# Examining Water Quality Indicators at Swim Sites located in the Los Angeles River Watershed, CA

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# Los Angeles River Watershed, CA


**Watershed Area:** 834 sq. mi.

**Population:** 4.5 million

**Land Use:**

| Type* | Residential | Commercial | Industrial | Agriculture | Recreation |
|---|---|---|---|---|---|
| % LA | 37.2 | 8.54 | 10.8 | 0.59 | 42.87 |

# Acknowledgement of Program Partners











**Brock Bernstein: Consultant**

# Los Angeles River Watershed Monitoring Program

1. What is the health of streams ?

2. Conditions at areas of unique importance ?

3. Are regulated discharges meeting WQ objectives ?

4. Is it safe to swim?

5. Is it safe to eat fish ?

**State of the Watershed**

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http://watershedhealth.org/programsandprojects/larwmp.aspx

# Los Angeles River Watershed Monitoring Program

**4.**

**Is it safe to swim?**

http://watershedhealth.org/programsandprojects/larwmp.aspx

# Is it Safe to Swim?

- Memorial Day- Labor Day (2009-)
- Enzyme Substrate (**SM 9223 B**) Colilert™
- Higher levels on holidays and weekends at most popular sites


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# 2012 Pilot Study

**OBJECTIVES**

1. Assess water quality of freshwater swim sites in Los Angeles River Watershed

2. Collect and correlate indicator concentrations with environmental/physicochemical parameters

3. Assess correlations between various pathogen/health indicators

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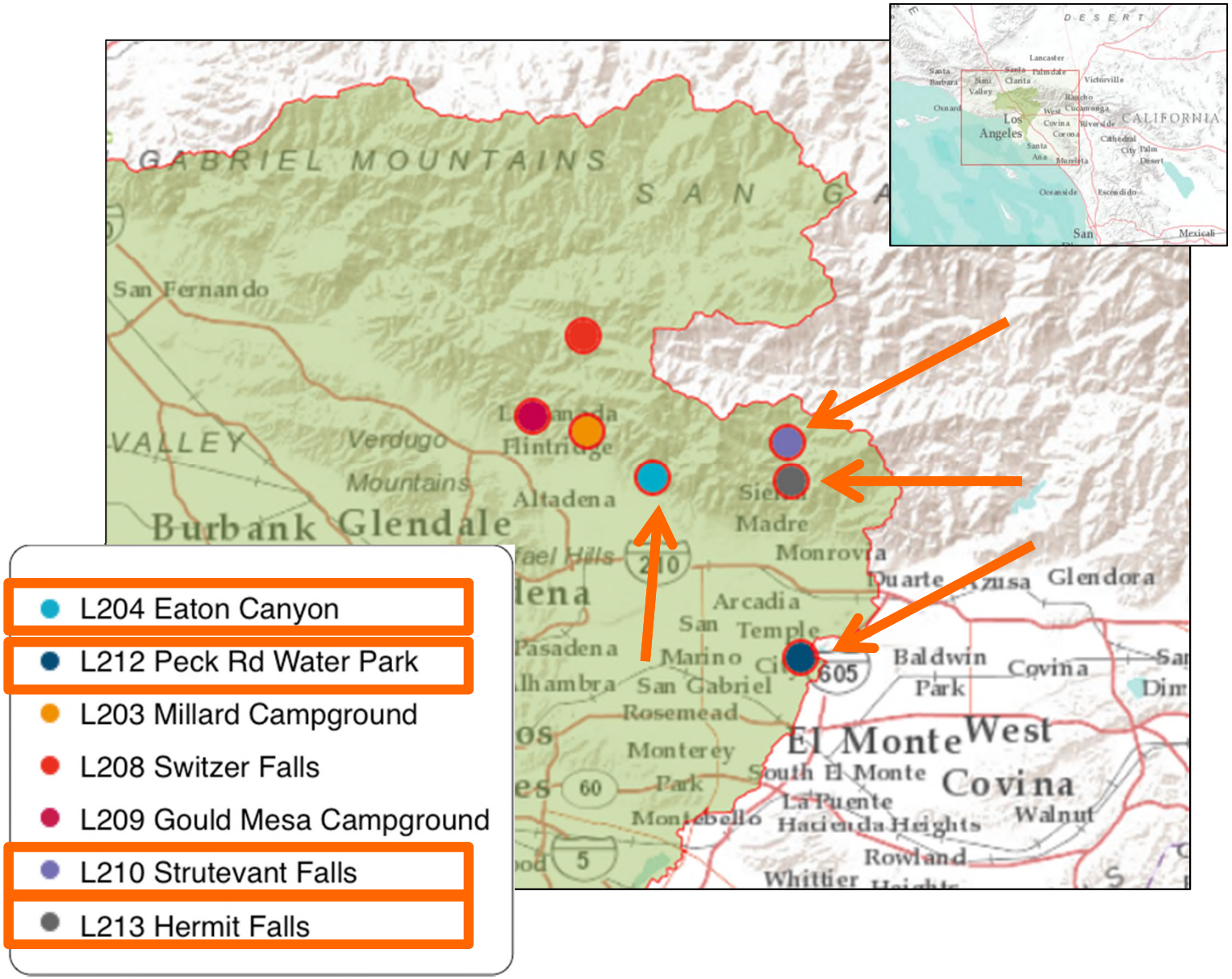
# SELECT SITES

