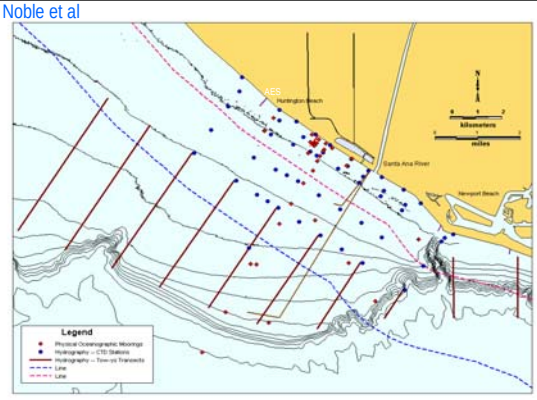
In the summer of 1999, bacterial contamination on Huntington Beach caused two months of beach closures.

This led to ....

The Great Huntington Beach Sewage Outfall Secondary Treatment Waiver Battle

www.hbonline.com

Noble et al



Does the sewage outfall contaminate the beach?

Timeline

1954: OCSD starts dumping treated sewage 2.1 km offshore
1958: OCSD starts measuring bacteria at H Beach
1965: new diffuser installed on outfall
=> bacterial concentration increased dramatically
1969: some raw sewage in Santa Ana River
=> worst beach contamination ever
1972: federal Clean Water Act defines dumping standards
1972: new outfall built 7.5 km offshore with federal $
=> improved water quality
1985: OCSD has secondary treatment waiver
1999: state AB411 standards for beach contamination
=> H Beach closed for 2 months
2000: OCSD starts treating runoff from river and marsh
=> reduced beach contamination
2002: secondary treatment waiver up for renewal
=> big public controversy

Battle at the Orange County Sanitation district
Things got all mixed up

Ways of thinking
- politics
- science
- emotions
- money

Issues
- beach contamination
- secondary sewage treatment

Topics regarding beach contamination:

- *Regulation:* State AB411 standards define bacterial contamination
- *Science:* identifying bacteria
- *Science:* transport between sewage outfall and beach
- *Regulation:* Federal Clean Water Act sets sewage treatment requirements
- *Technology:* how sewage is treated
- *Policy:* arguments and decisions --- what would you do?

- *Science:* sources of beach contamination
- *Science:* effects of chlorination
- *Regulation:* what are the laws in North Carolina?

Is it safe to swim at the beach?
California State AB-411 Standards,1999

Health Risks due to Bacterial Contamination
- stomach flu, diarrhea
- sore throat, respiratory infection
- fever, rashes

Indicator Bacteria
- easy to count
- do not cause health problems
- suggest presence of pathogenic microorganisms

Sources of Contamination
- storm drains
- sewage outfalls
- birds & animals

California AB-411 Standards: Bacteria

Kind of Bacteria	Number Allowed	Chance of Sickness
Total Coliform	10,000 / 100 ml	1 in 60 (skin rash)
Fecal Coliform	400 / 100 ml	
Fecal/Total ratio (for comparison:	1/10 1/2	1 in 85 (any illness) 1 in 20)
Enterococus	104 / 100 ml	1 in 77 (stomach flu)

are these standards strict enough?
we'll get to NC standards later

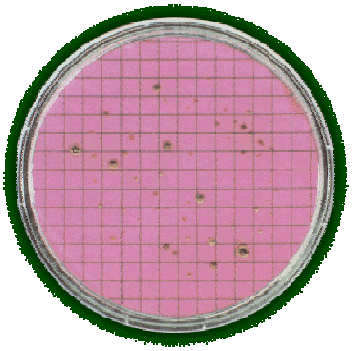
www.healthebay.org

Sampling for Bacteria in Surf Zone

G. Robertson et al

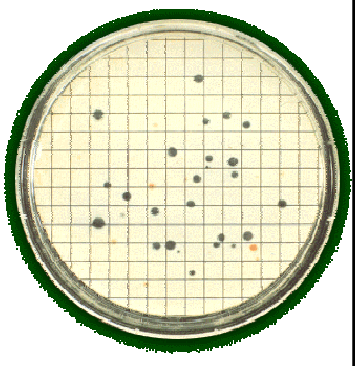
Total Coliform Colonies

"golden-green sheen"
with Schiffs Reagent



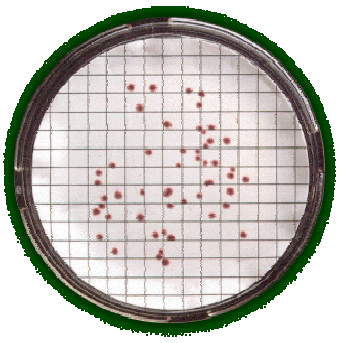
Fecal Coliform Colonies

Blue spots
with analine dye



Enterococcus Colonies

Red spots
with esculin



Take home points:

