# *Ecosystem Services and Trade-Offs Mediated by Urban Water Bodies for Homeless Populations in Phoenix*

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## INTRODUCTION

- Urban runoff entering stormwater outfalls in Phoenix have created "accidental" wetlands in the otherwise dry Salt River bed
- Urban wetland environments provide heat mitigation, privacy, and other services to the homeless population in Phoenix but high pathogen loading at outfalls presents public health concerns

## STUDY OBJECTIVES

- Assess the extent of use and the ecosystem services and trade-offs provided by the wetlands to the homeless population in Phoenix
- Monitor *Escherichia coli (E. coli)* loading levels and wetland-mediated attenuation rates of E. *coli* at points along flowpaths from six outfalls
- Determine source of fecal contamination at outfalls by analyzing environmental E. *coli* isolates' protein profiles with E. *coli* strains of human origin

## SAMPLING DESIGN

- Water samples collected during baseflow and storm conditions May–July 2013
- Samples collected at 3–5 points along flowpaths from outfalls and through wetland areas


## PHYSICAL VARIABLES IN OUTFALLS DURING BASE AND STORMFLOW

- Measured discharge, flow rate, dissolved oxygen (DO), and conductivity

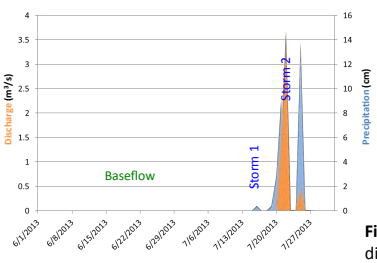
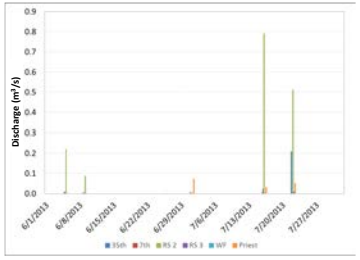


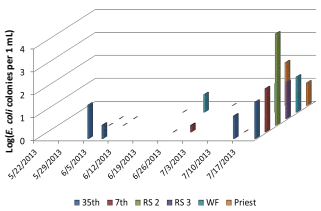

**Figure 1: (a)** Precipitation record and discharge exiting Priest site (USGS gage) during study period; **(b)** discharge measured in study outfalls on collection days.





## PATHOGEN LOADING AND ATTENUATION

- Water samples collected at sampling points analyzed within 12 hrs for coliform and *E. coli* levels by plating 500 µL on selective media (Brilliance®) and incubating at 70 ˚C for 20 hrs
- Attenuation along flowpath quantified as disappearance of *E. coli* colonies per 1 mL between loading at outfall and end of flowpath



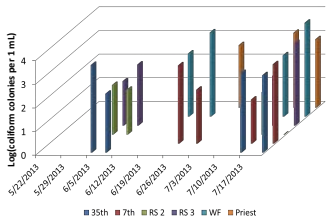




**Figure 2:** *E. coli* (left) and coliform (right) loading at outfalls. Coliform levels remained consistently high during base and storm flow; *E. coli* levels spiked during storms.

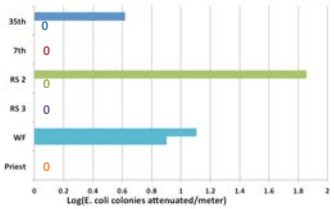



**Figure 3:** Attenuation rate of *E. coli* colonies between beginning (at outfall) and end of flowpaths during storm events. Little to no attenuation was observed during baseflow conditions.

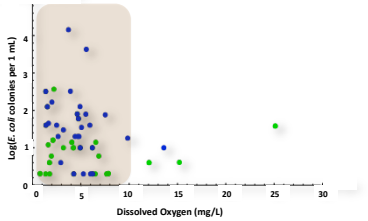
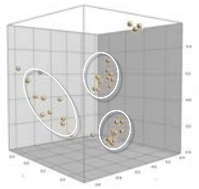



**Figure 4:** Baseflow (green) and storm (blue) *E. coli* concentrations at all sites regressed against dissolved oxygen; the data suggest a decrease in *E. coli* vitality below 10 mg/L $O_2$. Temperature, conductivity, and flow rate did not demonstrate a relationship with *E. coli* concentration.

## SOURCE TRACKING

- Approx. 120 *E. coli* colonies were isolated from Brilliance® media and purified by twice-culturing on TSA media and storing at -80 ˚C
  - ➢ *E. coli* of known human origin: raw sewage samples collected from Scottsdale Water Campus (SCW); plated within 36 hrs, cultured over 20 hrs
  - ➢ *E. coli* from environmental samples: samples collected at study sites; plated within 12 hrs, cultured over 20 hrs
- Protein extractions of isolated colonies were prepared with formic acid and Acetonitrile with alpha-Cyano-4-hydrocinnamic acid matrix solution
- Protein profiles of environmental and human strain *E. coli* isolates analyzed using MALDI-TOF-MS



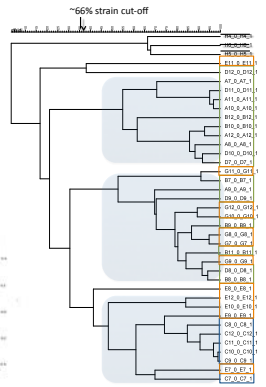



**Figure 5:** Select MALDI-TOF MS results. Right: Strain-level dendrogram; Orange = human derived (E: SCW strain #1; G: SCW strain #3), Green = baseflow (A: 35th Ave outfall; B: RS Central Ave outfall #2; D: Priest outfall), Blue = storm flow (C: RS 7th Ave outfall). Apparent clustering of *E. coli* strains from 35th Ave & Priest, RS Central Ave #2 & SCW strain #1, and RS 7th Ave & SCW strain #3. Left: 3D visualization of clustering.

## CONCLUSIONS

- Pathogen and *E. coli* loading at outfalls well exceed bathing and drinking water standards; levels also peak under storm conditions
- Wetland-mediated attenuation of *E. coli* from outfall to wetland area (end of flowpath) was observed under storm conditions
- Potential DO cut-off for environmental *E. coli* exists near 10 mg/L
- Preliminary MALDI-TOF-MS results show strain-level clustering of environmental with human strain *E. coli* isolates

## FUTURE DIRECTION

- Follow up on trash monitoring
- Nutrient analysis and analysis of other environmental variables along flowpaths may suggest ways in which wetland environments may remove pathogens
- Sucralose testing to support fecal contamination is of human origin

## ACKNOWLEDGEMENTS

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