



Appendix D.4

MACROINVERTERBRATES LETTER REPORT





WESTON SOLUTIONS, INC.
2433 Impala Drive
Carlsbad, CA 92010
(760) 795-6900 / (760) 931-1580 FAX
www.westonsolutions.com

March 9, 2011

Anne Jarque
Storm Water Division
City of San Diego
2781 Caminito Chollas, MS 44
San Diego, CA 92105

Subject: Implications of Storm Water Facility Maintenance on Benthic Macroinvertebrates

Dear Ms. Jarque:

At your request, WESTON Solutions has prepared the following letter to address the potential for storm water facility maintenance to adversely impact benthic macroinvertebrate (BMI) populations associated with these facilities. As the following discussion indicates, it is our conclusion that maintenance activities associated with storm water facility maintenance would result in short-term impacts to the BMI but the degree of impact would not be considered significant.

As a senior scientist with Weston Solutions, I have been working with BMI issues for over fifteen years. My experience includes a wide variety of small and large scale monitoring projects in support of county-wide NPDES permit compliance programs, stream restoration projects, BMP effectiveness studies and point source impact assessments. My involvement has been comprehensive; performing field collections and taxonomic identifications, data analysis, and authoring reports that have become public information.

As I understand it, the City of San Diego is proposing to adopt a Master Storm Water Maintenance Program (Master Program) to govern future maintenance activities in natural and man-made drainage facilities located throughout the metropolitan area. Typically, this maintenance will involve periodic removal of sediment and vegetation in order to maintain the ability of the affected storm water facilities to transport flood waters. These maintenance activities are expected to occur at frequencies which generally range between two and five years.

Background Information

BMI are important components of ecosystems associated with streambeds. Benthic macroinvertebrates include the larval and adult stages of aquatic insects as well as all life stages of non-insects (e.g., amphipods, crayfish, and flatworms). BMI provide a valuable food source for wildlife including fish, birds, and small mammals and also play an important role in the breakdown of organic matter. They are also a very useful tool for assessing the ecological health of aquatic ecosystems.



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The capacity of storm water facilities to support BMI is based on two primary factors: surface water flow and substrate characteristics. Flow may be classified as perennial, ephemeral and intermittent. Perennial facilities have continual flow throughout the year, ephemeral streams flow throughout the wet season but dry out in the summer, and intermittent facilities flow only during storms and for a short time thereafter. BMI typically colonize perennial and ephemeral streams with high abundances, but are generally not prevalent in intermittent facilities. The exception in intermittent facilities is situations where ponded water may stand for an extended period allowing for short-lived BMI to complete their aquatic life stages (e.g., midges and mosquitos).

Storm water facility substrate types may be classified as natural or artificial. Natural sites may have substrates dominated by cobble, vegetation, or fine sediments. Artificial channel substrates may include concrete, rip-rap, and gabion (rip-rap or cobble contained by wire mesh).

Benthic Macroinvertebrates in San Diego's Urban Streams

The BMI communities in urban streams in San Diego County have been extensively monitored using standardized stream bioassessment protocols since around 1996. Virtually all urban-influenced sites that have been sampled in the county have been shown to support degraded or impaired BMI communities (e.g., WESTON 2010) based upon the southern California Index of Biotic Integrity (IBI) (Ode et al, 2005). This is not unique to San Diego and "urban stream syndrome" has been well-documented throughout the United States and other countries (e.g., Walsh et al, 2005). The BMI communities in San Diego urban streams are, by necessity, tolerant to urban runoff and it may be presumed that the sensitive organisms (i.e., with a tolerance value of 0, 1, or 2) found at the more pristine, non-urbanized sites have either been eliminated from the urban environment or were never present due to pre-development hydrologic limitations. For example, in ten years of data for San Diego County NPDES stormwater permit monitoring (PCW 2010) there has not been a single record of a sensitive BMI taxon collected at sites with a high level of urban influence. A review of the proposed maintenance sites indicated that none of these conveyances currently support high quality BMI communities.

