Fecal Source Tracking at Pismo Beach

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The Problem

- Assembly Bill 411 (AB411) mandates beach sampling, and bacteria levels at which beaches must be posted for health advisories
- Concerns about beach water quality increased in the Pismo Beach as advisories posted at an increasing rate 2004-2006

Project Goals

Primary

- Identify the physical and environmental factors along with the biological sources that influence levels of Fecal Indicator Bacteria (FIB) at Pismo Beach resulting in bacterial advisory postings.
  - FIB = Total coliform, *E. coli*, *Enterococcus*

Secondary

- Compare specific pathogen incidence to fecal sources and FIB counts and provide an assessment of health hazards associated with bacterial advisory postings

Specific Project Tasks

- Five Sampling Plans
  - Year round
  - Summer daily
  - Summer ocean
  - Summer hourly
  - Rain events
- Ocean Current Mapping
- Volunteer Beach Survey
- Fecal Source Library
- Fecal Source ID methods
  - Human Enterovirus
  - *Bacteroides* Source Markers
  - Massive *E. coli* Library
  - TRFLP Source Tracking
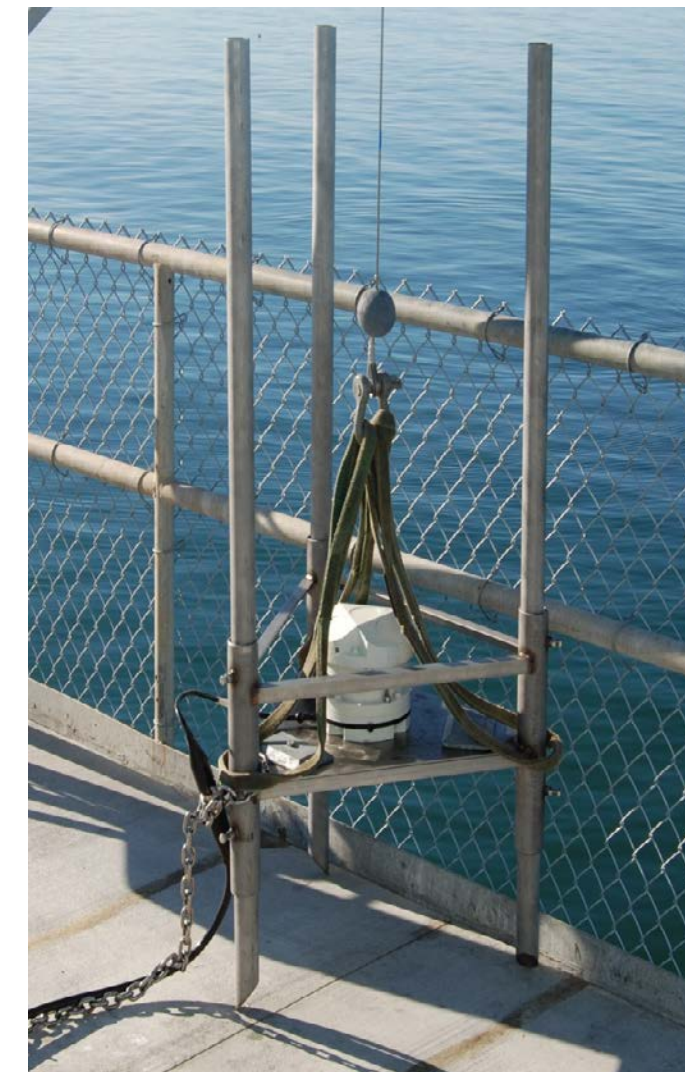- Rapid Human Assay Kit
  - Handheld Device
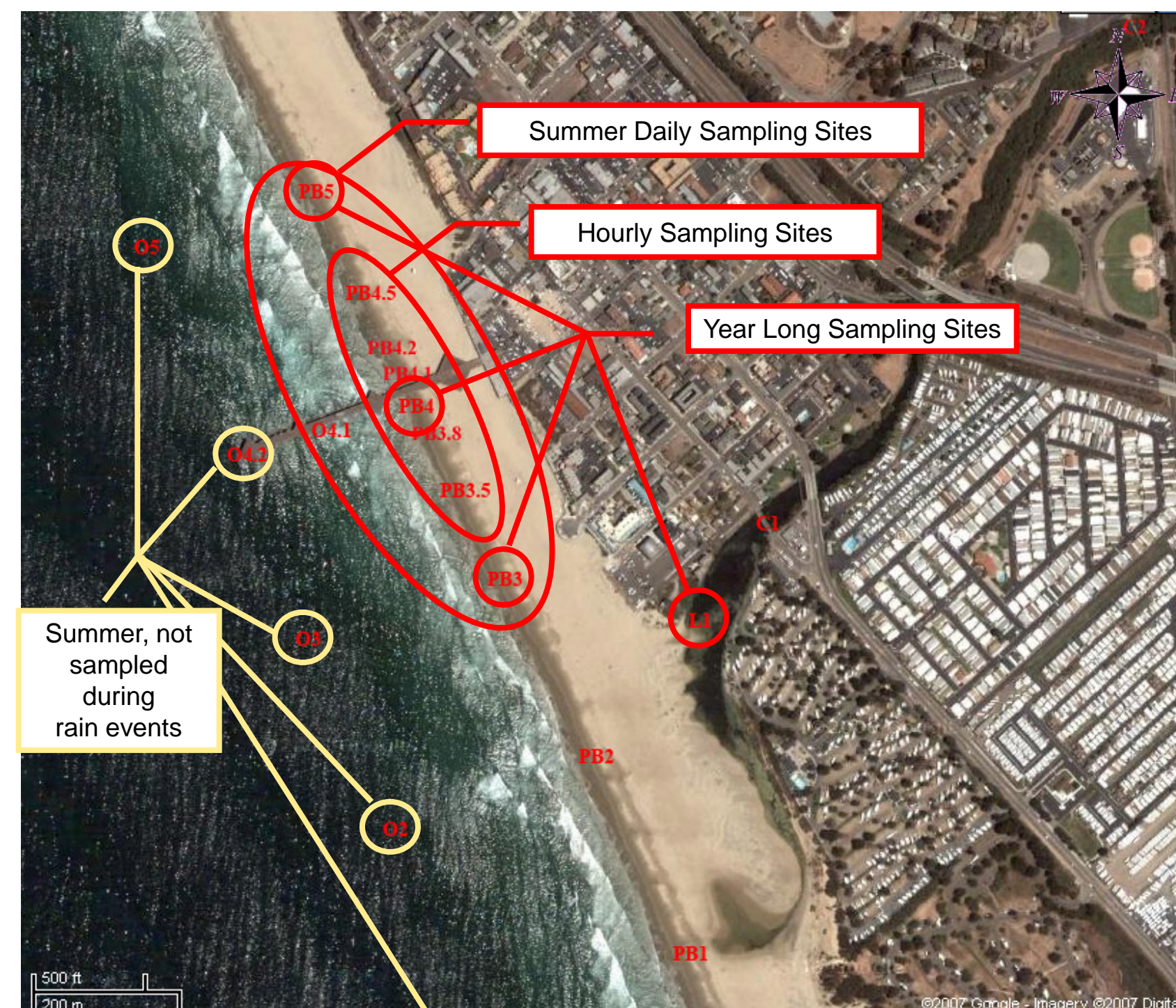
Sampling sites and sampling frequency