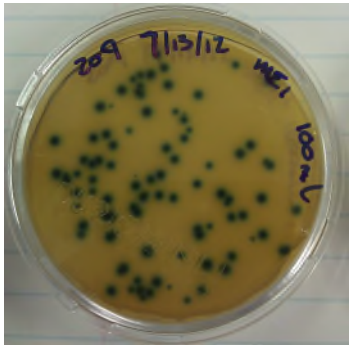


# Sample Assays

## Culture-based

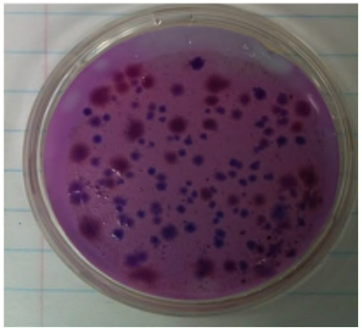
Membrane filtration- mTec *E.coli*

Enzyme Substrate (**SM 9223 B**) Colilert™



## Alternative methods/indicators

*Clostridium perfringens, Bacteroidales*

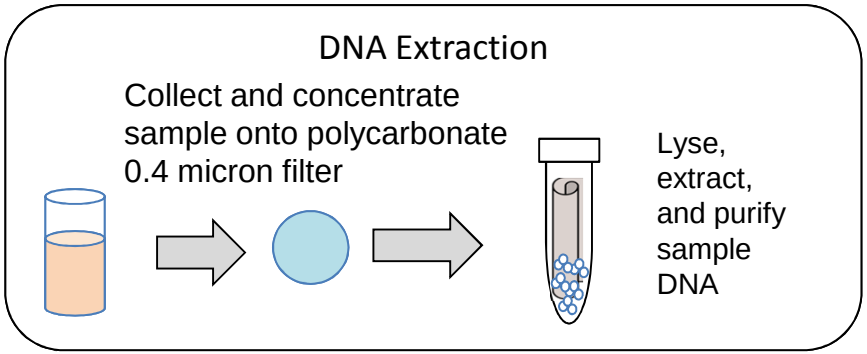


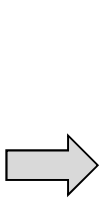
## qPCR

- Primers: E. coli uidA, Ent - Method A, Bacteroides - Method B, C perfringens

# qPCR OVERVIEW

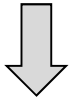
- Use of primers to identify segments of DNA or genes that are unique to that species or organism
- Rapid and specific (but non-viability based)
- Fluorescence dye attaches to PCR product as it amplifies, which can be measured and correlated to concentration using “Ct” values