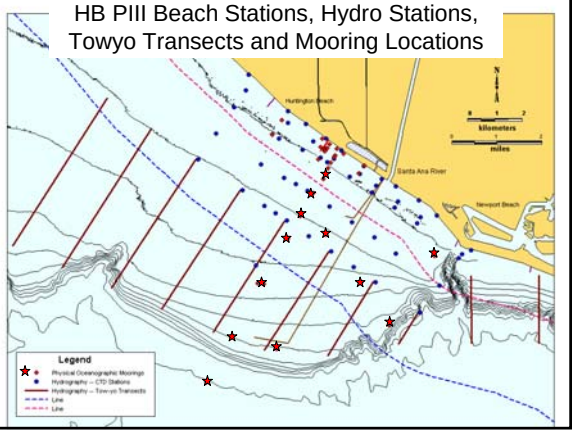
- state determines safe level of bacterial contamination
- each kind bacteria is tested in a different growth medium
- counting bacteria is very difficult

... questions so far?

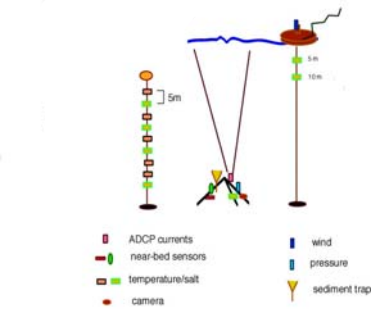
Can bacteria from the OCSD outfall hit the beach?

- count beach bacteria; compare with AB411 standards
- measure the outfall plume
- measure currents, temperature and salinity
- look for transport processes
- look for spatial connections