Ocean Monitoring Instruments

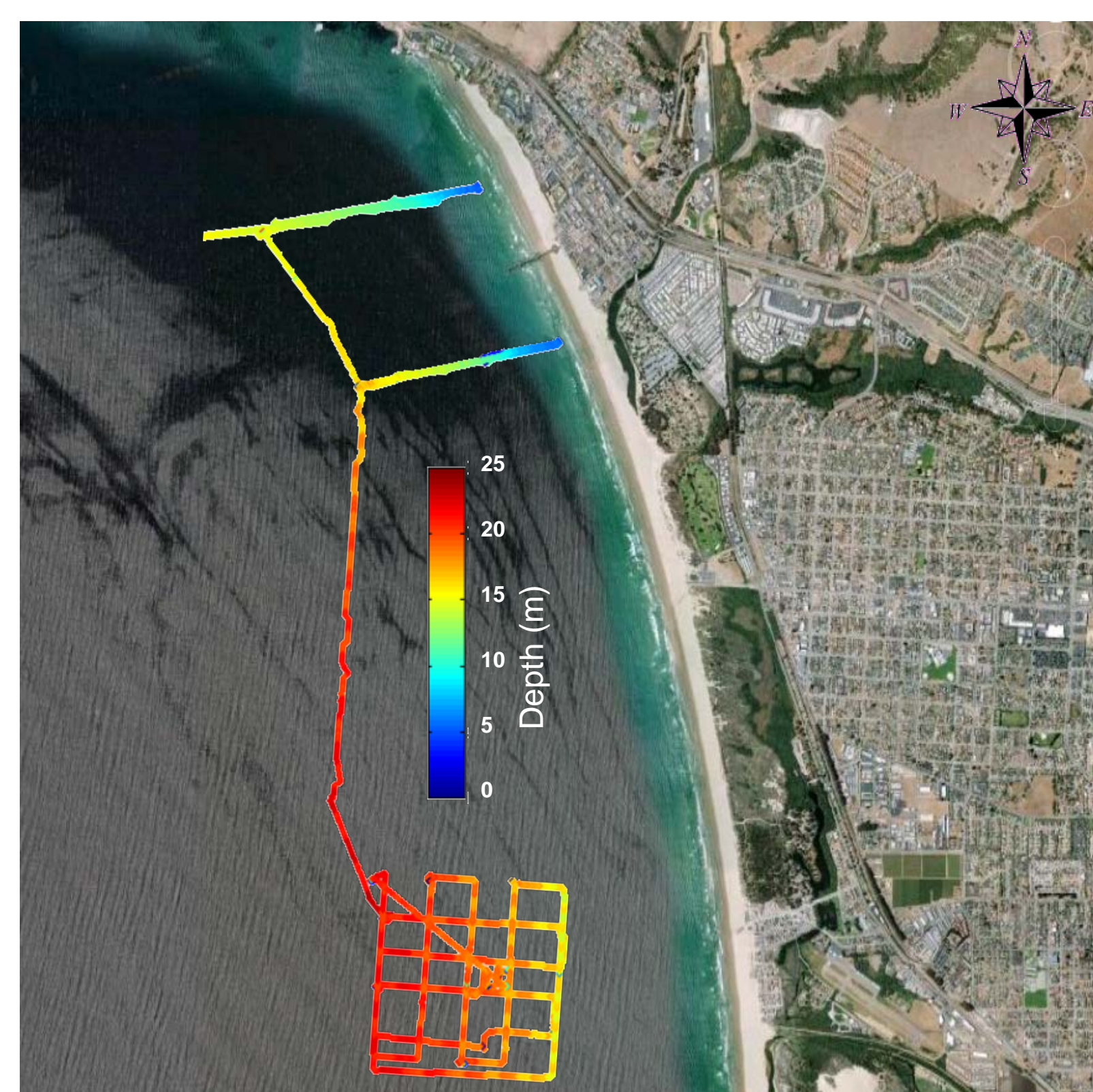The REMUS autonomous underwater vehicle (AUV)

