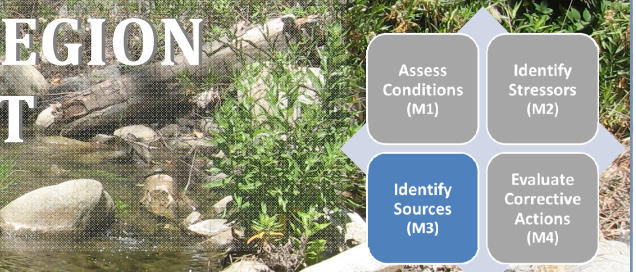
SAN DIEGO WATER BOARD
February 2017

PRESENCE OF CAFFEINE IN SAN DIEGO REGION STREAMS: PILOT STUDY



WHY IS CAFFEINE IN OUR STREAMS?

The Surface Water Ambient Monitoring Program (SWAMP) collected water samples from 2008-2015 to evaluate the presence of caffeine in San Diego Region streams in order to better understand if caffeine could be used as an indicator of human impacts on streams. Caffeine itself typically doesn't have toxic effects on aquatic organisms, but it can indicate the presence of other potentially harmful compounds, such as viruses, pathogens, and/or pharmaceuticals and personal care products (e.g., anti-depressants and microplastics), commonly found in wastewater. Therefore, its presence could be used to target investigations of pollution sources.

WHERE WAS CAFFEINE DETECTED?

- Streams in areas receiving raw sewage
- Wastewater treatment plant (WTP) effluents
- Streams in developed areas within WTP service areas
- Streams in developed areas near septic system(s)
- Streams in open space
- Streams in agricultural lands

Caffeine was detected year-round and was present in over half (58%) of the sampling sites

Among the sample site types, caffeine was detected in all samples from raw sewage, in many samples from developed areas, and in a few samples from agricultural areas, open spaces, and from treated wastewater.

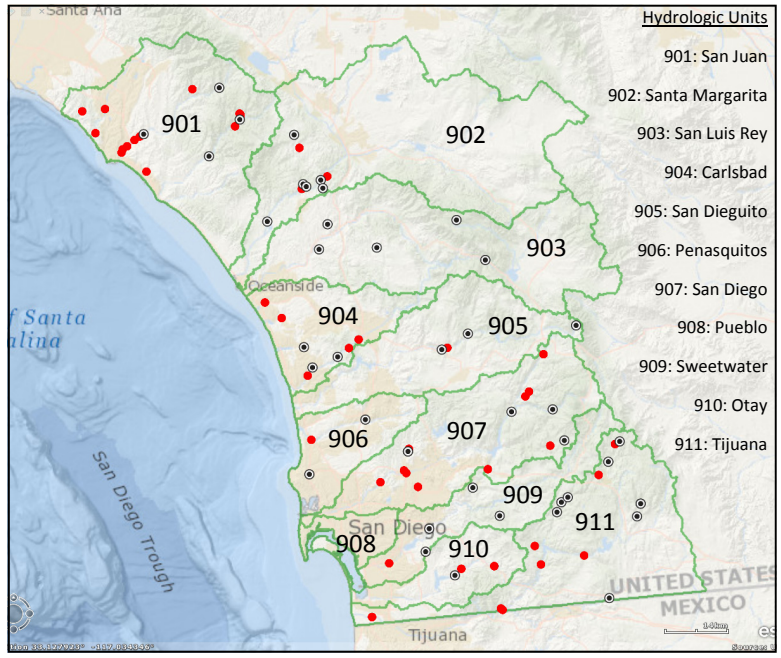
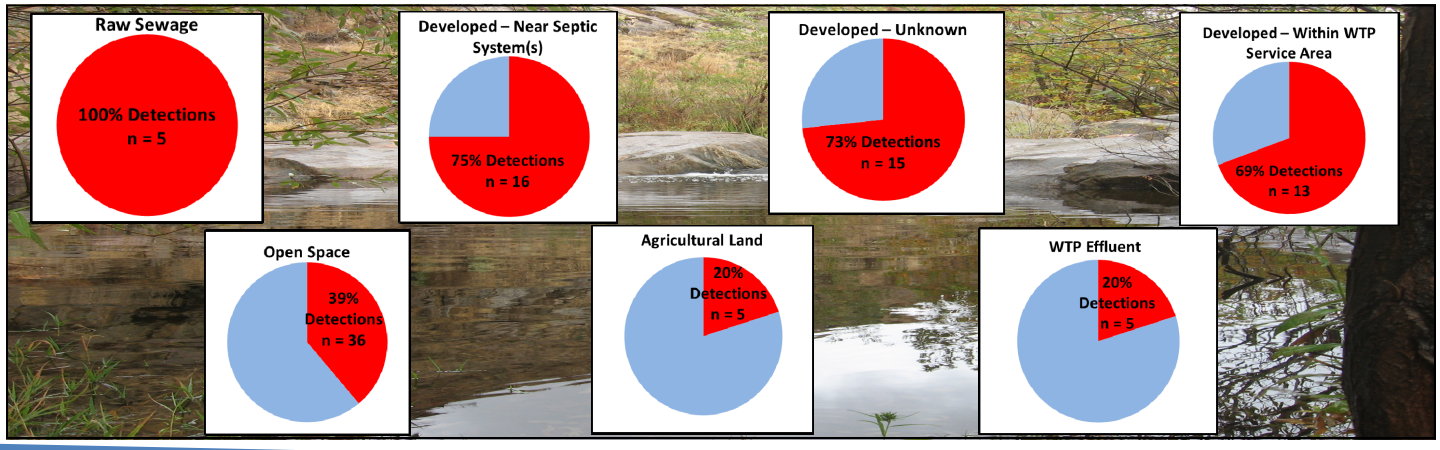


