

# Development of a pathogen prediction tool for south County coastal communities

- Previous work has improved our understanding of untreated sewage transport in coastal ocean
- Next step is to develop an operational forecast model



The San Diego Union-Tribune

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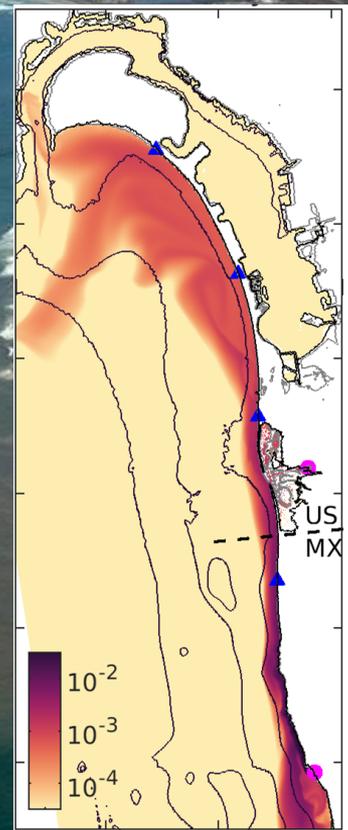
## Tijuana sewage pounded South Bay beaches last year. EPA says help is on the way



Signs warn of contaminated ocean water in Imperial Beach on May 30, 2019. Recent rains have contaminated the water in the region near the mouth of the Tijuana River. (K.C. Alfred/The San Diego Union-Tribune)

Imperial Beach shoreline near the international border was closed for 295 days last year.

BY JOSHUA EMERSON SMITH, WENDY FRY  
FEB. 13, 2021 7 AM PT



Prior SIO Modeling Work:  
|| showed importance of Pt. Bandera  
|| consistent with SD County ddPCR sampling  
|| funded by NSF and EPA

