Reducing Human Sources of Bacteria to Storm Drains, Creeks, and Beaches

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Clean Creeks
HEALTHY BEACHES
CITY OF SANTA BARBARA

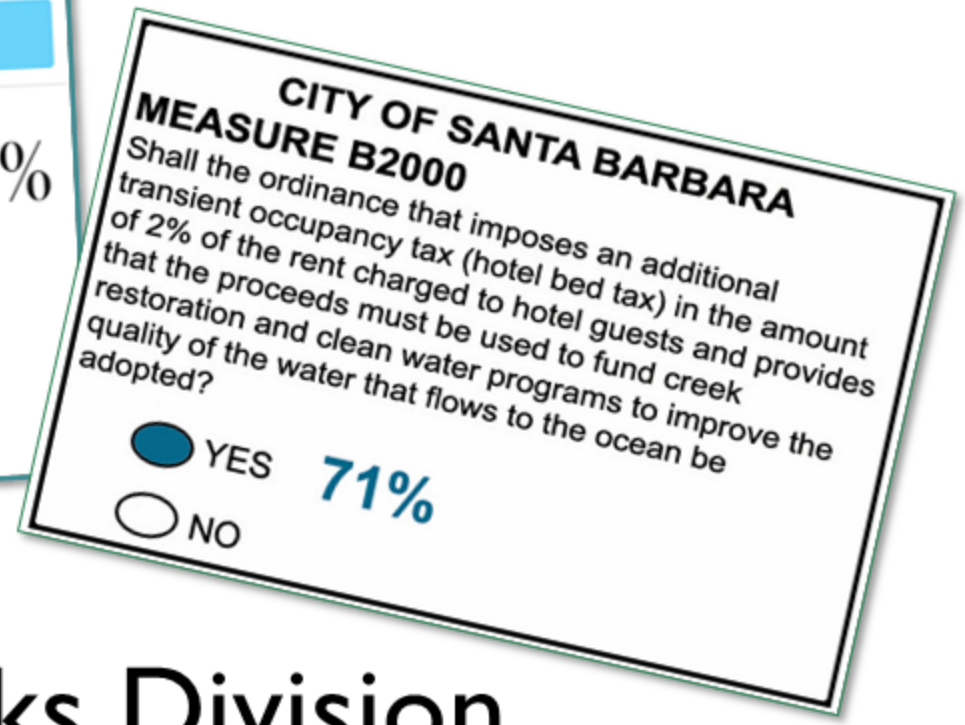

Los Angeles Times

SUBSCRIBE

U.S. Beach Closures, Advisories Rose 75% in '98; El Nino Blamed

L.A. TIMES ARCHIVES

JULY 16, 1999 12 AM PT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MEASURE B2000

Shall the ordinance that imposes an additional transient occupancy tax (hotel bed tax) in the amount of 2% of the rent charged to hotel guests and provides that the proceeds must be used to fund creek restoration and clean water programs to improve the quality of the water that flows to the ocean be adopted?

YES 71%

NO

City of SB Creeks Division

Measure B

Lodging tax rate from 10% to 12%, effective January 2001.

Mission

Improve creek and ocean water quality and restore natural creek systems

Creeks Advisory Committee

Representatives from the hotel/lodging industry, business community, and environmental field meet monthly to provide advisory role.

How can we reduce indicator bacteria at beaches, creeks, and storm drains?

Early Water Quality Improvement Projects

- ☒ Ultraviolet (UV) disinfection of storm drain discharge
  - – Indicator bacteria at background levels 200 ft downstream
- ☒ Low-flow storm drain diversions to sanitary sewer
  - – Conflict with restoration goals
- ☒ Bioswales
  - – Insufficient contact time

Funding from Measure B and Clean Beaches Initiative (Props 40, 50, 84), managed by Clean Beaches Task Force


• Why are there so many fecal indicator bacteria at this beach, creek, or storm drain?
• Are the fecal indicator bacteria from human or animal waste?
• What is the risk?
Dorsal Stream, CC BY-NC 2.0

