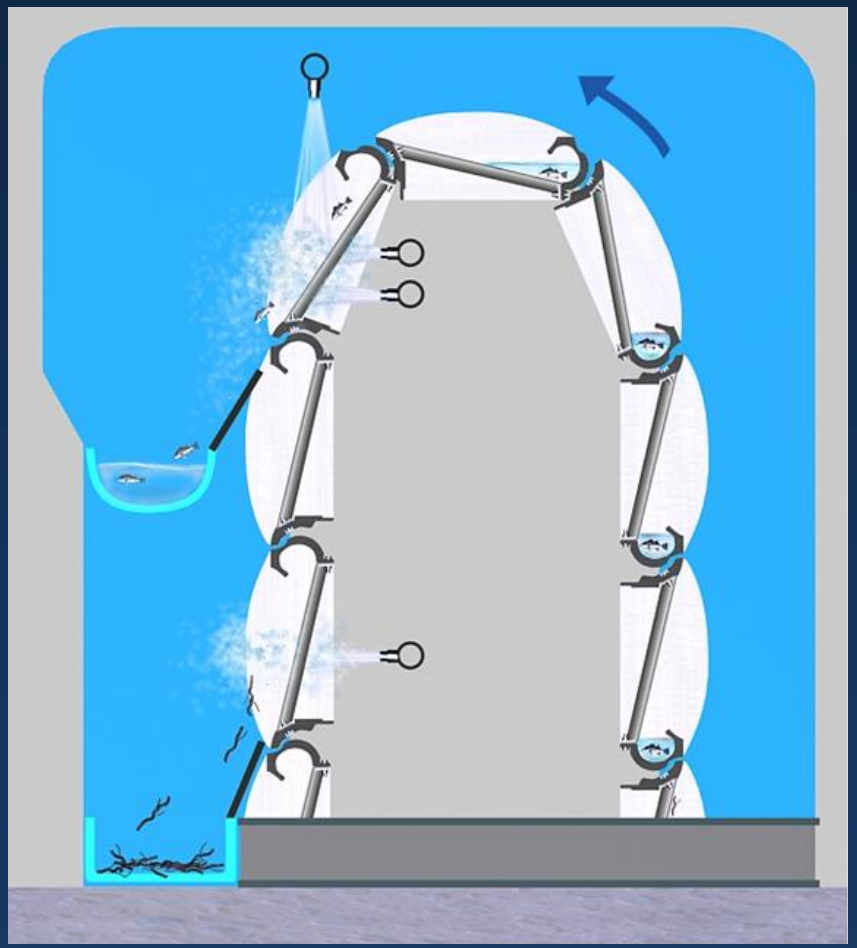


Intake velocity < 0.5 fps

Velocity cap structure for the 38 MGD Perth, Australia Desalination Facility

Traveling water screens are used with a velocity cap to minimize entrapment





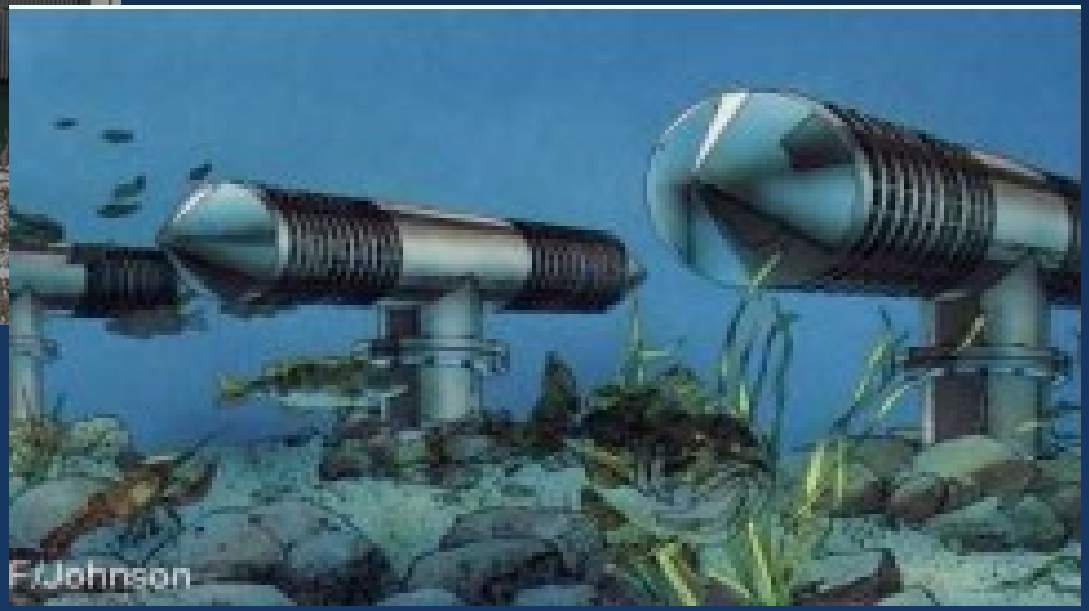
Wedgewire screens use narrow slot size and low velocities to prevent entrapment and impingement