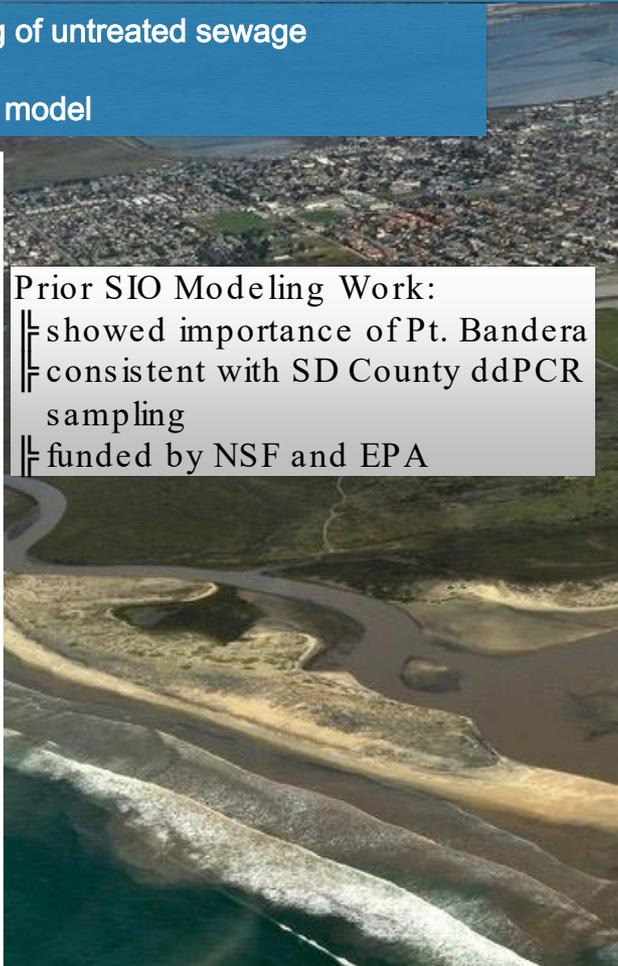


Photo: Serge Dedina

# Development of a pathogen prediction tool for south County coastal communities

## Next: Beach Forecasts of Human Illness Risk for the US/Mexico Border Region

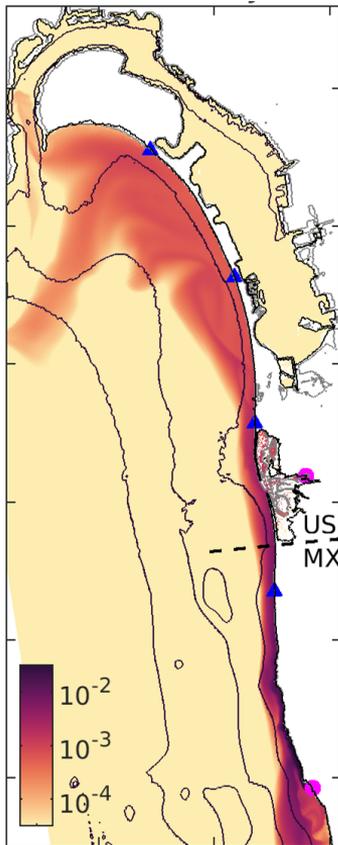
*Scripps Institution of Oceanography, UC San Diego*

Feddersen, Giddings, Barton, Bowman, Send, Spydell, Cornuelle, Anderson

### Goals

- Allow family in Chula Vista to know whether can take kids to the beach on the weekend
- Support water quality infrastructure investment validation via robust monitoring

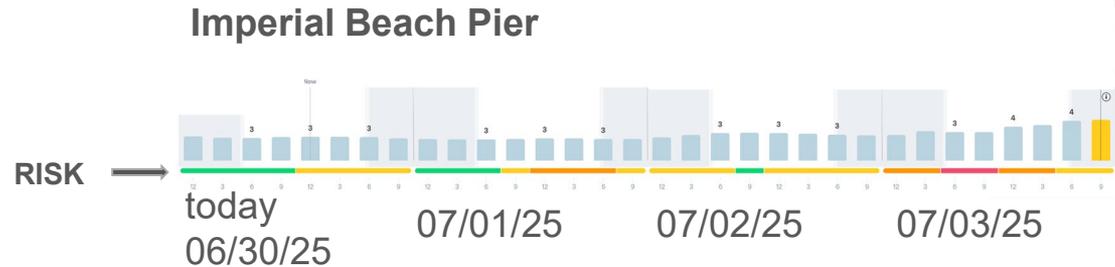
- Combine pathogen ecology & hydrodynamic models in forecast mode
- Leverage previous investment by NSF and NADB/EPA
- Provide regional 3-5 day forecasts for beach swimmers
- Interdisciplinary: Involves multiple SIO PIs
- Will complement Scripps airborne pathogen research and SDSU TJRE research



# Pathogen Forecast Model potential webpage mockup



The pathogen model webpage will have information like this. Locations on the map will be clickable to show forecast (e.g., surfline/weatherunderground) of **Swimmer Illness RISK**.