Figure 1. Caffeine detections throughout the San Diego Region. Detections are shown in red, and non-detections are shown in black. (n=95 samples collected from 85 sites).



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SWAMP Surface Water Ambient Monitoring Program
Southern California Stormwater Monitoring Coalition

POTENTIAL CAFFEINE SOURCES

Patterns of detection and concentrations suggest that caffeine sources within developed areas include leaky sewer lines, poorly maintained septic systems, food waste or beverage containers from trash receptacles or littering, recycled water used for irrigation, and storm-water runoff (Figures 2 & 3).

Figure 2. Stream system located in the Carlsbad watershed near septic systems where caffeine was detected.

Figure 3. Stormwater runoff containing food and beverage containers in the Tijuana River watershed.

UNEXPECTED FINDINGS

The results from the open space sites were contrary to expectations. Few to no detections were anticipated in areas with little to no development. However, over one third of the samples collected from open space sites contained caffeine. This prompted further investigation into the site characteristics that could account for the presence of caffeine. A pattern was observed when considering known recreational uses near the sample collection sites. No caffeine was detected in samples collected from the sites with little to no known recreational use, and caffeine was detected in all but two of the samples collected from sites with known recreational uses, such as hiking, fishing, or horseback riding (Figure 4).

Figure 4. An open space area in the San Mateo Creek watershed with high levels of recreational use where caffeine was detected.

CONCLUSIONS AND RECOMMENDATIONS

Caffeine detections were a common occurrence in many streams throughout the San Diego region and across land use types, which limits caffeine's use as a sole indicator for a specific source of pollution. In developed areas, the source(s) of caffeine could be leaky sewer lines, septic systems, trash, recycled water used for irrigation, and stormwater runoff. **Further studies are underway to determine how to use caffeine in combination with other chemicals, like pharmaceuticals, to identify specific sources.** For caffeine in open space areas, future studies should include exploring the connection between recreation and the presence of caffeine:

1) What are the main pathways of caffeine delivery to the streams?
2) What can the presence of caffeine indicate about pollution or threats to streams?
3) What are potential means for preventing caffeine and associated contaminants from entering the streams?