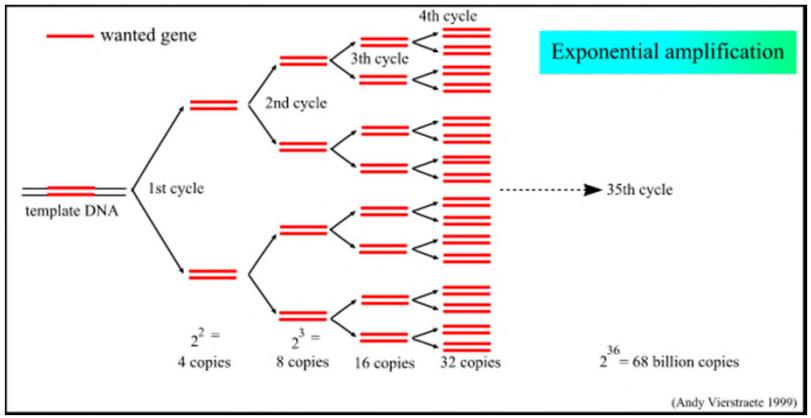


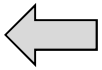



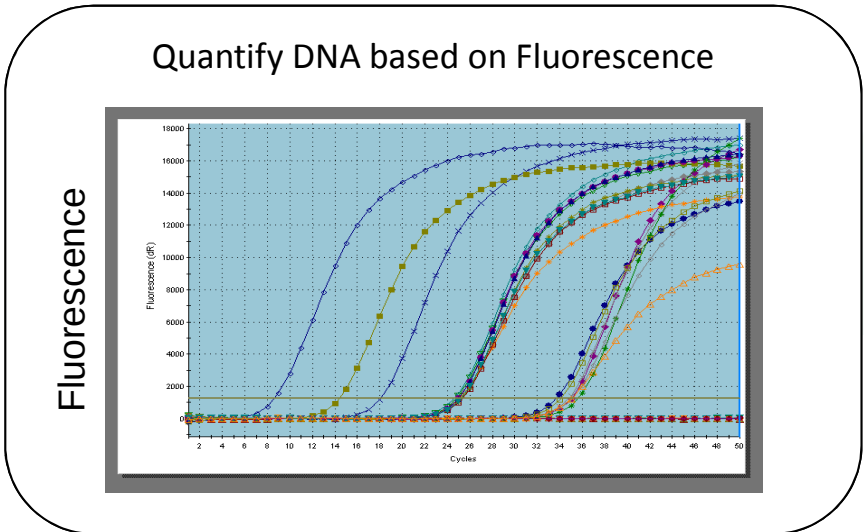


| Primer Sets |
| --- |
| *E. coli* |
| *Bacteroidales* |
| *Clostridium perfringens* |







# 2012 Pilot Study

**OBJECTIVES**

1. Assess water quality of freshwater swim sites in Los Angeles River Watershed

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# Colilert Results

Estimated Illness Rate (NGI): 32 per 1,000 primary contact recreators

(320 cfu/100 mL STV)

| Site | 5/28/12 | 5/29/12 | 6/5/12 | 6/9/12 | 6/10/12 | 6/24/12 | 6/29/12 | 7/4/12 | 7/5/12 | 7/13/12 | 7/21/12 | 7/29/12 | 8/6/12 | 8/12/12 | 8/18/12 | 8/22/12 | 8/31/12 | 9/2/12 | 9/3/12 | 9/4/12 | STV (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| L204 Eaton Canyon | 1350 | <10 | 75 | 121 | 31 | <10 | <10 | 279 | <10 | 153 | 98 | 677 | 1450 | 292 | 52 | <10 | <10 | 86 | 2010 | 2360 | 25 |
| L213 Hermit Falls | <10 | <10 | 41 | 298 | 183 | <10 | 884 | 295 | 789 | 85 | 122 | 62 | 75 | 98 | 20 | 52 | 63 | 393 | 41 | 63 | 15 |
| L212 Peck Rd | 86 | 50 | 122 | 1310 | 145 | 135 | 1470 | 161 | 85 | 1350 | <10 | 41 | 20 | 341 | 30 | 75 | 554 | 41 | 108 | 41 | 25 |
| L210 Sturtevant Falls | 146 | 75 | 20 | 20 | 20 | 309 | 20 | 292 | 305 | 216 | 86 | 110 | 246 | 146 | 74 | <10 | 63 | 41 | 158 | 41 | 0 |
| # Exceedance | 1 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | Σ =13 |

Holiday/ Day Following

Weekday

Weekend

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# Colilert Results

Estimated Illness Rate (NGI): 32 per 1,000 primary contact recreators

(100 cfu/100 mL GM)

| Site | June n=5 | July n=6 | August n=7 |
|---|---|---|---|
| L204 Eaton Canyon | 49 | 243 | 363 |
| L213 Hermit Falls | 283 | 271 | 62 |
| L212 Peck Rd | 636 | 329 | 204 |
| L210 Sturtevant Falls | 78 | 202 | 108 |

