Pesticide Mass Loading from a Constructed Water Quality Treatment Pond in Folsom, CA

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Background

Urban runoff can transport pollutants that degrade water quality. Municipalities in California are charged with developing and implementing a storm water management plan to reduce the discharge of pollutants (including pesticides) to the "maximum extent practicable" [1]. Storm water management plans can include outreach and education or best management practices (BMPs). Constructed water quality treatment ponds (CWQTPs) have commonly been used as BMPs to remove pesticides with mixed results [2]. For several years, the California Department of Pesticide Regulation (CDPR) has conducted ambient urban monitoring at source (storm drain outfall) and stream level. In Folsom, effluent from two monitored storm drain outfalls drain into a small CWQTP. CDPR has been monitoring its outfall to determine pesticide load into the receiving water. We have reported earlier that pesticides can be detected CWQTP outfalls, although mass was not quantified [3,4]. These conclusions were based on detections of 1-L grab samples. Since 2014, at the Folsom CWQTP, with the assistance of the University of California at Davis (UCD) [5], we have collected flow-weighted samples and have looked at the mass of pesticides leaving the Folsom CWQTP.

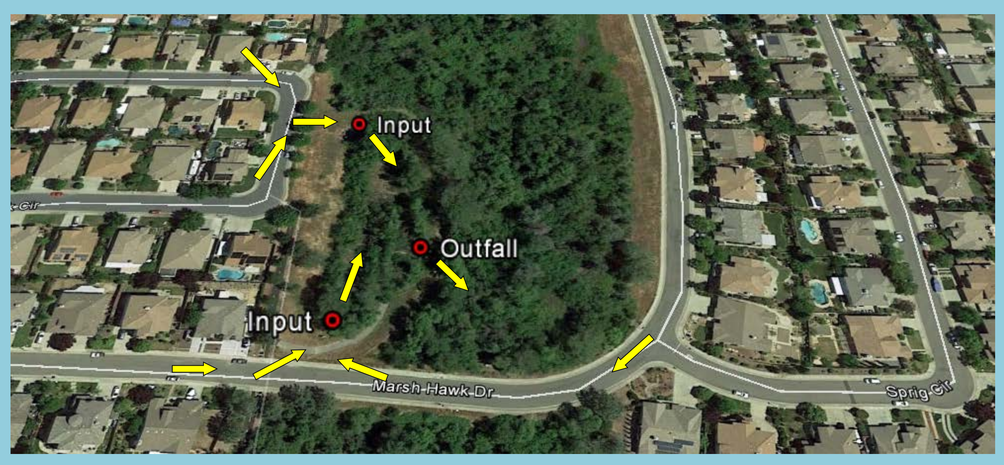

Figure 1. CWQTP in Folsom with flow schematic (Google Earth image)

Objectives:

1) Measure flow at the outfall of a CWQTP in Folsom, California
2) Estimate the mass of frequently detected pesticides leaving the CWQTP during storm events
3) Determine the toxicity of storm urban runoff to *Hyalella azteca* in 96-hr water column laboratory tests