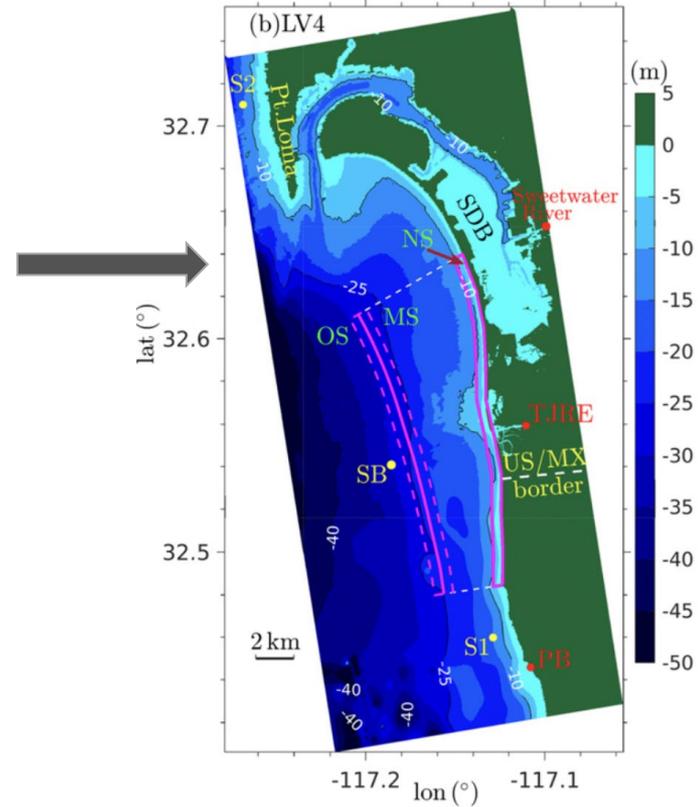


## Components

1. Computing
2. Pathogen Ecology Experiments
3. Real time Mooring Deployment
4. Measurements in Mexico

## Resources

- Pathogen forecast model will be run locally on a 400 CPU cluster.
- Cluster is now operational.
- Software is currently being developed to run the forecasts.
- The region has been previously modeled and this software is being used for the Pathogen forecast model.
- The “Live Ocean” forecast model is public and similar. We are using this existing software for the Pathogen model.



# Example of Another Forecast Model (LiveOcean)

- LiveOcean is an analogous forecast model system for Pacific Northwest focussed on Harmful Algal Blooms
- LiveOcean is open-source software which we will adapt to our purposes

## LiveOcean

Today's Forecasts	New	Background	Gallery
<a href="#">Full Region Surface Salinity and Drifters</a>	<a href="#">Surface Drifter Tracks - full domain</a>	<a href="#">How Tides Work in Puget Sound</a>	<a href="#">A Year of Modeled Salinity</a>
<a href="#">Full Region Bottom Oxygen</a>	<a href="#">Surface Drifter Tracks - Puget Sound</a>	<a href="#">Observed Long-term Trends in Puget Sound Water Properties</a>	<a href="#">A Year of Modeled Oxygen</a>
<a href="#">Washington Shelf Bottom Oxygen (5 days)</a>	<b>About the Model</b>	<a href="#">The Estuarine Exchange Flow</a>	<a href="#">A Year of Modeled Phytoplankton</a>
<a href="#">Puget Sound Surface Temperature</a>	<a href="#">How the Model Works</a>	<a href="#">References</a>	
<a href="#">Puget Sound Surface Currents</a>	<a href="#">How We Test the Model</a>		
<a href="#">Coastal Estuaries Surface Ocean Acidification</a>	<a href="#">Real-Time Data from the NANOOS NVS Site</a>		
<a href="#">Coastal Estuaries Bottom Ocean Acidification</a>			
<a href="#">Full Region Surface Salinity and Drifters with Close-ups</a>			

**LiveOcean is a computer model simulating ocean water properties. It makes 3-day forecasts of currents, temperature, salinity and many biogeochemical fields including harmful algal blooms.**

LiveOcean is an ongoing project of the UW Coastal Modeling Group: Dr. Parker MacCreedy (UW Oceanography, lead), Dr. Samantha Siedlecki (U. Connecticut, oxygen & carbon chemistry), Dr. Ryan McCabe (UW JISAO, validation), Dr. Neil Banas (University of Strathclyde, Scotland, ecosystem modeling), and David Darr (computational systems).

The model output presented here is part of ongoing research into the realistic simulation of ocean biology and chemistry. This is an experimental product and intended for research use only. Our goal in making it publicly available is to facilitate communication between resource users, managers, and scientists, and to improve the quality and utility of the forecasts. Any use of these forecasts is done at the risk of the user.

Questions or comments? Please email Parker MacCreedy: pmacc@uw.edu

The left map displays surface water temperature in degrees Celsius for August 23, 2021, along the Pacific Northwest coast. The temperature scale ranges from 12°C (blue) to 20°C (red). The right map shows the bottom water Aragonite Saturation State, with a scale from 0.0 (blue) to 3.0 (red).

# Observations of pathogens to support pathogen transport model

## Collect critical data to support the development of a pathogen transport model:

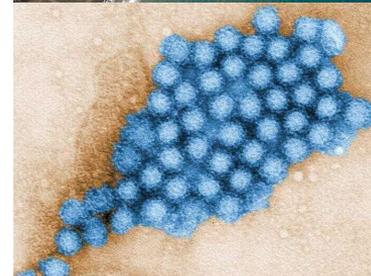
- Pathogen load
- Pathogen persistence

## Initial efforts focused Norovirus, pathogen gives most swimmer risk

- Norovirus is a common food and water-borne pathogen that causes severe gastrointestinal symptoms
- Infectious at low numbers
- Previously detected following storm events at regional rivers (Tourmaline Creek and San Diego River)
- Other pathogens to follow