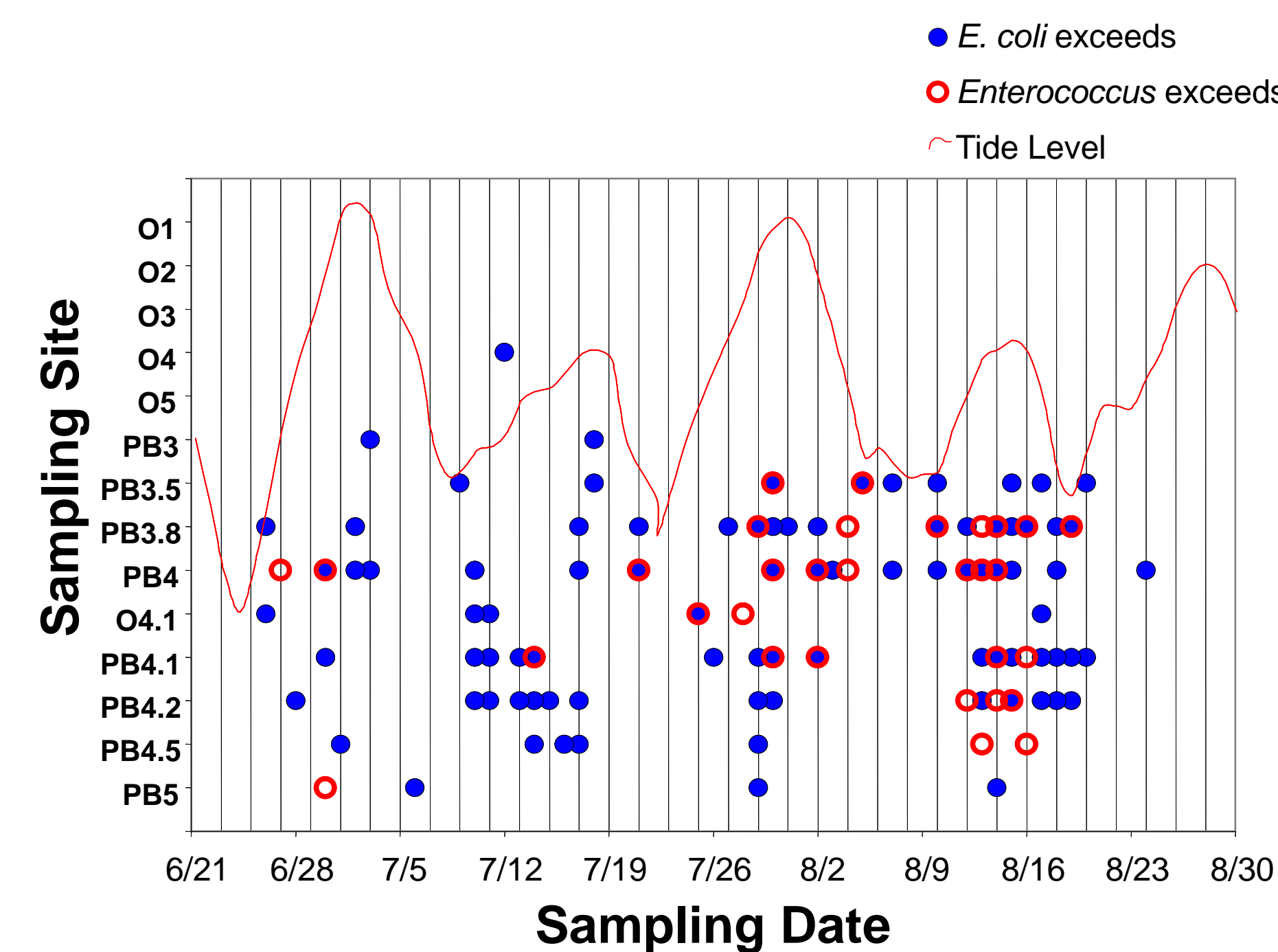The Nortek Acoustic Wave And Current (AWAC) profiler