vertical screens

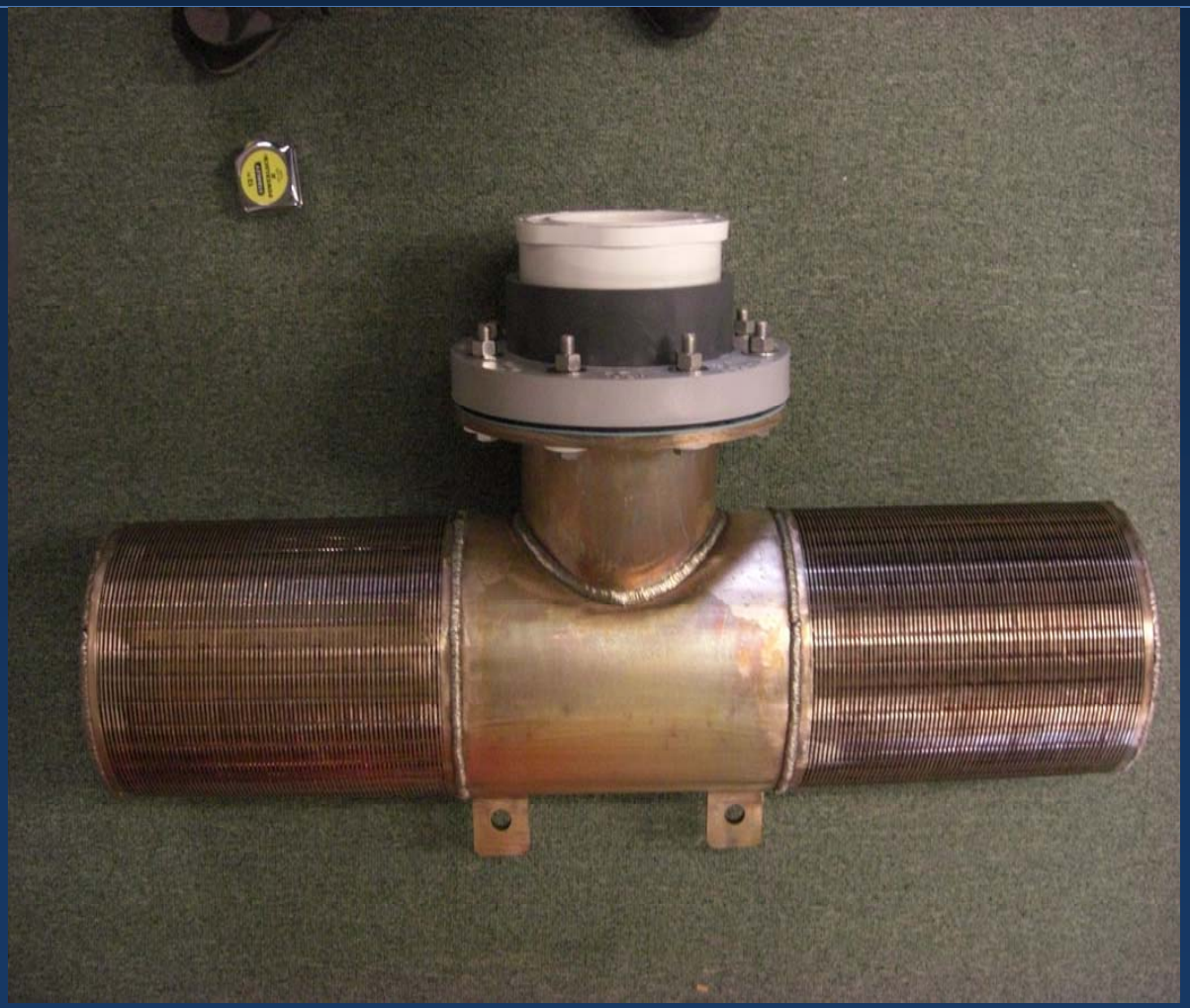
Slot size of 2 to 3 mm

Intake velocity < 0.5 fps

cylindrical screens



Wedgwire screen intakes tested in Marin, Santa Cruz, and West Basin CA



Aquatic Filter Barriers have worked well in lakes with minimal current forces on the fabric barrier