Microbial *Source* Tracking

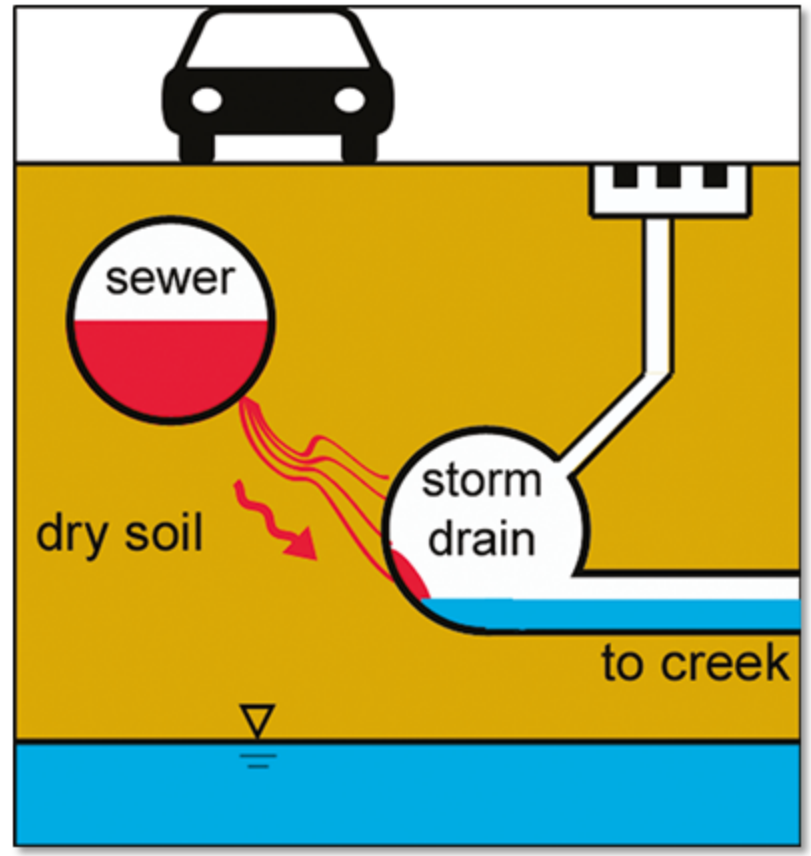
- Professor Patricia Holden, UCSB
- Molecular revolution
- Human waste *was not* detected at some project sites
- Human waste *was* detected in some storm drains
- Indicator bacteria did not correlate with human waste markers

Pause ….

- Proposed to Creeks Advisory Committee to focus on human waste due to risk

Microbial Source *Tracking*

Macaulay, 1976, *Underground.*



(Sercu et al. 2011, ES&T)

Laguna Watershed Study and Microbial Source Tracking Protocol Development Project (Funded by Clean Beaches Initiative), collaboration with UCSB and Geosyntec