HB PIII Beach Stations, Hydro Stations, Towyo Transects and Mooring Locations



Example Mooring Array



Noble et al

Offshore and Surf zone Sampling

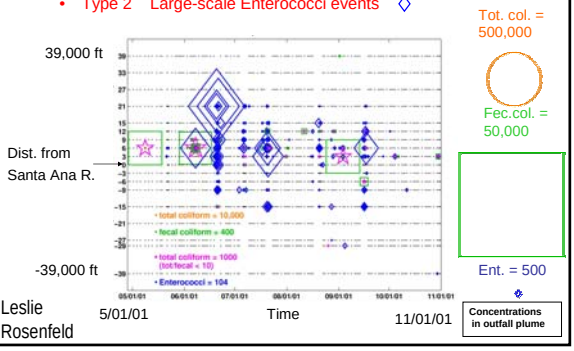
CTD

Surf zone

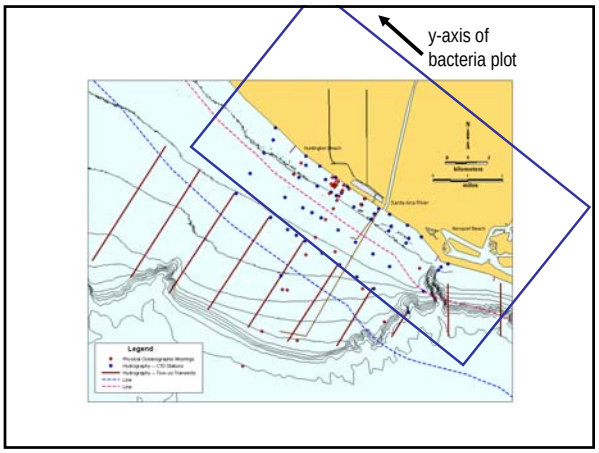
Towyo

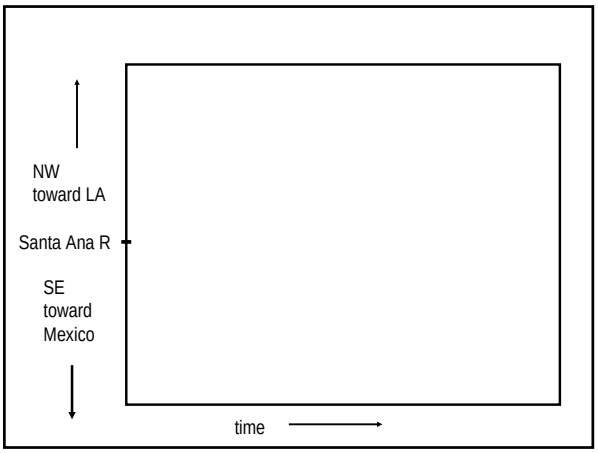
Surfzone Bacteria Patterns

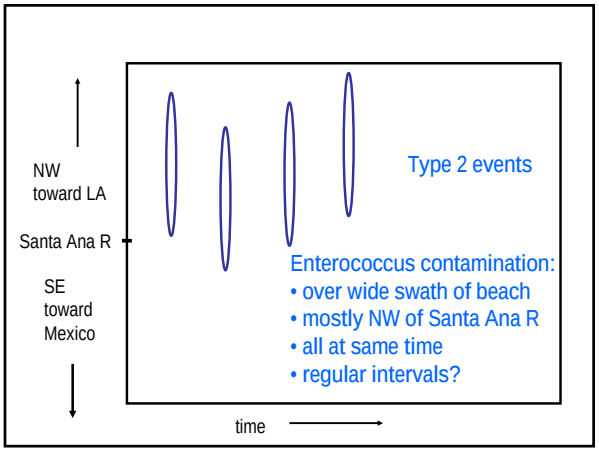
- Type 1 Localized total and fecal coliform events ☆ □
- Type 2 Large-scale Enterococci events ◊