Data transmission line to the Cal Poly pier from Pismo pier AWAC

Ocean Current Monitoring Tracks

REMUS path for current monitoring

FIB counts exceeding AB411 limits from the 2008 summer samplings broken out by sampling site.
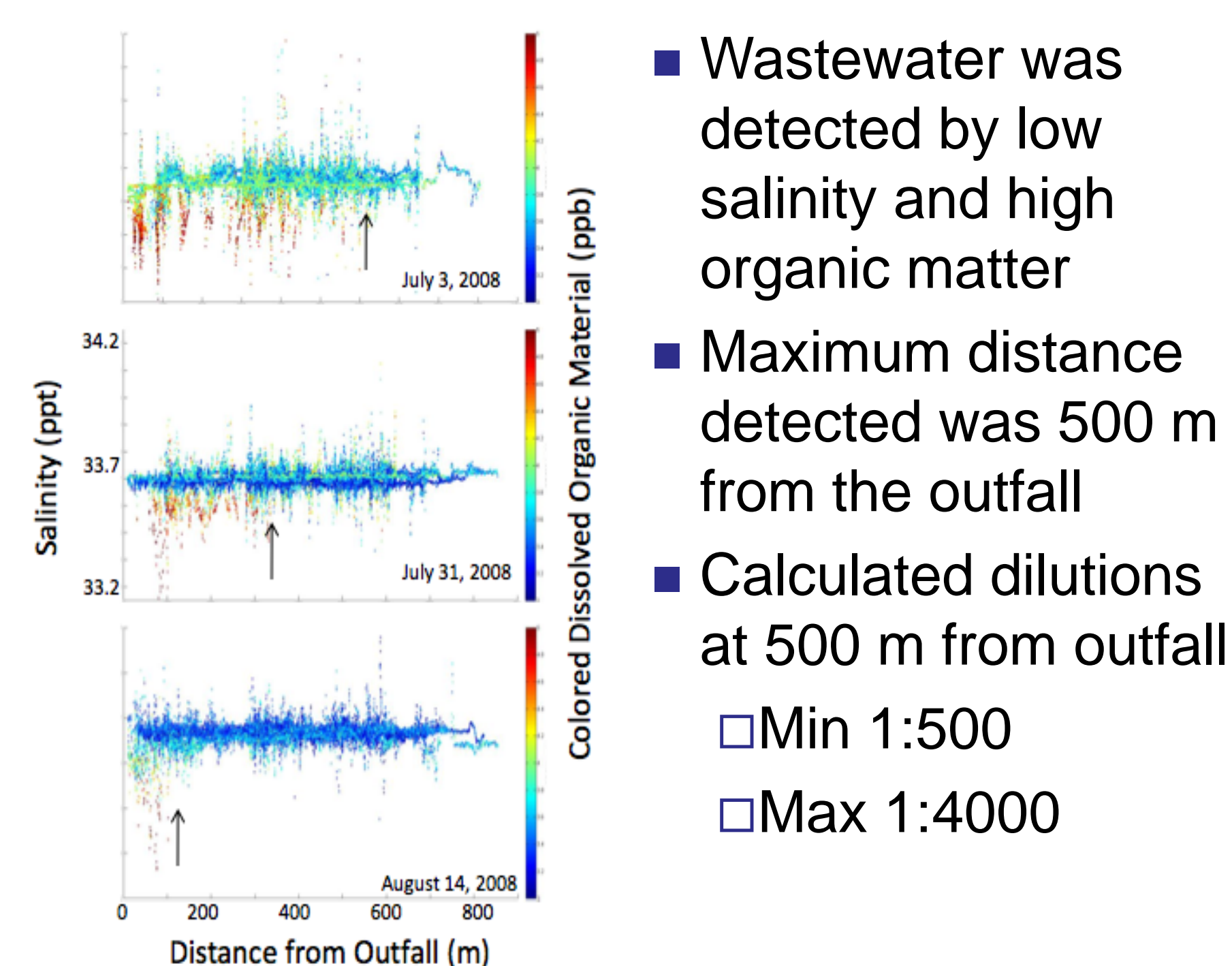
Days over AB411 limits (out of 60)

Site	Ent	T.C.	E.coli	Total
PB5	1	0	5	6
PB4.5	2	0	5	7
PB4.2	3	0	14	16
PB4.1	5	1	16	18
PB4	9	0	19	20
PB3.8	7	0	16	18
PB3.5	2	0	9	9
PB3	0	0	3	3
O4.1	2	1	6	7

43/60 = 72%!!

Number of days *Enterococci* (Ent), Total Coliforms (T.C.) and Fecal Coliforms (*E. coli*) counts exceeded limits specified by CA Statue AB411 for each type of Fecal Indicator Bacteria (FIB). (Note: total may not be additive)