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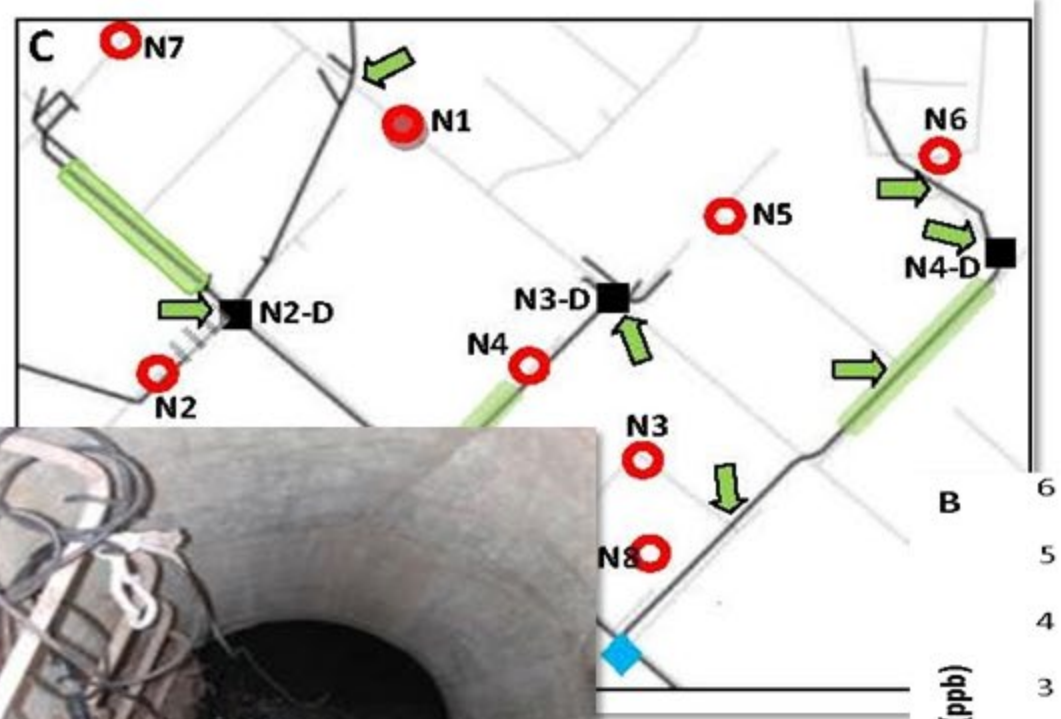
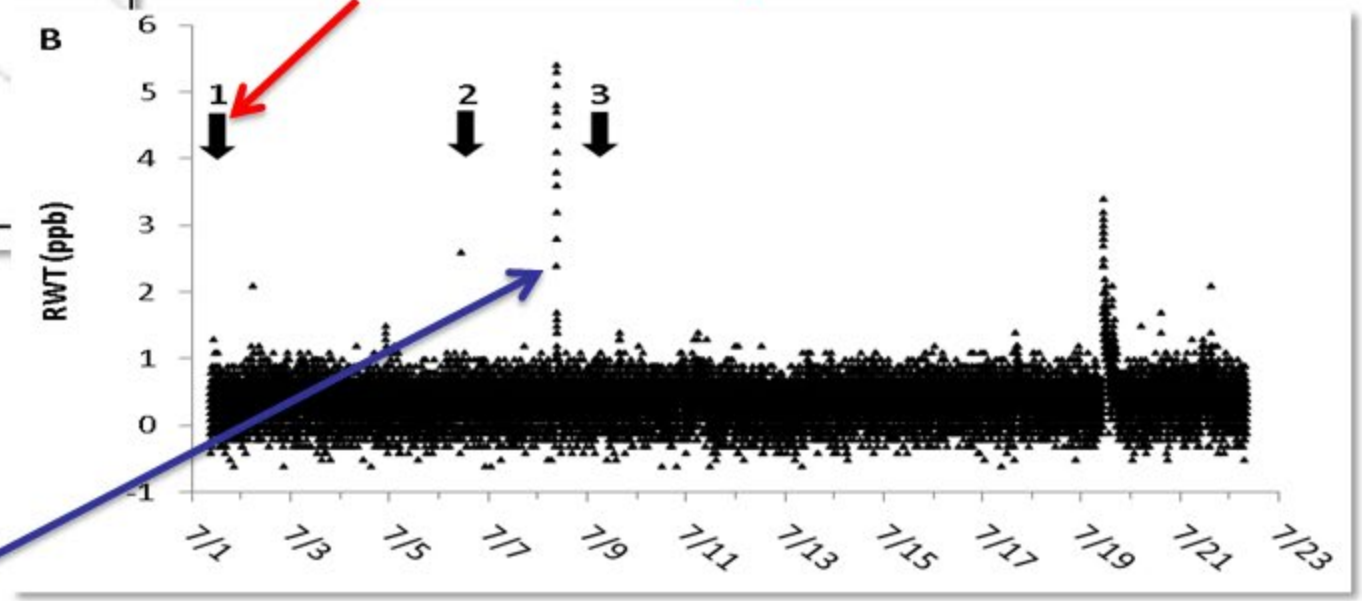
Geosyntec consultants