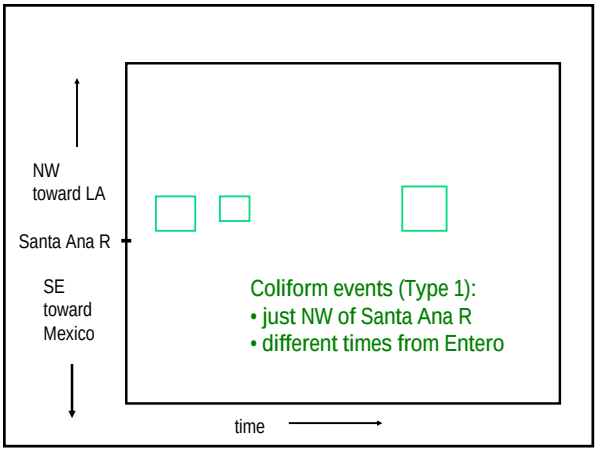


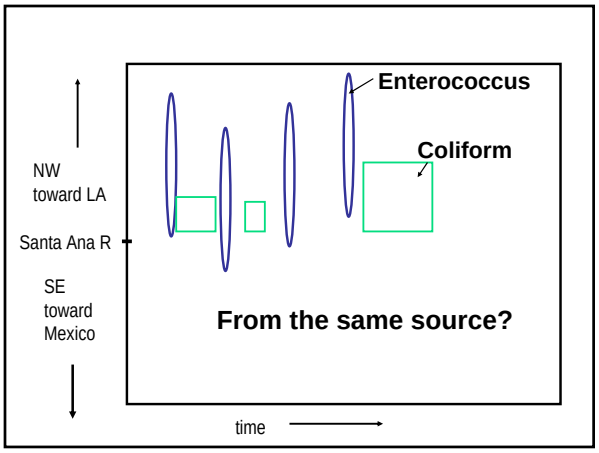
Leslie Rosenfeld

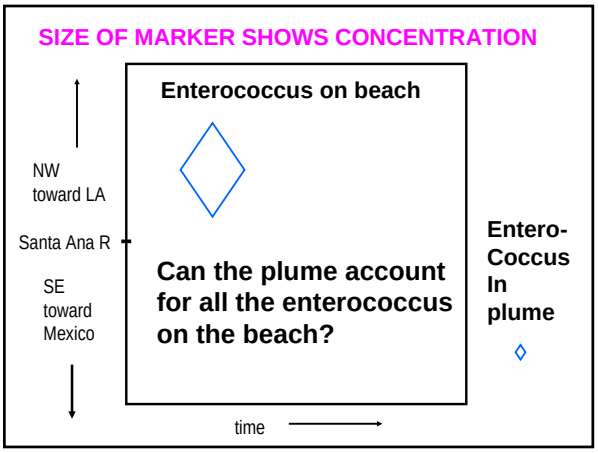

y-axis of
bacteria plot

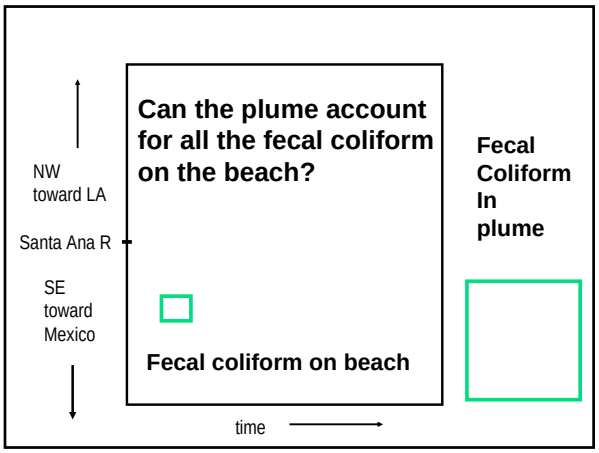

NW
toward LA
Santa Ana R
SE
toward
Mexico
time

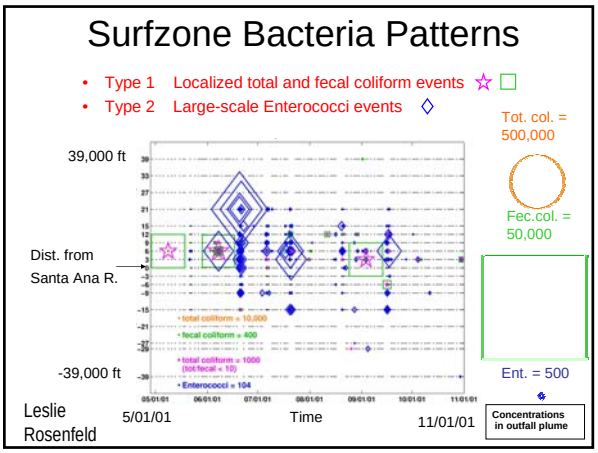

NW
toward LA
Santa Ana R
SE
toward
Mexico
Type 2 events
Enterococcus contamination:
• over wide swath of beach
• mostly NW of Santa Ana R
• all at same time
• regular intervals?
time

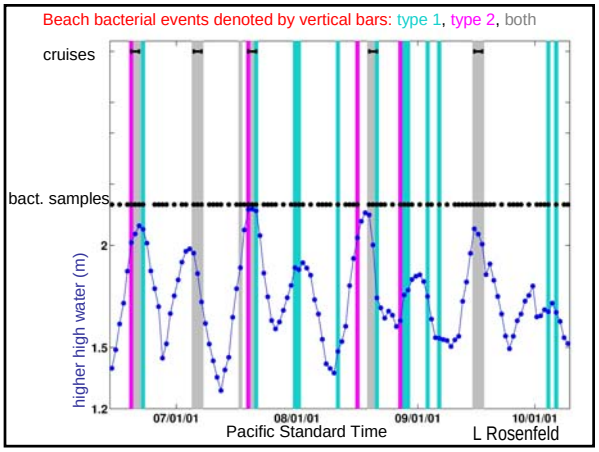

NW
toward LA
Santa Ana R
SE
toward
Mexico
Coliform events (Type 1):
• just NW of Santa Ana R
• different times from Entero
time

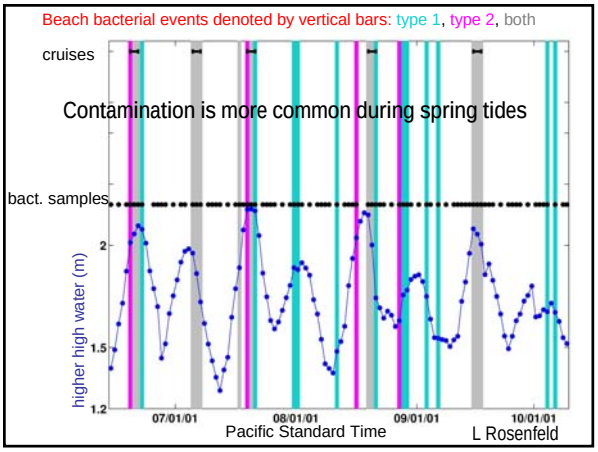

Enterococcus
Coliform
NW
toward LA
Santa Ana R
SE
toward
Mexico
From the same source?
time