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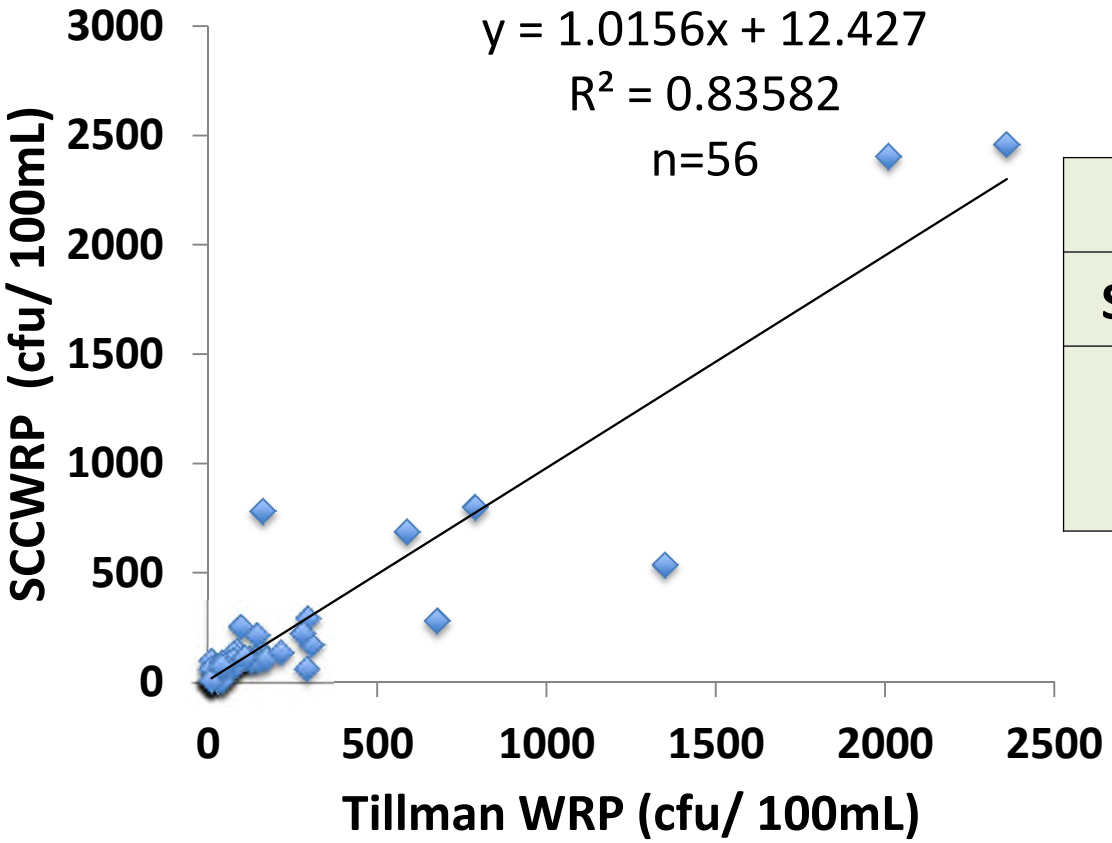
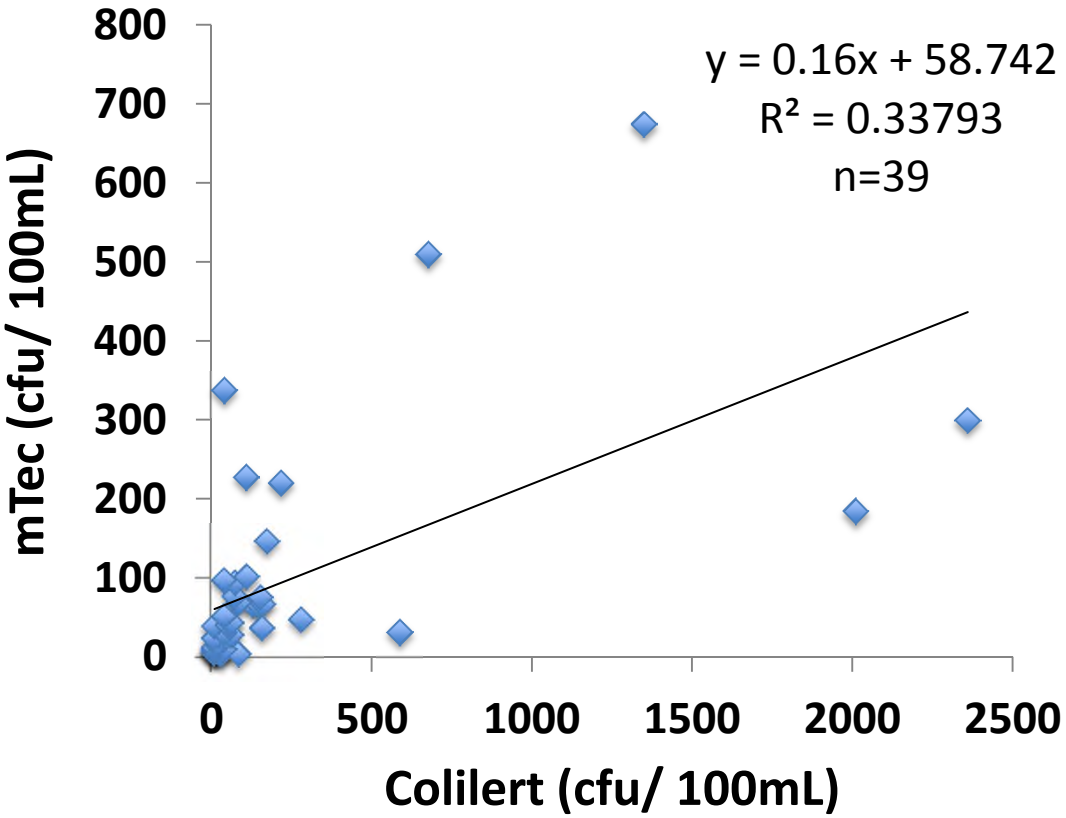
# Colilert Inter-Lab Comparison