Dye Studies



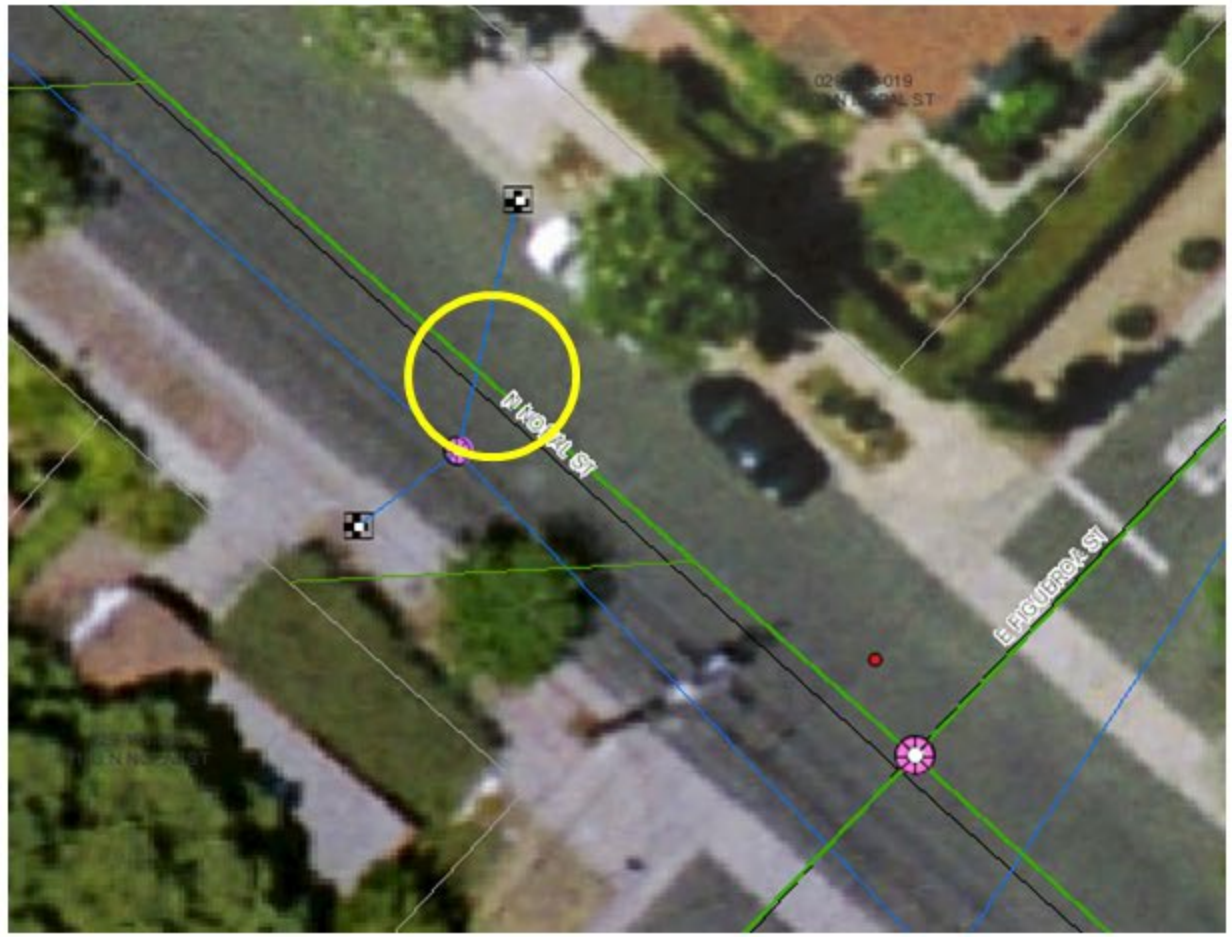
Dye in Sanitary Sewer

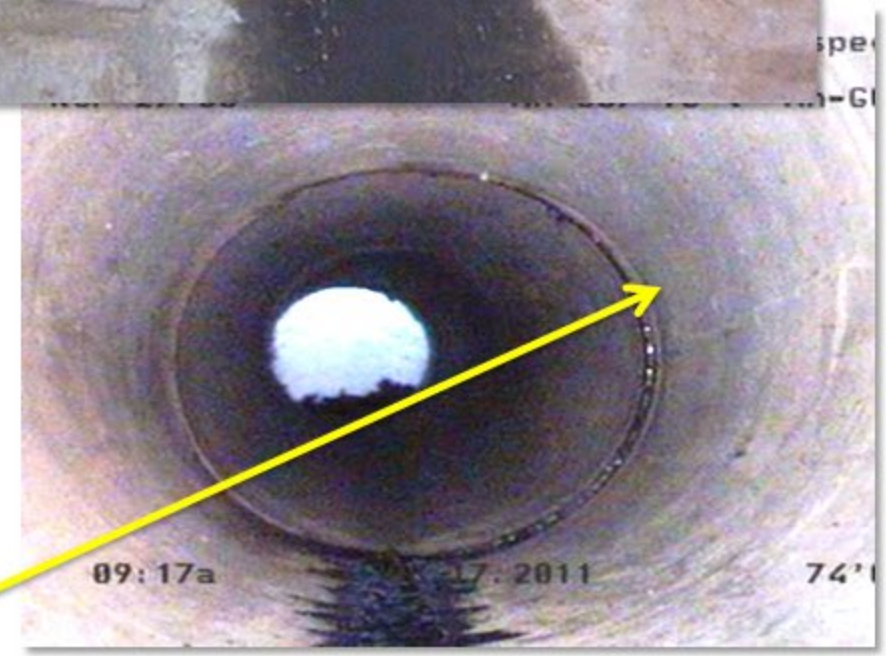


Probe in Storm Drain

Sercu et al. 2011 ES&T

Video of Storm Drains

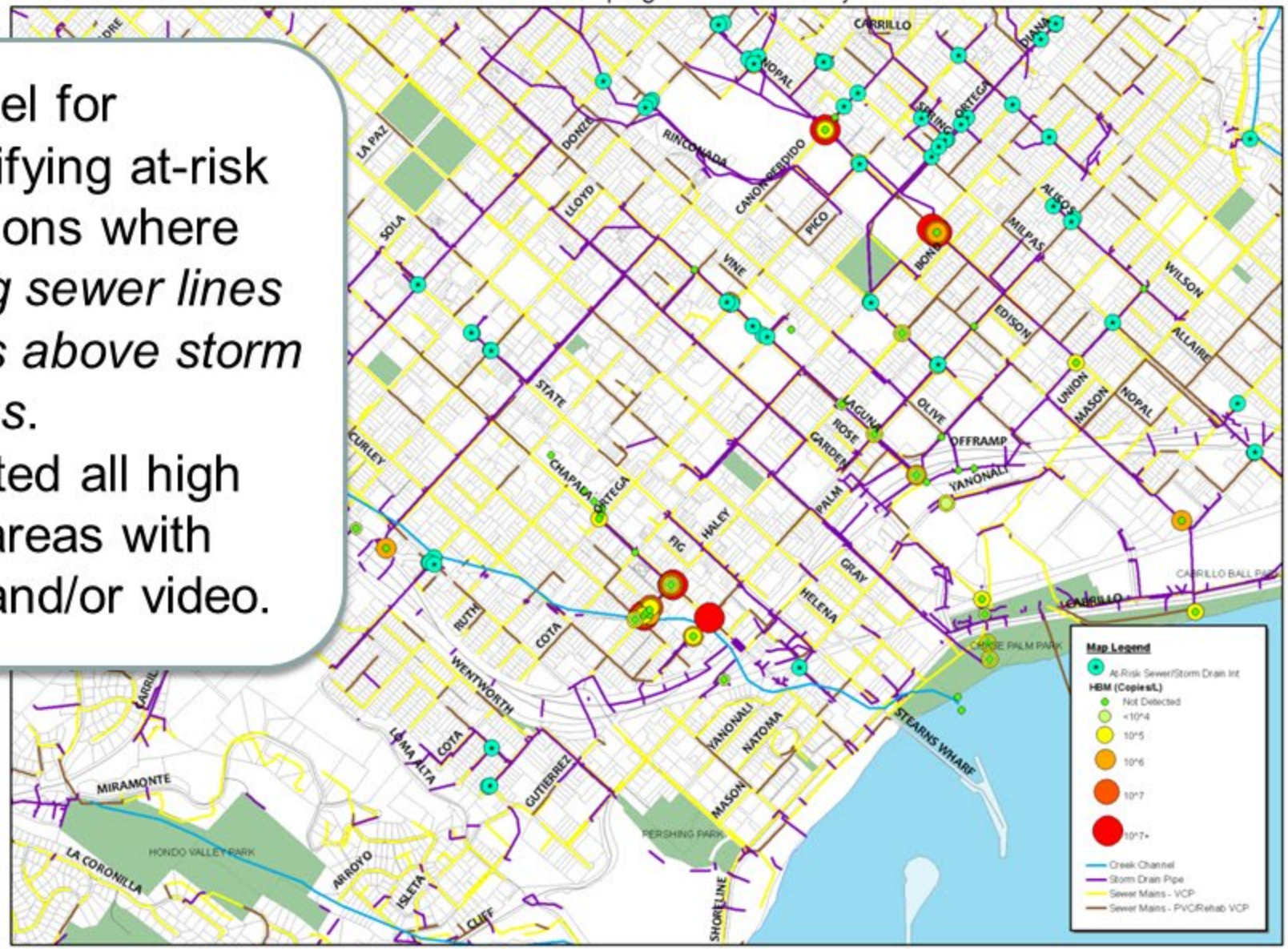




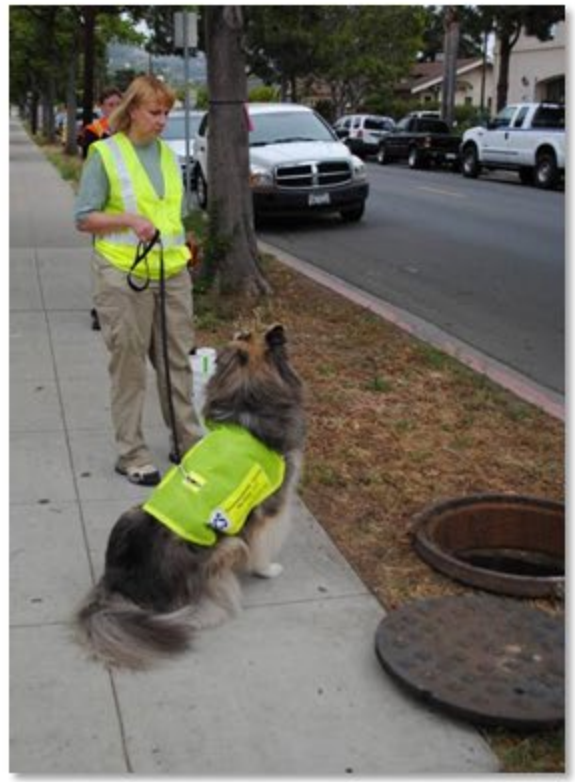
Wastewater Infiltration

GIS Tools

- Model for identifying at-risk locations where *aging sewer lines cross above storm drains*.
- Tested all high risk areas with dye and/or video.



Sewage Sniffing Dogs



Environmental Canine Svc., LLC

UCSB

Van De Werfhorst et al. 2014, Wat. Env. Res., Funded by WERF

Tools for Tracking Human Fecal Pollution in Urban Storm Drains, Creeks, and Beaches

- *Sources*
- *Tools*
- *Strategies*

Dye entering Mission Creek (Santa Barbara, CA) after being flushed down toilets in nearby businesses. A private sewer lateral serving six businesses was found to be leaking into a storm drain.