SIZE OF MARKER SHOWS CONCENTRATION
Enterococcus on beach
NW
toward LA
Santa Ana R
SE
toward
Mexico
Can the plume account for all the enterococcus on the beach?
Entero-
Coccus
In
plume
time









Questions About Possible Transport Processes

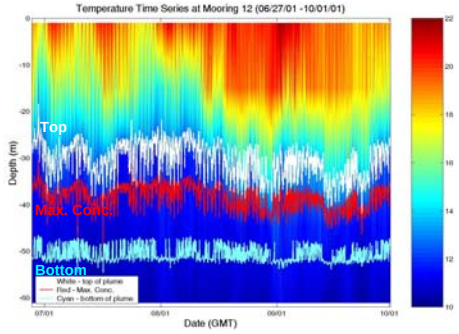
- Did we observe the process?
- Could the process transport plume water to the surf zone?
- Did we observe an association between the process and contamination events onshore?

Noble et al

One possible transport process: Internal Tides

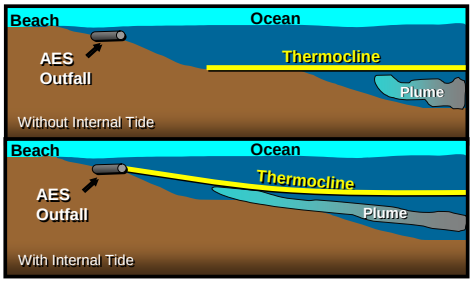
- where is the sewage plume?
- what is an internal tide?
- could internal tides bring sewage to the beach?
- do they actually do so?