- **Fabric barrier supported with floats and anchors**
- **Laser cut perforations exclude marine life**
- **Ocean wave and current forces will damage the fabric**
- **Bio-fouling may be an issue in seawater**

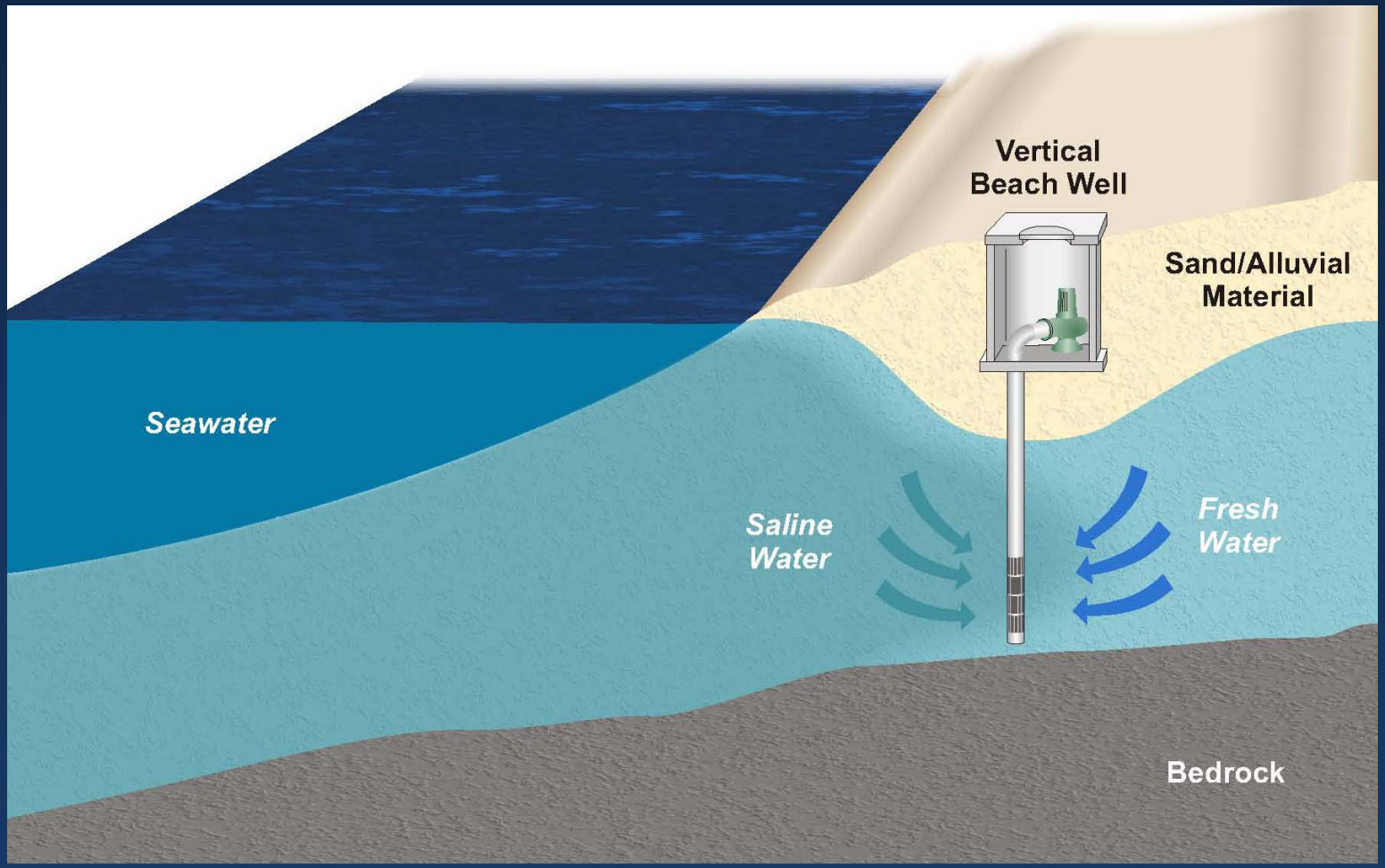
Major types of subsurface/sub-floor intakes for seawater desalination

- **Vertical Wells (Beach Wells)**
- **Horizontal Collector Wells (Ranney Collector)**
- **Slant Wells (Directionally Drilled Wells)**
- **Engineered Infiltration Gallery**