| | Exceed | Not Exceed |
|---|---|---|
| SCCWRP | 10.70% | 89.30% |
| Tillman WRP | 10.70% | 89.30% |

# Culture-based Method Comparison




| | Exceed | Not Exceed |
|---|---|---|
| mTec | 7.70% | 92.30% |
| Colilert | 15.40% | 84.60% |

# 2012 Pilot Study

**OBJECTIVES**

2. Collect and correlate indicator concentrations with environmental/physicochemical parameters

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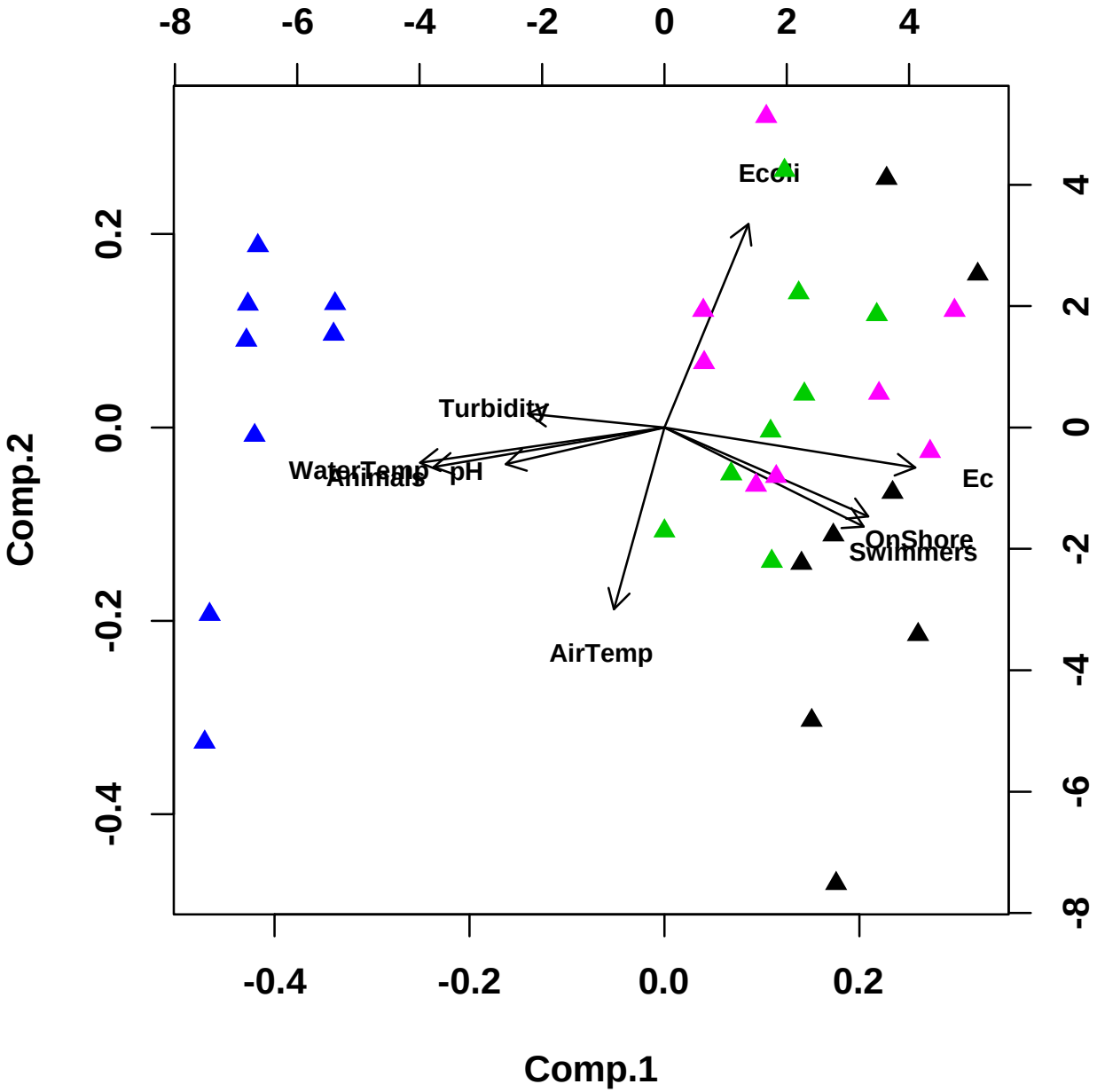
# Relationships between Environmental Parameters

