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Role of a Constructed Wetland in the Mitigation of Pesticide Load of an Urban Creek in Aliso Viejo, California

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Introduction

Constructed wetlands (CW) are a best management practice (BMP) designed to mitigate downstream transport of organic compounds[1]. CWs have been used in agricultural settings to reduce pesticide loads into surface water via adsorption to sediment and macrophyte biofilms[2]. However, little is known about their potential mitigation benefits within urban settings. A CW was built in Orange County, CA, by the City of Aliso Viejo at the headwaters of Wood Canyon Creek (WCC) to improve water quality entering the watershed. The 3.5 mile canyon originates within a high density residential area and terminates at the Pacific Ocean. The area has experienced much development along its ridges, which has likely caused increased pesticide loading into the watershed[3]. Over 57,800 lbs of pesticides are applied annually in Orange County for structural control purposes as reported by the California Department of Pesticide Regulation (CDPR)[4]. In addition, a recent survey of local home improvement stores found numerous pesticide products registered for home use, which are not reported by CDPR. The high pesticide usage within the surrounding residential areas in conjunction with steep topography justify the need for BMP measures to mitigate pesticide loads. In this project the efficiency of the CW as a BMP is assessed.

Project Goal

To assess the efficiency of a constructed wetland in the removal of pesticide loads of an urban creek in southern California.

Materials and Methods

- Inflow and outflow collected during two sampling events (baseflow and post-storm).
- Water placed in cooler for transport and stored at 4° prior to analysis.
- Sediment sampled using composite method.
- Pesticide analysis included 11 pyrethroids.
- Statistical analysis used pooled data in Wilcoxon Signed Rank Test.

Figure 6. Residential area located above constructed wetland in Aliso Viejo.

Figure 7. Retaining pond.

Figure 1. Wood Canyon Creek Wetland. Arrows represents flow path.

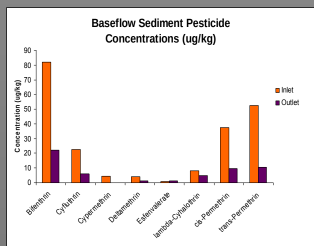

Figure 2. Baseflow sediment samples.

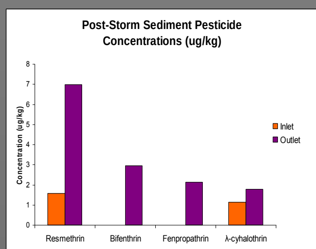

Figure 3. Post-storm sediment samples.

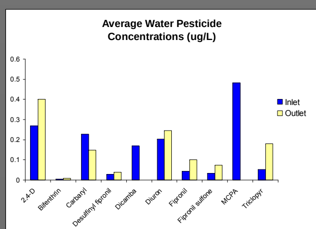

Figure 4. Average Water Samples

Results

- Higher concentrations (nd - 81.9ug/kg) in sediment compared to water (nd - 0.71ug/L) indicate pyrethroid preference for bound phase.
- Wetland effectively removed pyrethroids (40-100%) through soil deposition during baseflow conditions [Fig.2] (Wilcoxon Signed Rank Test, $p < 0.01$).
- Pyrethroid laden sediment transported downstream during intense storm event (1.5" in 24 hrs) [Fig.3].
- Wetland does not effectively remove more hydrophilic compounds such as herbicides [Fig.4].

Table 1. Percent removed by sediment at baseflow.

Analyte	% Pesticide Removed by Sediment
Bifenthrin	73
Cyfluthrin	73
Cypermethrin	100
Deltamethrin	73
λ-cyhalothrin	40
cis-Permethrin	74
trans-Permethrin	78

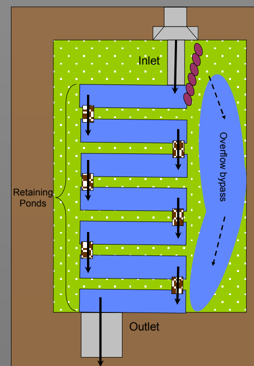

Figure 5. Flow pattern of constructed wetland which increases flow path > 3x than overflow bypass

Conclusion

- Sediment samples taken at baseflow show CW was efficient in removing 40% - 100% of pyrethroids.
- Samples taken after major storm showed a reverse trend, indicating removal efficacy compromised during storm flow conditions.
- Continued sampling necessary to evaluate wetland efficacy on temporal scale.
- Wetland shows promise for effective mitigation of pesticides in an urban setting as a best management practice.
- Wetland is efficacious for baseflow, but size is inadequate for intense rain events.

References
1) Gregoire, C, D Elsaesser, D Huguenot, J Lange, T Lebeau, A Merli, R Mose, E Passeport, S Payraudeau, T Schulz, G Tapia-Padilla, J Tournebize, M Trevisan, A Wanko (2009) Mitigation of Agricultural Nonpoint-Source Pesticide Pollution in Artificial Wetland Ecosystems. Environ Chem Lett **7:** 205-231
2) Moore, MT, CM Cooper, S Smith, RF Collum SS Knight, MA Locke, ER Bennett (2007) Diazinon Mitigation in Constructed Wetlands: Influence of Vegetation. Water Air and Soil Pollution **184:** 313-321
3) City of Aliso Viejo, California. 2010. Environmental Care: Wood Canyon Emergent Wetland Project. http://ci.aliso-viejo.ca.us/environmental_care/special_projects.php. Verified March 11, 2010
4) CDPR (California Department of Pesticide Regulation (2010) California Pesticide Information Portal http://calpip.cdpr.ca.gov/main.cfm. March 11, 2010.

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