The success of a subsurface intake depends on the local geological conditions

- **Sand and alluvial materials hydraulically connected to ocean**
- **Characteristics of the alluvial materials – fine sand and clays can reduce production**
- **Sufficient horizontal area to permit multiple wells for larger facilities**
- **Depth of sand to protect intake screens from storm erosion and damage.**

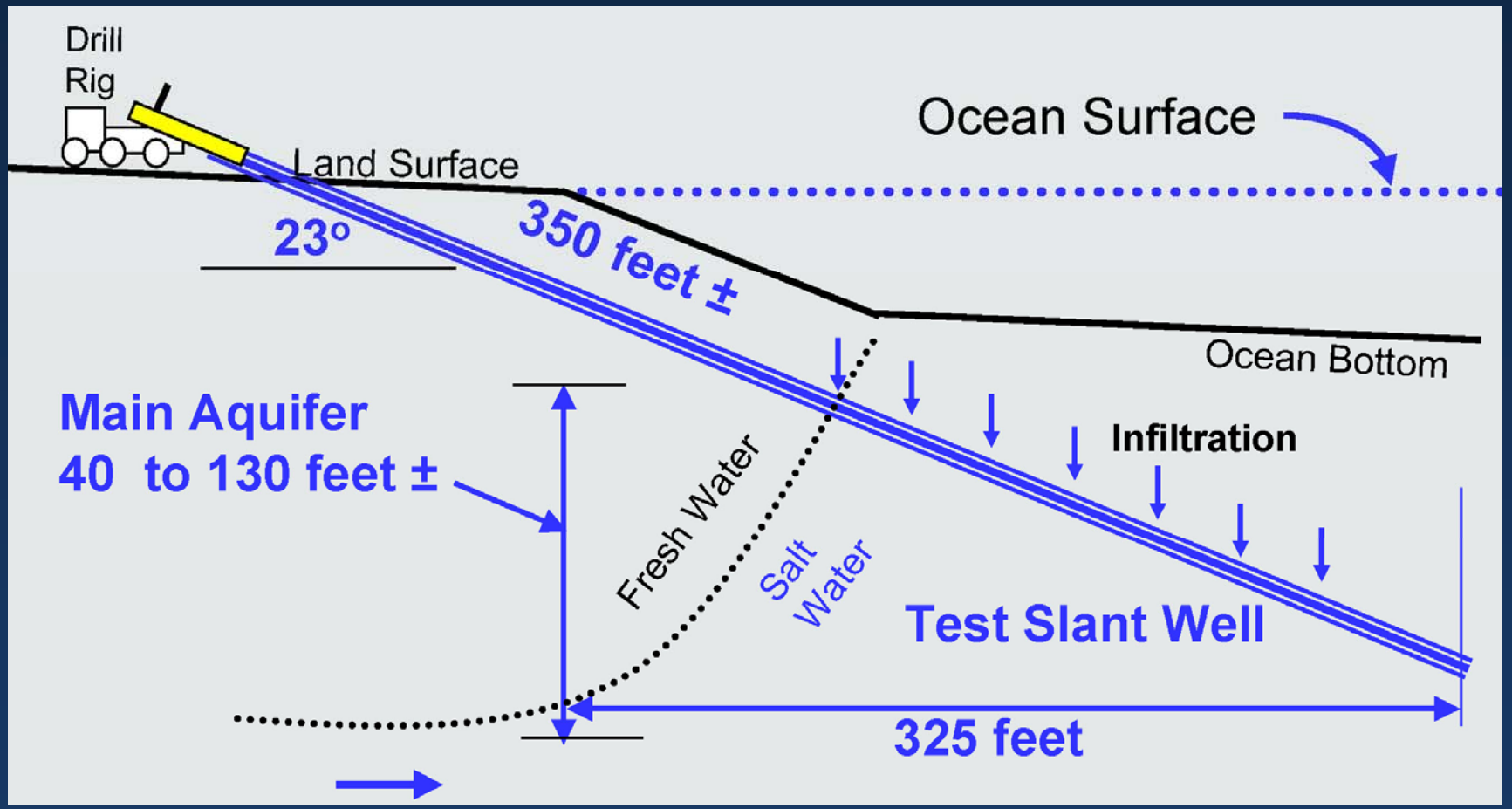
Vertical beach wells and collector wells require relatively deep, protected beaches with large-grain sands and good hydraulics