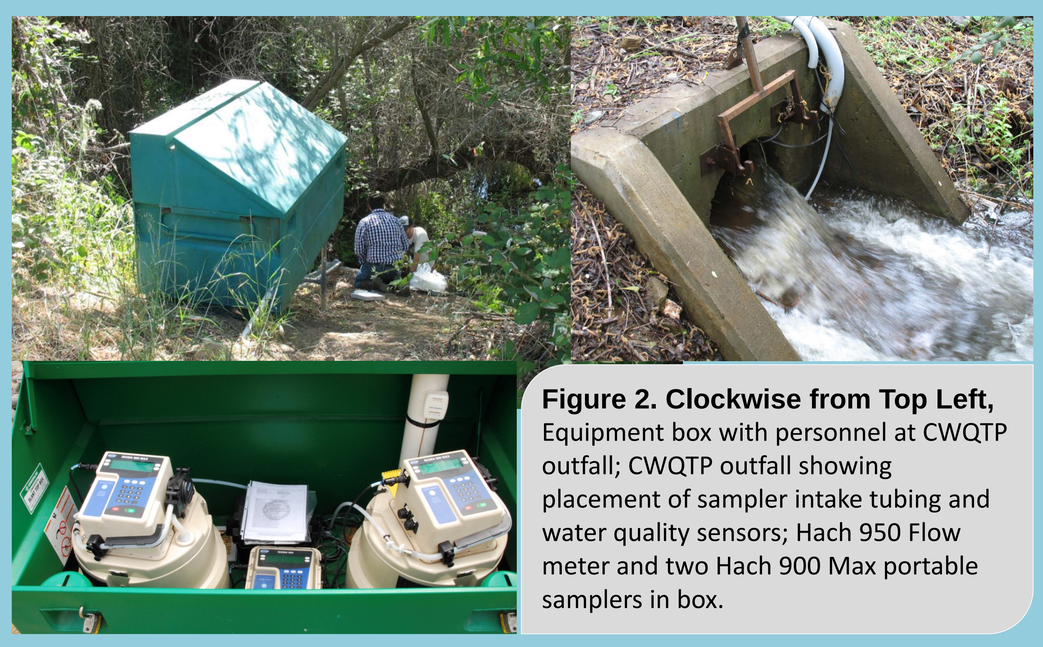

Figure 2. Clockwise from Top Left, Equipment box with personnel at CWQTP outfall; CWQTP outfall showing placement of sampler intake tubing and water quality sensors; Hach 950 Flow meter and two Hach 900 Max portable samplers in box.

Materials and Methods

- Water samples were collected at the outfall from a ≈ 0.3 ha CWQTP in Folsom, California, between 2015 – 2017 (Figures 1, 2)
- Hach 950 flow meter recorded and calculated flow based on water level and velocity measurements, and recorded rainfall information [5]
- Rainfall >0.05 cm over 15 min triggered a Hach Sigma 900 Max portable sampler to collect flow paced composite samples from the outfall [5]
- Aliquots of the composite samples were distributed into 1-L amber bottles
- Chemical analysis (fiproles [fipronil and degradates], imidacloprid, pyrethroids, synthetic auxin herbicides) by the California Department of Food and Agriculture (diuron added FY16/17) [6]
- 96-hr water toxicity tests conducted by UCD Aquatic Health Program [7]

Results and Discussion:

- Six storms were monitored between 2015 – 2017, with 77-100% of total storm sampled (Figure 3). Good correlation between rainfall totals and calculated runoff volume for all storms except for April 2017 storm (Figure 4). April storm had higher levels of runoff due to exceptionally wet water year and saturated soil at end of storm season.
- Bifenthrin, fiproles, imidacloprid, 2,4-D, triclopyr, and diuron were detected exiting the CWQTP. The herbicides 2,4-D and triclopyr accounted for the largest mass (Figure 5).
- Significant toxicity to *H. azteca* was observed during 3 of the 5 storms. Bifenthrin concentration weakly correlated with toxicity, but other, non-measured factors may have also contributed, especially in the February and April 2015 storms which had limited rainfall due to California's drought (Figure 6; no toxicity testing for the April 2016 storm).

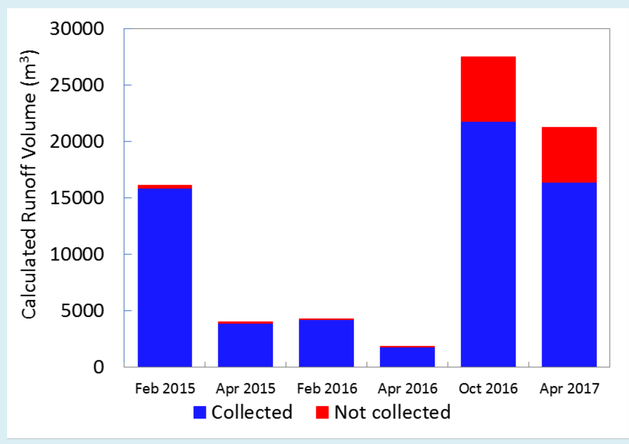

Figure 3. Percentage of storm runoff sampled.