Modeled Plume
stays in cold water near bottom

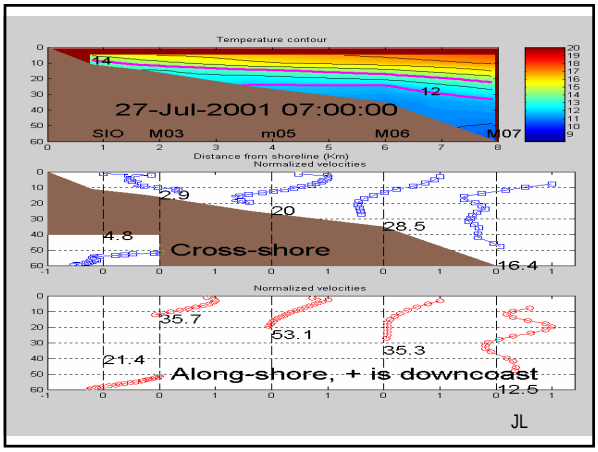


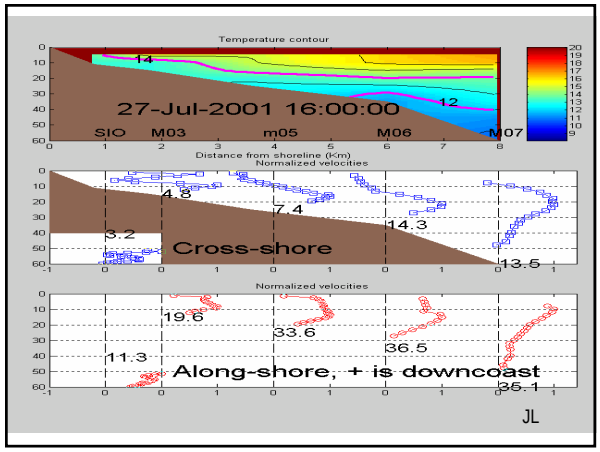
Internal Tides

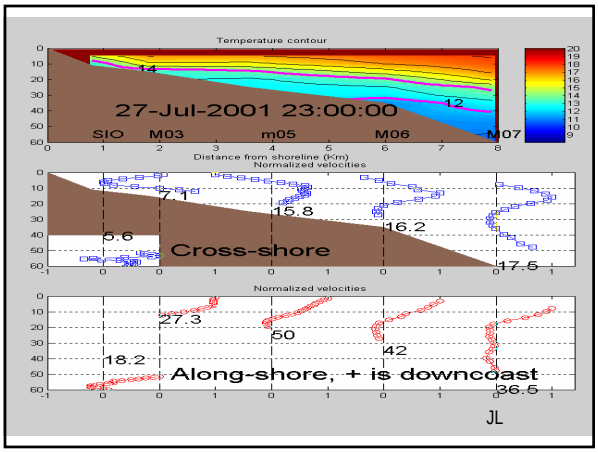
- Onshore and alongshore currents.
- Can occur every 12 or 24 hours.

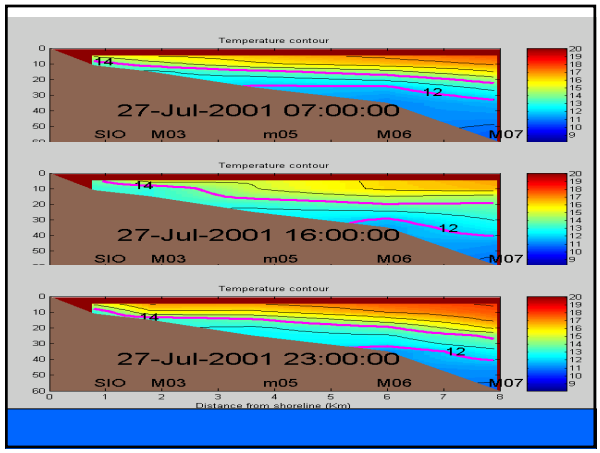


John Largier

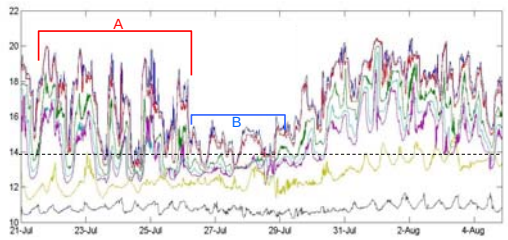






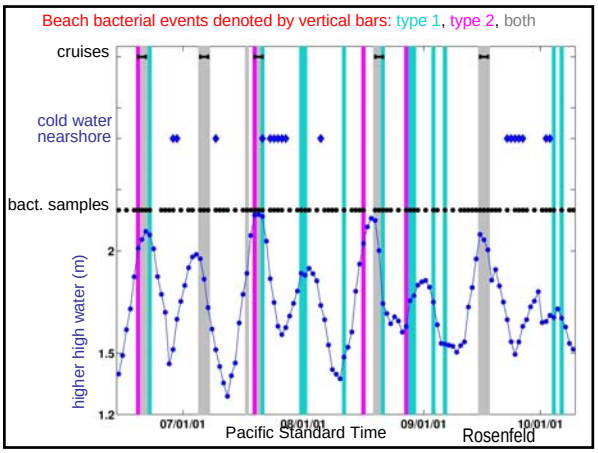


Cooling Events



A – Cooling due to tidal surges
B – Longer term cooling events

JL



Conclusion for Cold Events

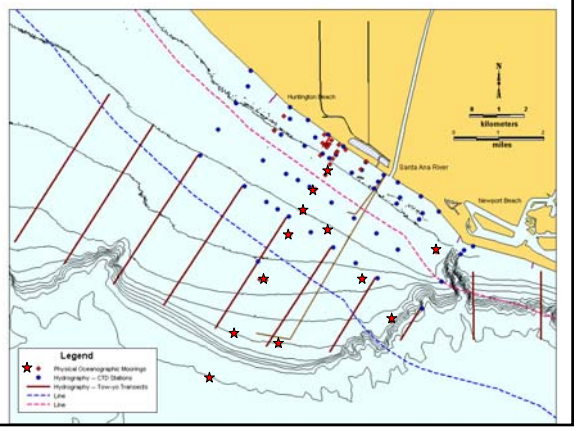
- Internal tides exist.
- Temporal disconnect between transport and contamination.