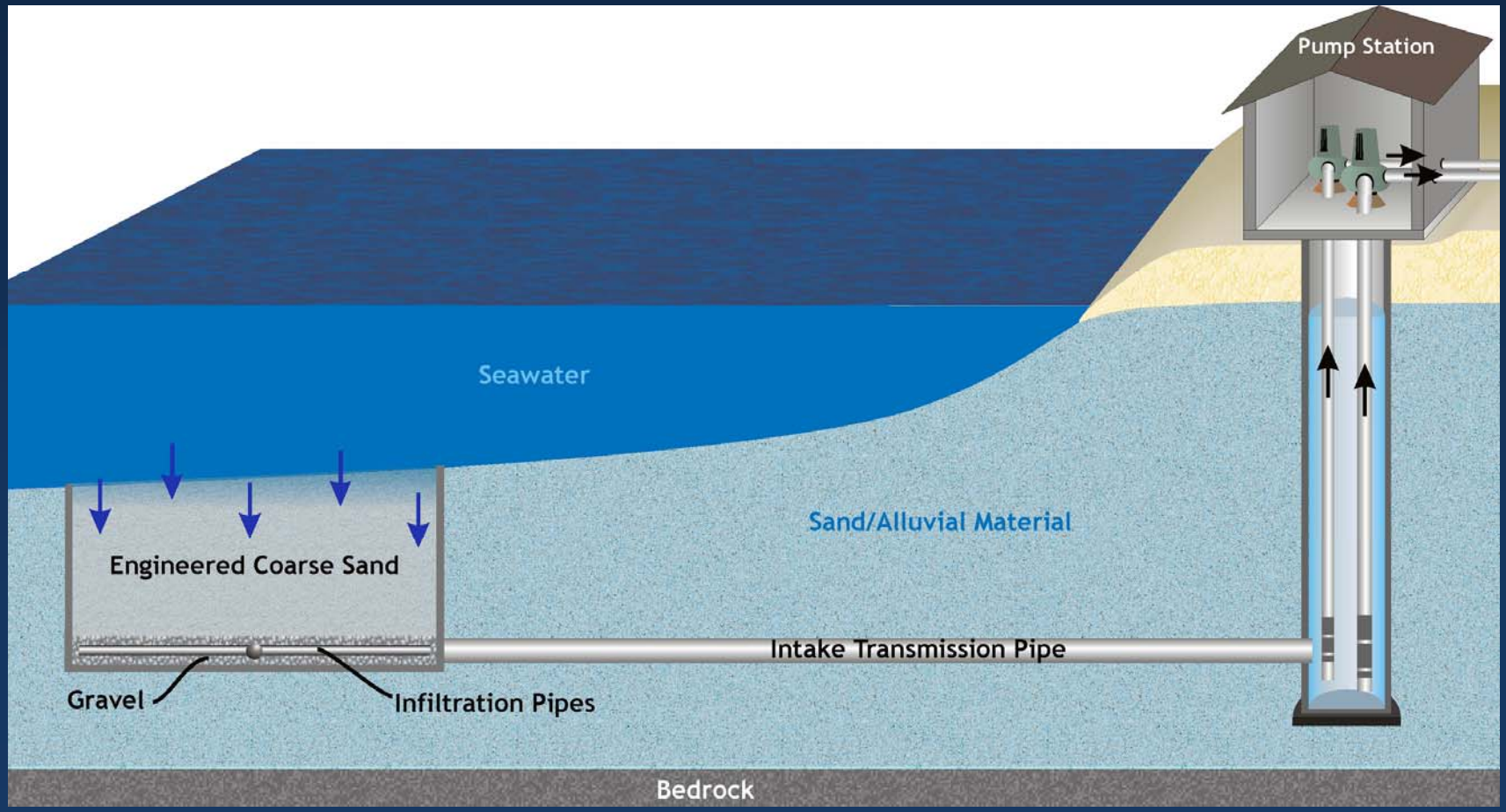
In some coastline locations, beach wells and collector wells will not work

- **Shallow beaches over bedrock**
- **Fine-grained sands**
- **Significant seasonal beach erosion**
- **Alluvial deposits with organics, silts and clay**