Dilution of Wastewater

- Wastewater was detected by low salinity and high organic matter
- Maximum distance detected was 500 m from the outfall
- Calculated dilutions at 500 m from outfall
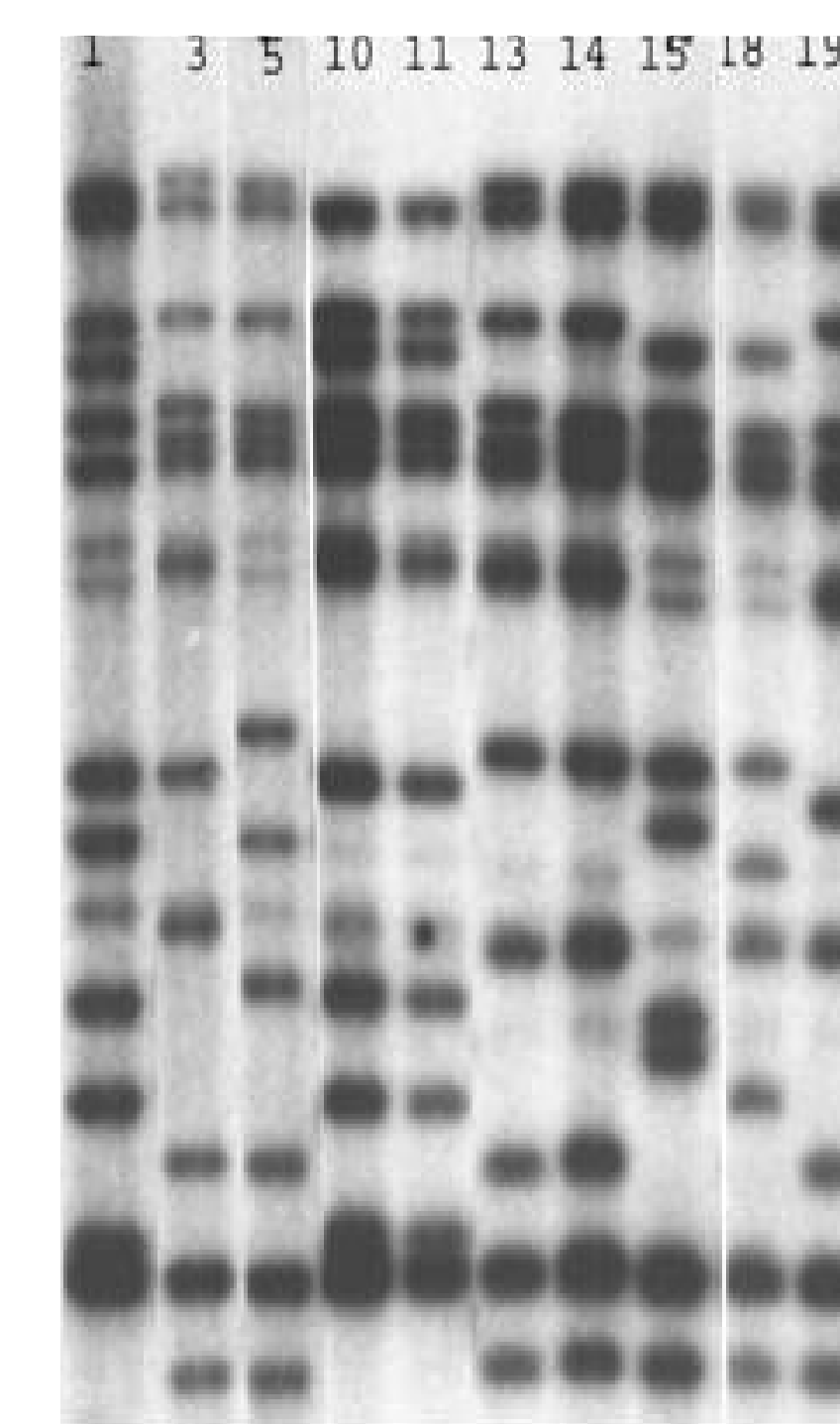 - Min 1:500
  - Max 1:4000