## Due to small size and low abundance, Norovirus is difficult to capture and detect in water. We have:

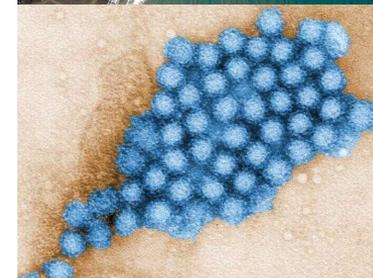
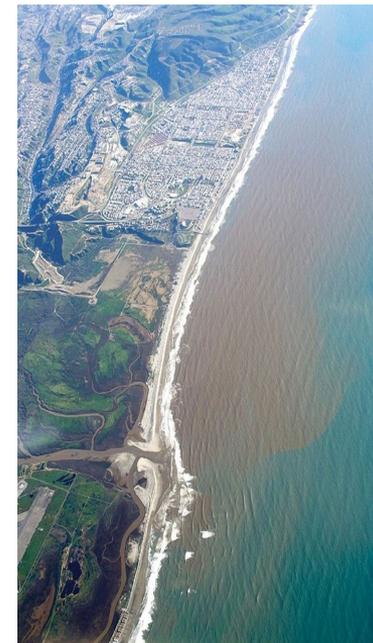
- Developed methods to capture Norovirus at low cost, at the scale needed for developing and testing the model
- Optimized a ddPCR-based method for detecting Norovirus. The ddPCR methods will be extended to other pathogens to supplement ongoing efforts by San Diego County



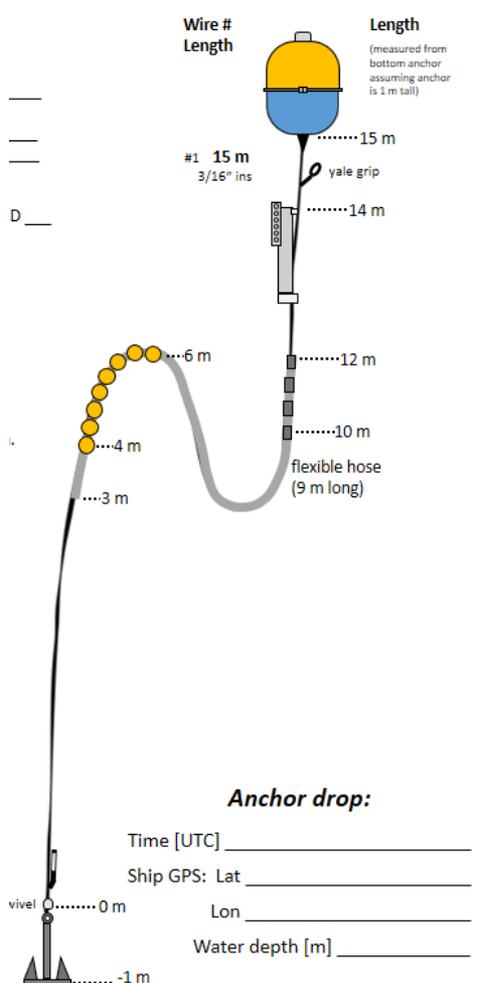
# Observations of pathogens to support pathogen transport model

Preliminary field work in the TJR system and offshore of IB has started, with our full field program scheduled to begin in June.