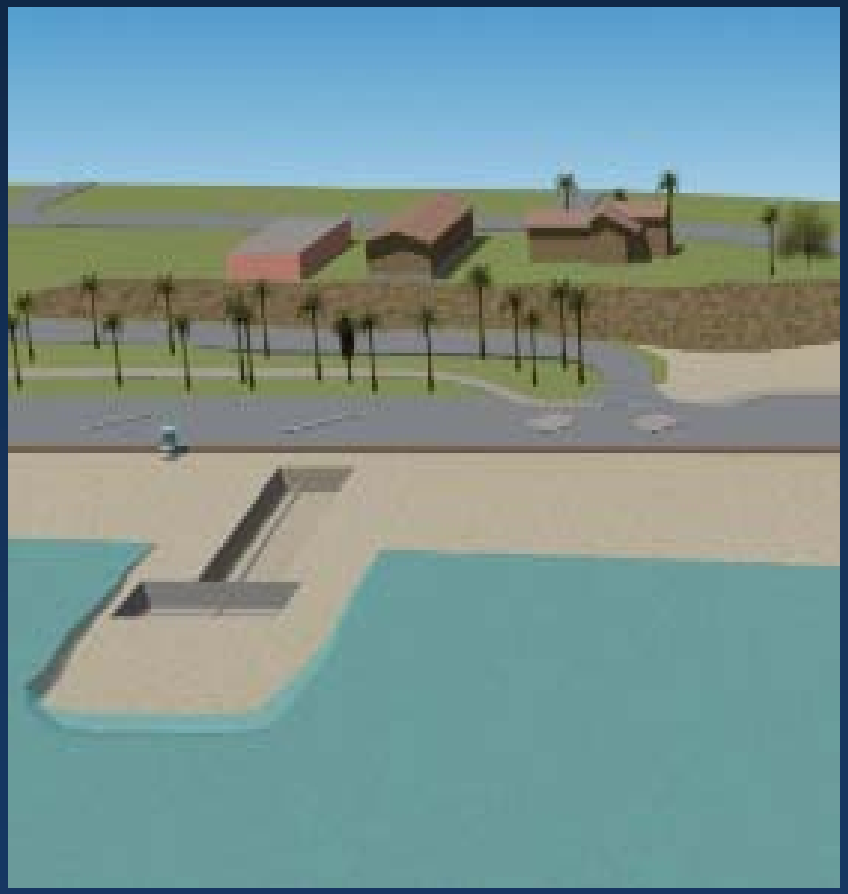
Slant wells, being tested at Dana Point, CA, show promise where natural sands are suitable



An engineered infiltration gallery could work where natural sands are not suitable



Long Beach, CA is evaluating an engineered beach infiltration gallery approach



(Graphic courtesy of LBWD)

- **Replace native fine-grain sands with large-grain sand**
- **Pilot gallery in the surf zone for natural cleaning of the surface**
- **Relatively calm waters with little sediment**
- **Low filtration rates of <0.1 gpm/ft2**

However, USGS data shows that fine sediments from rivers could likely plug up an engineered infiltration gallery in some areas