Salinity as a function of distance away from the Pismo/Grover/Oceano Joint Outfall for each of the three missions. Overlaid on the salinity values are the concurrent values for cDOM. Effluent from the outfall is characterized by both lower salinity and high cDOM. Black arrows indicate the distance at which effluent was no longer detected.
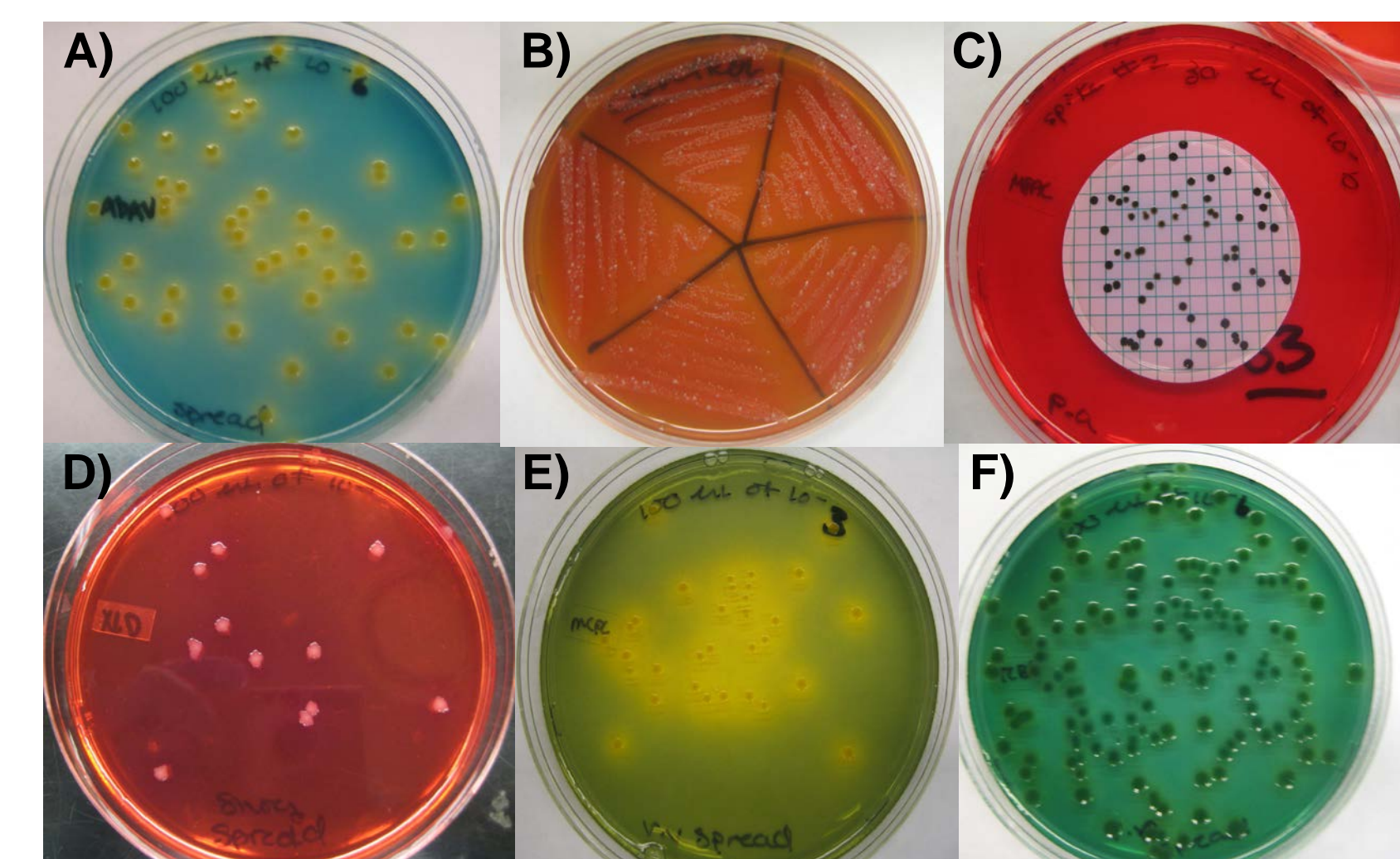

Volunteer Monitoring Zones

Massive *E. coli* library – Ribotyping

- *E. coli* collected from known fecal sources (>150,000 strains at IEH)
- Extract DNA and produce a fingerprint (ribotype)
- Compare to database
- Some strains matched avian ribotypes

Patterns generated by ribotyping

Colonies of water-borne pathogens

A) *Aeromonas hydrophila*, B) *Campylobacter jejuni*, C) *Pseudomonas aeruginosa*, D) *Shigella sonnei*, E) *Vibrio vulnificus*, F) *Vibrio parahaemolyticus*

Conclusions

Sources of FIB at Pismo Beach

- Physical location for fecal contamination is the beach in the general vicinity of the pier
  - FIB counts, Tide Wash, Waves and Currents
- Most prevalent biological source is birds, most likely pigeons
  - Volunteer counts, Ribotype matches
- Humans and dogs contribute little to FIB
  - Though some input is quite common (*Bacteroides*)

Joint Wastewater Outfall

- High rates of dilution and distance from the pier rule out the wastewater outfall as a consistent source of FIB at Pismo Beach
  - Does not rule out accidental releases of high FIB
- Human and Dog *Bacteroides* were detected above the outfall (O1) indicating that dilute wastewater does occasionally reach the surface
  - FIB counts never reached AB411 limits and remained very low in all samples collected at O1

Suggestions for Controlling FIB

- Dramatically reduce the number of pigeons using the pier as a nesting and/or roosting site
  - Netting, capture and removal, contraceptives
- Consider increasing restroom access to reduce accidents during high usage times
- Educate folks about picking up after their dogs