City of Santa Barbara, Creeks Division

In partnership with:

University of California, Santa Barbara

June 1, 2012

Microbial Source Tracking
High Hanging Fruit

- UCSB & Geosyntec, funded by Clean Beaches Initiative
- Two additional SB beaches, extensive hypothesis testing
- Frequent, low-level detections of human waste marker (HF183)
- Infrequent, low-level pathogen detection
- Many hypotheses ruled out
- Two were not …

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Geosyntec consultants

Swimmers and treated wastewater effluent

Water Research
Volume 202, 1 September 2021, 117378

Sources of Low Level Human Fecal Markers in Recreational Waters of Two Santa Barbara, CA Beaches: Roles of WWTP Outfalls and Swimmers

Dong Li [a], Laurie C. Van De Werfhorst [a], Brandon Steets [b], Jared Ervin [b], Jill L.S. Murray [c], Avery Blackwell [b], Naresh Devarajan [a], Patricia A. Holden [a]

[a] Bren School of Environmental Science & Management, University of California, Santa Barbara, United states
[b] Geosyntec Consultants, Santa Barbara, CA 93101, United states
[c] Creeks Division, Department of Parks & Recreation, City of Santa Barbara, CA, United states

Received 23 January 2021, Revised 11 June 2021, Accepted 17 June 2021, Available online 20 June 2021, Version of Record 8 July 2021.

Highlights

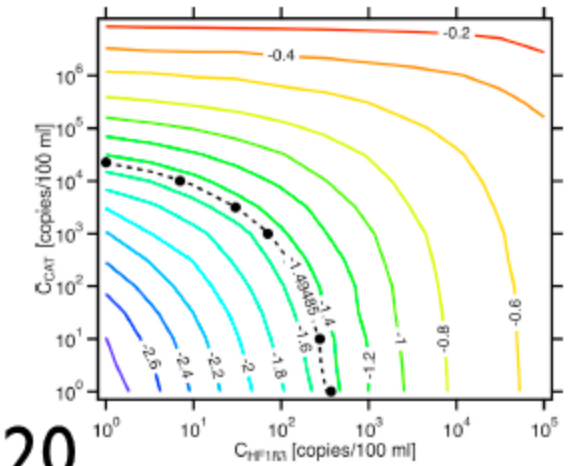
- Dogs and seabirds were sources of fecal indicator bacteria in surf zone water.
- HF183 human markers were low but chronic in surf zone water over three study years.
- Watersheds did not supply HF183 to surf zone water.
- Higher levels of HF183 occurred in afternoons than in mornings.
- WWTPs possibly contributed, but swimmers correlated to HF183 markers directly.

Additional support:

- Li et al. 2021, Front. Micro. (Goleta Beach)
- Toubiana et al. 2021, Front. Micro. (France)
- Li et al 2022, Wat. Res. (Bacterial community sequencing)
- Li et al 2022, J. Appl. Micro. (HF183 in skin and urine microbiomes)

Microbial Source Tracking – Current Work

- Annual surveillance ("New Sources")
  - Including wet weather, chemical markers
  - Community sequencing
- Quantitative Microbial Risk Assessment
  - Pilot project in response to Boehm and Soller, 2020
  - Co-occurring gull and human waste marker (HF183)