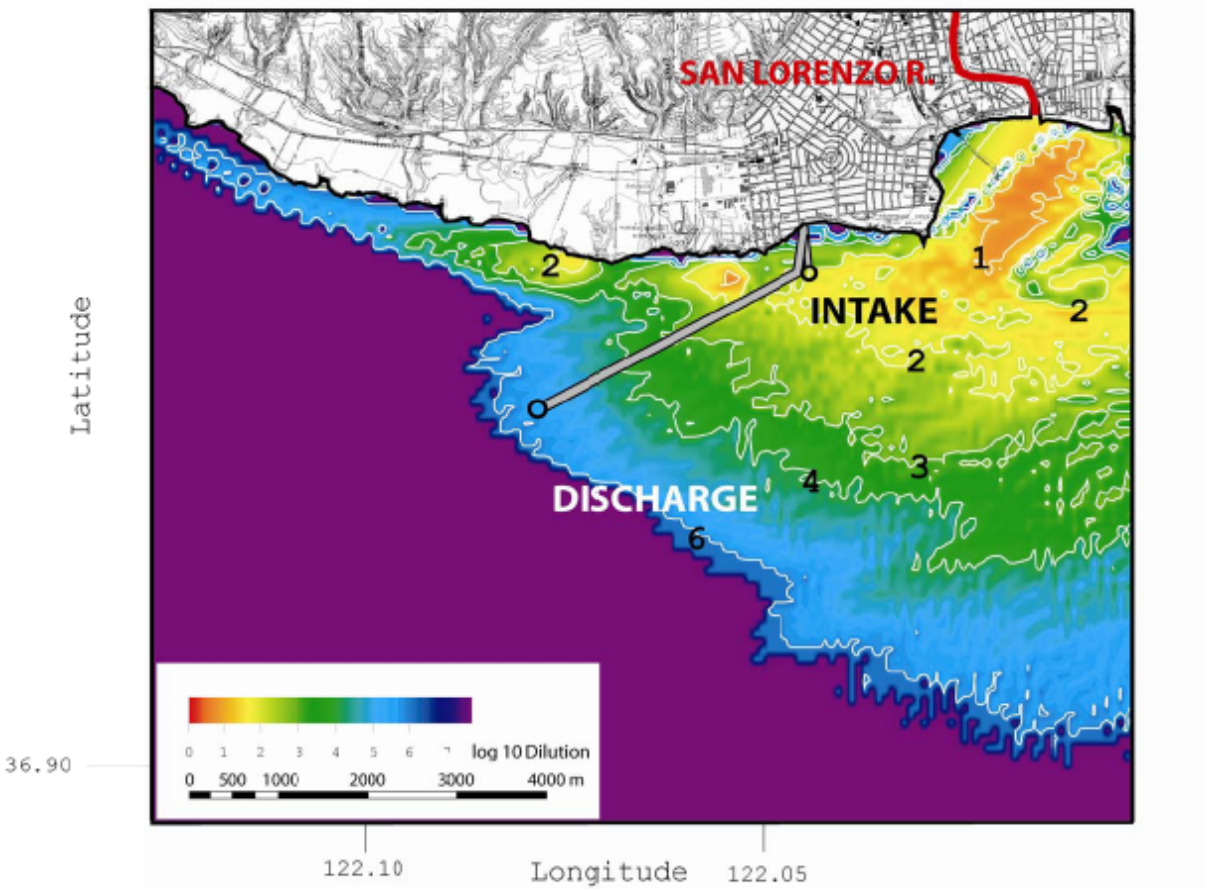
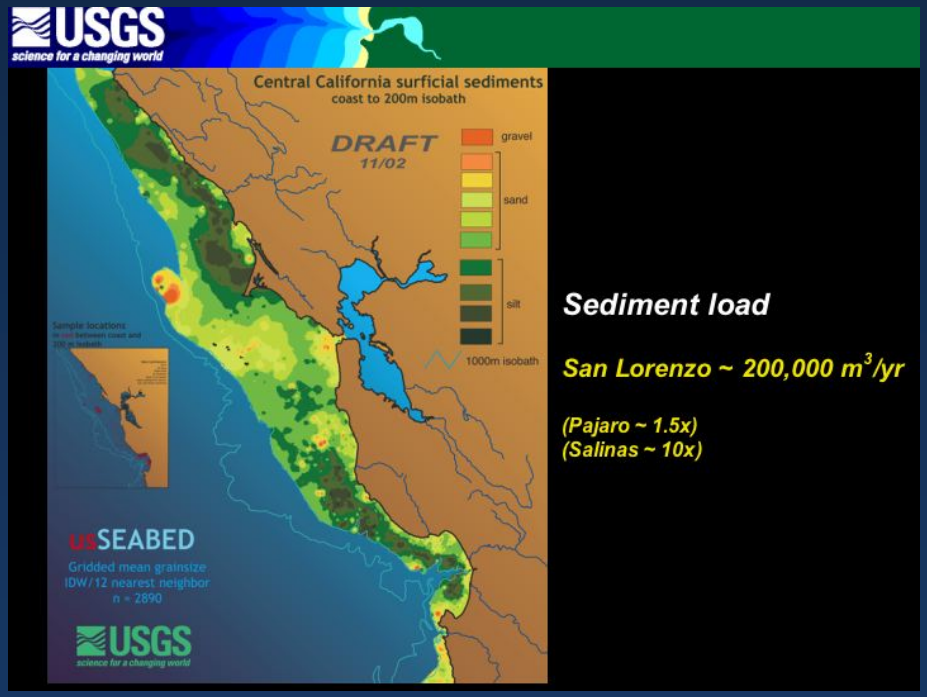


Figure 4.9. Surface dilution field of storm water runoff from 3 February 1998 storm event. Intake flow rate = 7.0 mgd.