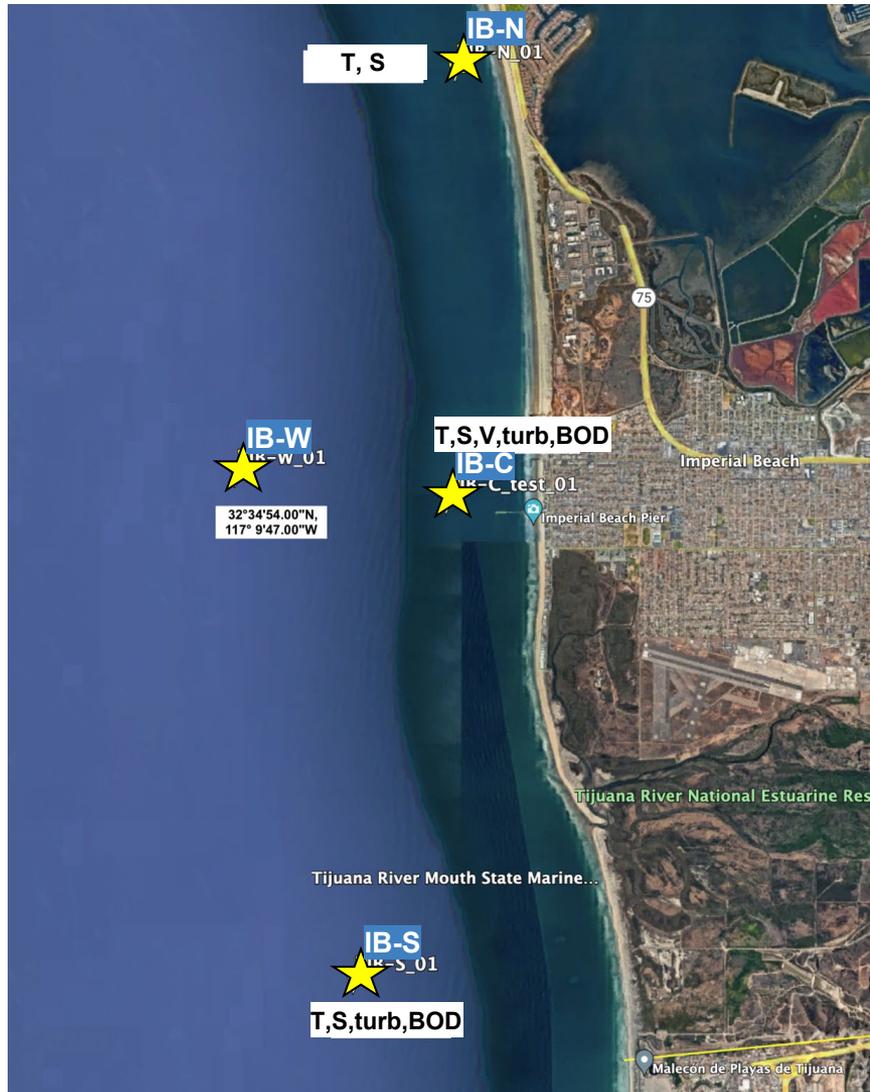
Fieldwork will coincide with laboratory experiments to determine how long Norovirus and other pathogens are viable in the environment.



# IB mini-mooring network to support model



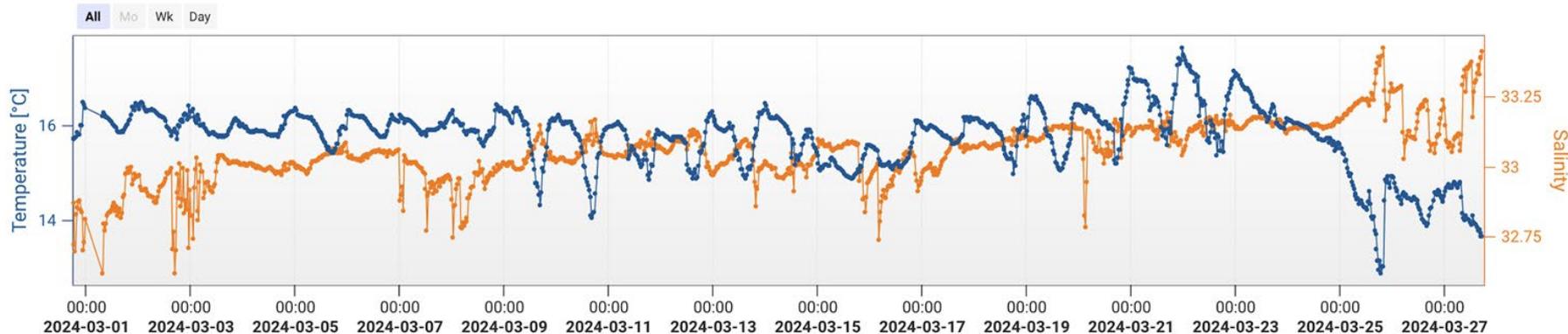
- permits in hand
- test mooring in water
- sensors ordered
- mini-mooring bodies ready



# Ongoing test deployment with real-time data

[https://mooring.ucsd.edu/mini\\_moorings/ib-c/ib-c\\_01/](https://mooring.ucsd.edu/mini_moorings/ib-c/ib-c_01/)