Noble et al

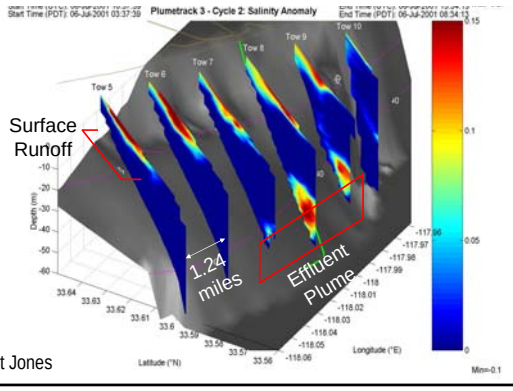
Topics regarding beach contamination:

- *Regulation:* State AB411 standards define bacterial contamination
- *Science:* identifying bacteria
- *Science:* transport between sewage outfall and beach
- *Regulation:* Federal Clean Water Act sets sewage treatment requirements
- *Technology:* how sewage is treated
- *Policy:* arguments and decisions --- what would you do?

- *Science:* sources of beach contamination
- *Science:* effects of chlorination
- *Regulation:* what are the laws in North Carolina?



Where is the Bacterial Plume?



Burt Jones

Spatial disconnect movie goes here

Take home points on sewage transport

- temporal disconnect – internal tides / contamination
- spatial disconnect – beach / plume

Do you think the plume is responsible for beach contamination?

Scientist's Conclusions

"We have not yet found a connection between coastal ocean processes and bacterial contamination on the beaches."

"We do not think bacteria in the plume contributes substantially to the contamination events on the beach that exceed the AB411 standards."

Noble et al

.. but OCSD was still not obeying the federal law.

Regulatory Issues

1972, federal Clean Water Act
- controls what is dumped in the ocean
- requires secondary sewage treatment for ocean outfalls
- OCSD was not in compliance with CWA

? Does compliance with CWA ensure safety by AB411 standards?? ... actually, no

Sources: www.wef.org, www.healthebay.org

Settlement Tank
Johnstown, PA
WWW.CTCnet.Net

Primary Treatment
40% of solids

1. **Filter**
2. **Settle**
   - **a) solids sink to bottom**
   - **b) oils float to surface**
   - **c) middle cleaner**

Secondary Treatment
85% of solids
- biological treatment + more filters
- required by 1972 CWA
- does **not** kill bacteria
- upgrade $270 – $400 **million**

Oxidation ditch – encourages bacteria

Secondary Treatment: bacteria decompose organics

- activated sludge
- filter through rocks
- lagoons in sun

Final clarifier

Tertiary Treatment

- reverse osmosis
- micro-filtration
- activated charcoal
- water your crops!!

… OR …

kill bacteria

The Argument: (as of early July, 2002)

OCSD

- has a waiver allowing only 50% secondary treatment
- believes they are not harming environment
- wants to save money on treatment ($400 million)
- suggests chlorine to kill bacteria

Scientists

- believe beach contamination from other source than plume

The Argument:

Environmentalists

- want clean beaches and clean ocean
- believe bacterial contamination due to OCSD outfall
- demand an end to the secondary treatment waiver
- cite non-compliance with Clean Water Act
- object to chlorine disinfection

The Irony:

- secondary treatment does not kill bacteria
- disinfection kills bacteria

Issues for decisions on sewage treatment

Where do the bacteria on the beach come from?
Would secondary treatment make the beach cleaner?

... but ....

are these the only issues to be considered?

Whose needs should we consider?

How can we make this important decision?

Do you care about
bacteria counts on the beach
OR
any sewage anywhere in the ocean?

Should decision be based on
cost / benefits analysis
OR
zero tolerance for impact?

What other issues are important?

Should OCSD go to full secondary? VOTE!!

1. **full secondary**
2. **chlorination**
3. **further study**
4. **other ideas?**

The Result

July 17, 2002, OCSD Board of Directors
voted 13/12 to go to full secondary treatment

- can't demonstrate no impact on beach bacteria
- possible water reclamation
- public opinion
- cost now somewhat lower ($270 million)

Also plan chlorine bleach disinfection + dechlorination, by August 12, 2002.

What if ....

- imagine you're a student at UCSB
- Goleta Beach is next to campus
- sewage outfall is at beach
- it was not full secondary in 2002
- cost of upgrade is $8/person/month
- beach is contaminated after rain

would you vote to pay for the upgrade?

santabarbara.com