Santa Cruz Intake Evaluation Approach

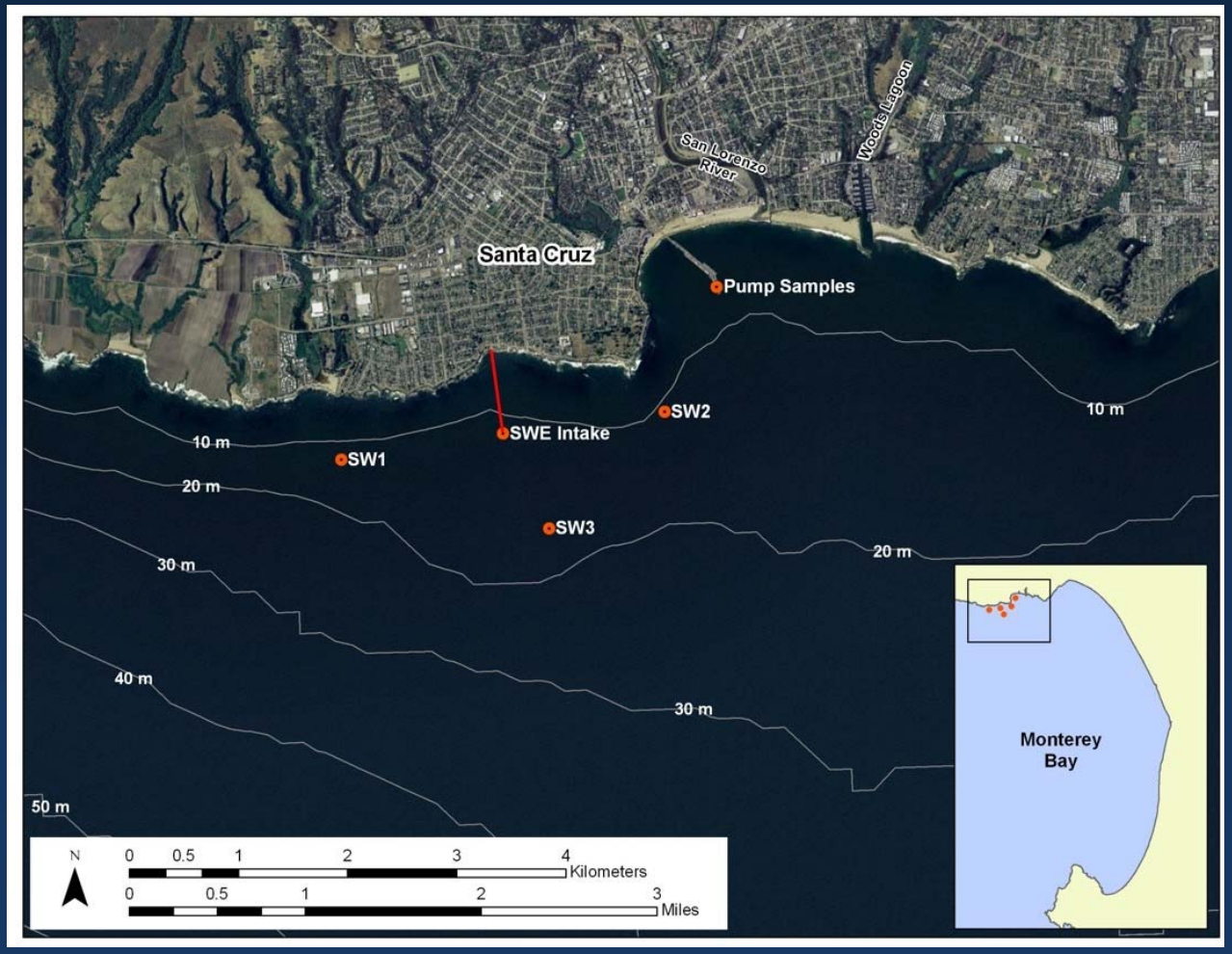
- **Investigate alternative sub-surface and screened open water intakes in parallel**
- **Communicate and collaborate with regulatory agencies and scientific community through a Technical Working Group**
- **Evaluate intake approaches based on:**
  - **Feasibility**
  - **Capital Cost**
  - **Operating Cost**
  - **Environmental Mitigation**

Technical Working Group and USGS provide independent, scientific guidance, review and data for intake studies



- **TWG Regulators**
  - California Coastal Commission
  - Regional Water Quality Control Board
  - National Marine Fisheries Service
  - California Department of Fish and Game
  - Monterey Bay National Marine Sanctuary
- **TWG Scientists**
  - University of California, Santa Cruz
  - Moss Landing Marine Laboratory
  - US Geological Survey

A 13-month study is being conducted to evaluate the impingement and entrainment impacts from a screened open-water intake



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From USGS data, there is an alluvial channel offshore of Santa Cruz that may support an subsurface intake

From the intake studies and conceptual designs an appropriate intake approach will be selected

- **Work with regulators through the EIR process**
- **Capital costs of intake systems and piping to the desalination facility**
- **Operations and Maintenance costs of intake system and desalination system**
- **Environmental impacts and mitigation costs**
  - **Construction Impacts**
  - **Operational Impacts**

Questions