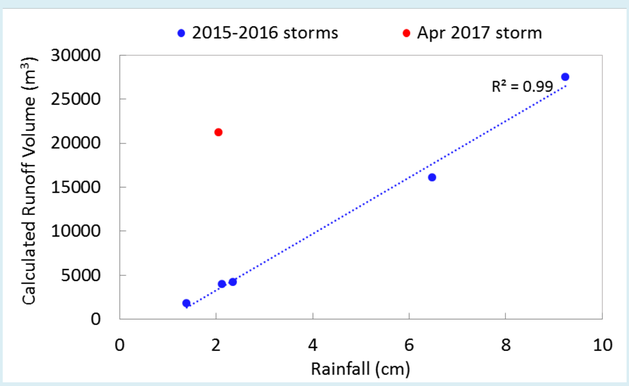

Figure 4. Correlation between rainfall and calculated water volume through the CWQTP. Red marker (April 2017 storm) not included in correlation.

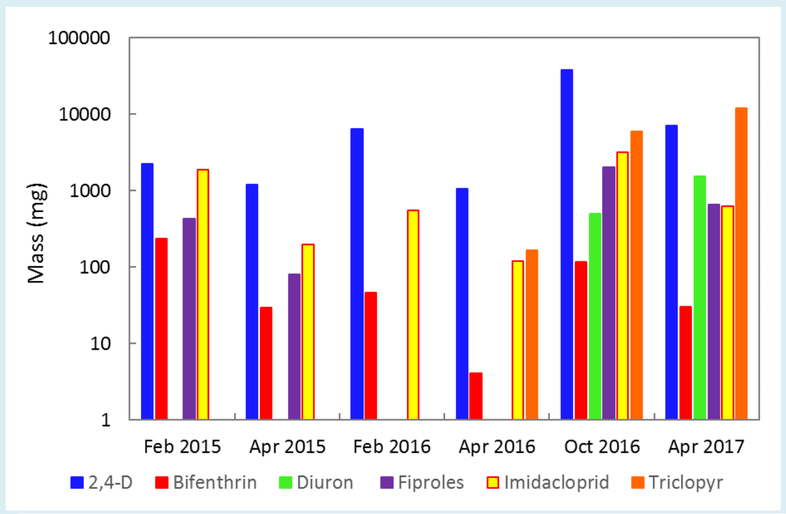

Figure 5. Pesticide mass calculated for complete storm at the outfall of the CWQTP.

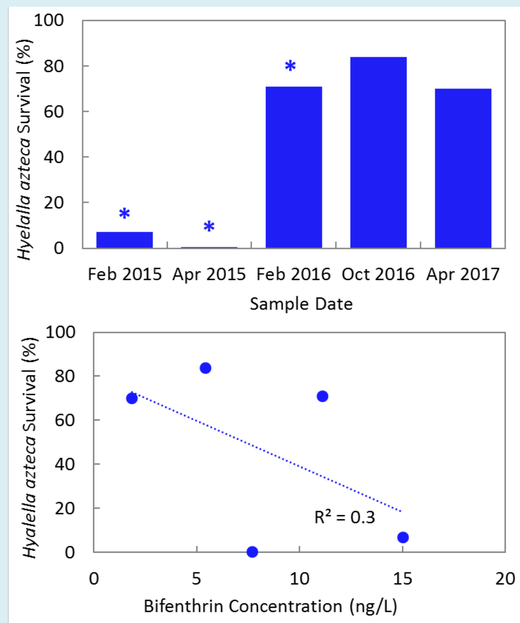

Figure 6. Top, *Hyalella azteca* survival at the CWQTP outfall (*, significantly different from controls); bottom, bifenthrin correlation to survival.

Conclusions: Flow weighted sampling can effectively be used to collect representative runoff from a complete rain storm event. During storm events, small CWQTPs may not adequately trap or collect all pollutants, and toxicity can be observed in waters exiting the CWQTP. Outreach to local residents on reducing pesticide use and other BMPS are still warranted.

References.
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