| | *E. coli* | Air Temp | pH | Ec | Water Temp | Turbidity | On Shore | Animals |
|---|---|---|---|---|---|---|---|---|
| Air Temp | -0.269 | | | | | | | |
| pH | -0.241 | 0.060 | | | | | | |
| Ec | 0.196 | 0.035 | -0.483 | | | | | |
| Water Temp | -0.266 | 0.279 | 0.359 | -0.736 | | | | |
| Turbidity | 0.081 | 0.084 | 0.137 | -0.355 | 0.623 | | | |
| OnShore | 0.035 | -0.129 | -0.322 | 0.601 | -0.559 | -0.170 | | |
| Animals | -0.328 | 0.074 | 0.463 | -0.839 | 0.737 | 0.388 | -0.407 | |
| Swimmers | 0.091 | -0.039 | -0.303 | 0.649 | -0.493 | -0.160 | 0.790 | -0.365 |

# Sites in Relation to Environmental Parameters




**L212 Peck Rd**
**L204 Eaton Canyon**
**L210 Sturtevant Falls**
**L213 Hermit Falls**

PC 1 and 2 explain 60% of variance

PC 1: 45% (Human use/Temp)
PC 2: 15% ( E.coli/ Air Temp)

n=32

# 2012 Pilot Study

**OBJECTIVES**

3. Assess correlations between various pathogen/health indicators

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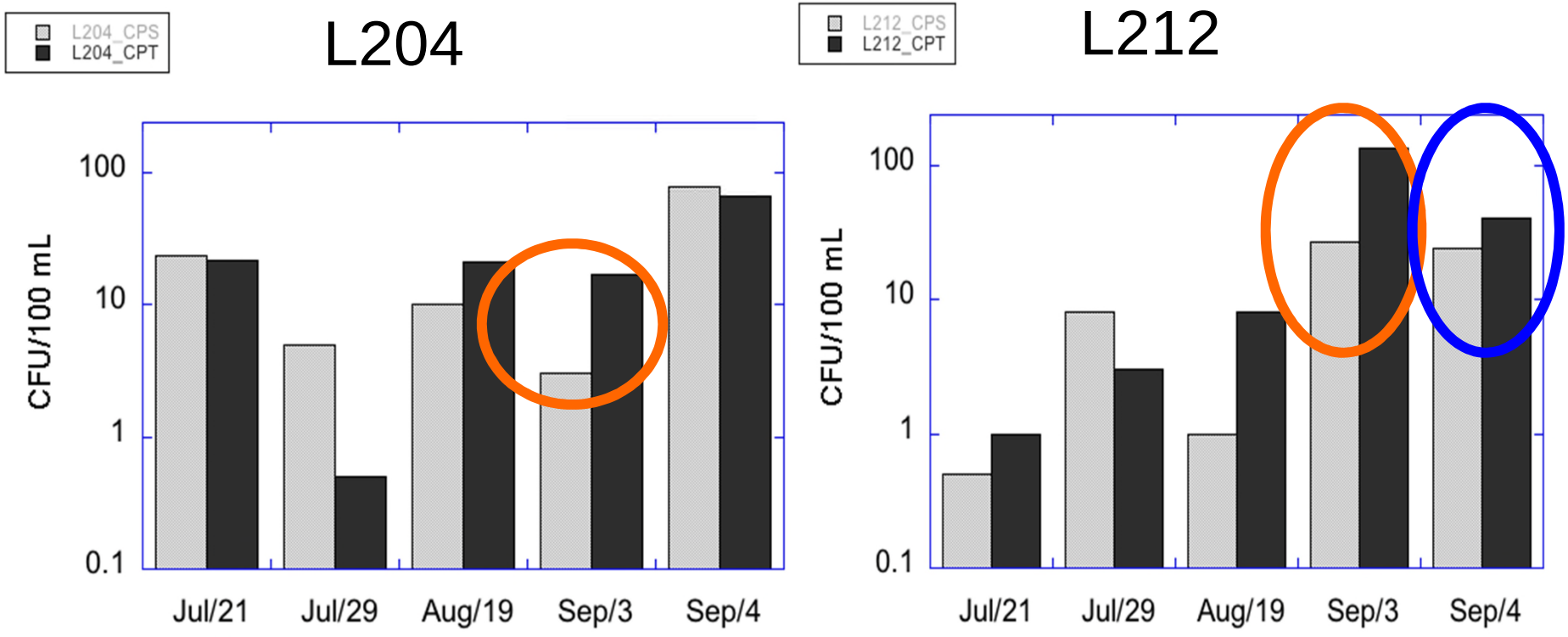
# *Clostridium perfringens* ratios




Interesting preliminary results about CP ratios – can we use this ratio to “date” the contamination event?

# Correlation matrix

| | EC MF | CPT MF | CPS MF | EC qPCR | FB qPCR |
|---|---|---|---|---|---|
| CPT MF | 0.21 (<0.001) | - | | | |
| CPS MF | 0.22 (<0.001) | 0.83 (0.110) | - | | |
| EC qPCR | 0.45 (0.738) | 0.20 (<0.001) | 0.34 (<0.001) | - | |