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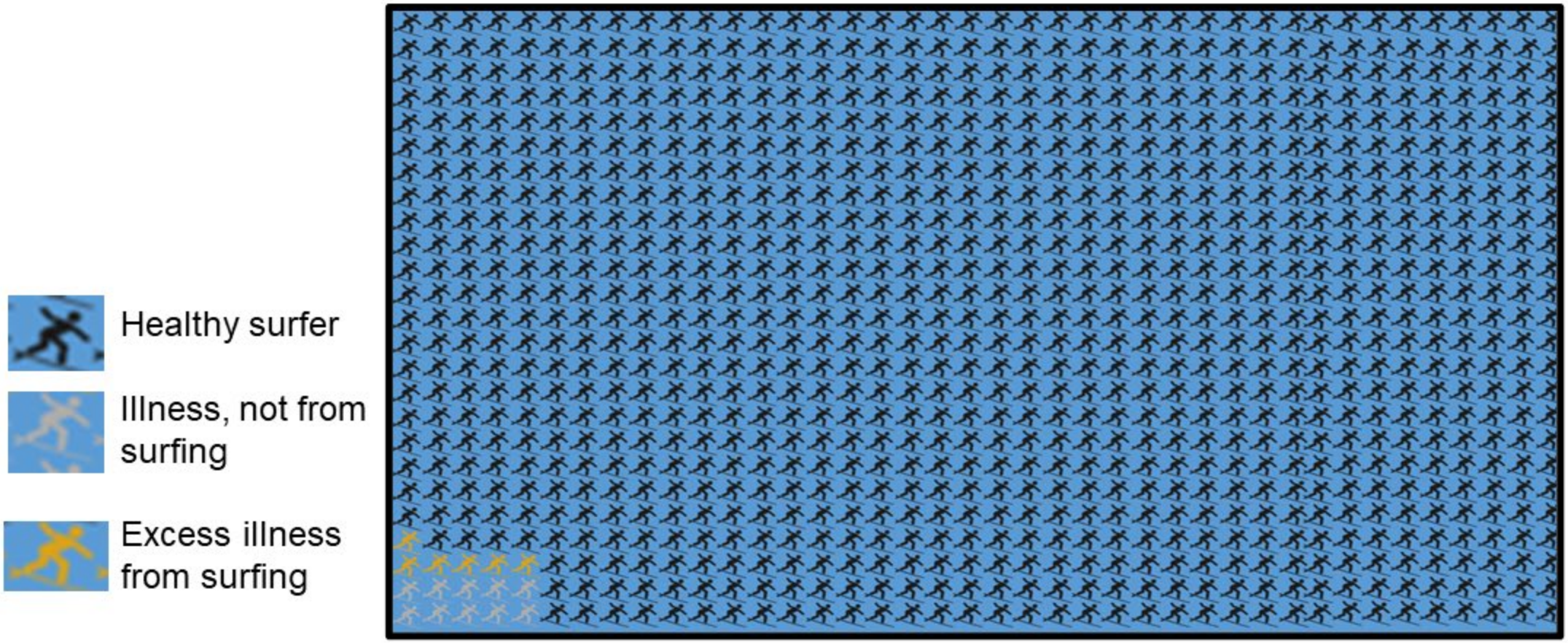
How to reduce human waste?

- Focus on human waste
- Well-funded, nimble water quality program
- Remove feces directly
  - $200,000 toward cleanup of creeks, beaches, and homeless encampments (5,544 piles of feces/yr)
  - $20,000 for trash cans and porta-potties
- Locate sources, fix immediately
  - Science-driven, adaptive program
  - Conduct research internally
  - Partner with top academics and consultants
- Community support, transparent communication

What does it mean to be safe to swim?



1,000 Surf Sessions

SCCWRP, 2014 Surfer Health Study

Public Health vs. Individual Risk

Exposure Scenario	Excess Annual Illnesses
Surfs twice per month, more often in wet weather	Nearly the same as background.
Surfs twice weekly	0.5 GI bug, 1 earache/ear pain, 1 sinus pain/infection.

What about other risks?

Odds Ratios (all published before Covid)

1.6 -2.0 – Common for ocean swimming studies

1.5 – Influenza after attending child's checkup

3.5 – *Campylobacter* for baby in shopping cart near raw meat

3.5 – GI illness in child attending preschool

10 – Virus when living with sick family member

20 – Cold due to air travel

What are we giving up while we continue weekly FIB indicator bacteria tests and postings?

Unbridled Joy

Will Rogers State Beach

Rustic Canyon Creek Estuary

Will Rogers State Beach

Santa Monica Canyon low-flow diversion

Swimming banned

Environmental Justice: Creating Undue Fear of Free Recreation, Connection, Exercise