CTD



## Tentative timeline:

- March-May engineering test deployment
- June-July ADCP current sensor test deployment
- August-September test of one mooring with all sensors
- October-December trial operation of complete mini-mooring array
- 2025 begin of routine operation of array

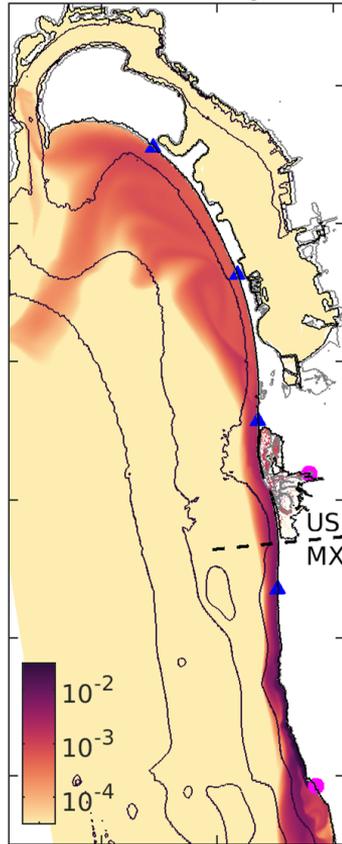
# Current observations in Mexico to support model

## UABC will deploy instruments in Mexico:

- Dra. Amaia Ruiz de Alegría Arzaburu
- 3 ADCPs from Pt. Bandera to Playas Tijuana
- Start this summer, maintain for a year
- Provide data to calibrate hydrodynamic model

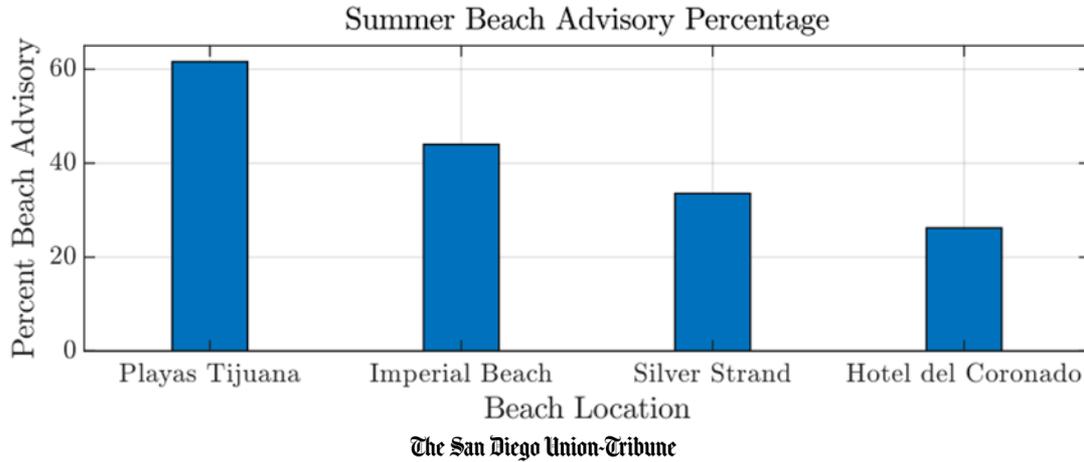


## Questions?



Thank you State Senator Padilla, SD state Assembly Delegation, and many others for support

# Model predicts large summer time beach advisory percentage



ENVIRONMENT

## Will Coronado, Imperial Beach shorelines be closed all summer? New testing reveals rampant Tijuana sewage

South Bay officials fear beach closures could have widespread social and economic impacts, possibly ending junior lifeguards and other programs

BY JOSHUA EMERSON SMITH

JUNE 14, 2022 3:57 PM PT

- *criticism*: HdC not that contaminated!
- but...FIB testing used culture based methods
- FIB die quickly
- norovirus lives a long time (14 d half life)
- summer 2022: county switched to ddPCR based method and...

kpbs

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Weekend Edition

Local

## New pollution tests wreaking havoc on South San Diego County beaches

By Erik Anderson / Environment Reporter  
Contributors: Roland Lizarondo  
Published June 16, 2022 at 5:17 PM PDT

*This is exactly what the 2017 NADB model predicted for summer 2017*