| FB qPCR | 0.06 (0.287) | 0.05 (0.024) | 0.01 (0.052) | 0.18 (0.320) | - |
| CPT qPCR | 0.58 (<0.001) | 0.03 (<0.001) | 0.08 (<0.001) | 0.37 (0.012) | 0.005 (0.057) |

# Correlation matrix

| | EC MF | CPT MF | CPS MF | EC qPCR | FB qPCR |
|---|---|---|---|---|---|
| CPT | 0.21 | | | | |
| EC qPCR | 0.45 (0.738) | 0.20 (<0.001) | 0.34 (<0.001) | - | |
| FB qPCR | 0.06 (0.287) | 0.05 (0.024) | 0.01 (0.052) | 0.18 (0.320) | - |
| CPT qPCR | 0.58 (<0.001) | 0.03 (<0.001) | 0.08 (<0.001) | 0.37 (0.012) | 0.005 (0.057) |

Matrix of only a subset of summer samples; L212/213 were inhibited, so were excluded from this analysis. n = 18 total samples analyzed for all these variables, across all sites except the inhibited samples

# Pilot Achievements

- First to test qPCR at freshwater swim sites in LARW
- Comparison of multiple indicators/methods
- Use of *C. perfringens* spore ratios as another way of assessing contamination events (how recent)
- Moderate and significant relationship amongst organisms method/indicators

# Next Steps

- Investigate the use of alternative qPCR approaches to overcome inhibition issues

- Microbial Source-tracking → recommend monitoring/mitigation strategies

# Thanks

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JPL Jet Propulsion Laboratory California Institute of Technology

CITY OF LOS ANGELES SANITATION DEPARTMENT OF PUBLIC WORKS

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