The Mediterranean climate of San Diego allows for year-round BMI populations with only minor seasonal variation. Most variation involves total abundance or feeding group distributions within a population. Many streams have a spring bloom of collector taxa (organisms that feed on fine particulate organic matter) which are replaced over the summer with predator taxa. Scouring storm flows may naturally decrease overall abundance at some sites during the winter season, but taxa richness (diversity) is relatively consistent throughout the year. The impacts of storm flows are highly variable, depending on watershed size and the amount of impermeable surface area within the tributary watershed as well as streambed consolidation. Storm flows in concrete-lined channels generally stress the resident BMI population the most as there is less refugia habitat or substrate niches than in natural streambeds.



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Response to Disturbance

The BMI communities in urban streams are generally subjected to a greater amount of disturbance than those in open space sites. Hydromodification creates higher intensity storm flows that are more erosive and urban runoff from impervious surfaces introduces a greater amount of fine particulates, anthropogenic contaminants, and suspended solids. Additionally, channel maintenance operations and restoration efforts impart direct physical disturbances to the streambed, which can substantially affect BMI habitats and populations.

Physical disruption to a limited section of a stream generally has a short-term, quickly reversible impact to BMI communities. This has been documented in numerous situations in San Diego County in recent years. A good example is the streambed restoration project of Forester Creek in the City of Santee. Restoration in Forester Creek began in 2005 with a complete removal of the stream substrate for a length of approximately 800 meters. Construction activities took approximately 1 ½ years to complete. Weston conducted two pre-restoration BMI surveys, two surveys during restoration, and three post-restoration surveys. Figures 1, 2, and 3, show the condition of the creek throughout the three phases of the project. Table 1 shows the IBI scores for all surveys for each site, the mean taxa richness, and the mean BMI abundance-density values.

The study of Forester Creek shows that BMI community quality, richness, and abundance are affected to a moderate degree by disruption of the streambed (Table 1), but that even major disturbance (Figure 2) does not eliminate the BMI community altogether. While restoration activities were underway, the survey conducted in June 2006 had relatively high IBI scores (for urban monitoring sites), the greatest taxa richness of all seven surveys, and a moderate abundance of organisms. The November 2006 survey had low IBI scores and taxa richness, but abundance was relatively high. In January of 2008, all metrics indicated the most degraded BMI community. However, this could be due to the fact that sampling occurred during the wet weather season when scouring flows negatively impacted the BMI community (this was the only survey conducted during wet weather, which is generally not recommended for ambient monitoring). By June 2008, the BMI community had recovered to similar or better conditions than was seen pre-restoration. Notably, the Downstream Site had an IBI score that rated the site “unimpaired” (albeit by a single point and within the margin of error), which is extremely uncommon at urban influenced sites in San Diego County. This study indicated that vegetation and sediment removal had only moderate short term impacts on the BMI community which were entirely reversed once the site had been restored.

A number of other studies have shown that re-colonization by BMI occurs relatively quickly after channel alteration, including the Woodside Basin BMP study (Weston 2006), the Sulpher Creek Restoration Project (Weston 2007), the Narco Channel Restoration Project (Weston 2008), and the Tijeras Creek Sewage Spill Monitoring Project (Weston 2010b).



Figure 1: Forester Creek in June 2005, pre-restoration



Figure 2: Forester Creek in November 2006, mid-restoration



Figure 3: Forester Creek in June 2008, Post-restoration



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Table 1: Benthic Macroinvertebrate Community Metrics for the Forester Creek Restoration Study

Restoration Project Status	Survey Date	IBI Score (0-70 scale)		Mean Taxa Richness	Mean Abundance (#organisms/ft ²)
		FC-DS (Downstream)	FC-US (Upstream)		
Pre-restoration	June 28, 2005	11	12	17.0	1651
Pre-restoration	October 28, 2005	9	9	16.5	940
Restoration underway	June 15, 2006	21	18	18.0	513
Restoration underway	November 2, 2006	8	4	12.5	1484
Post-Restoration	January 3, 2008	6	6	12.5	131
Post-Restoration	April 1, 2008	13	5	13.0	917
Post-Restoration	June 18, 2008	28	10	20.5	1634

The example of Forester Creek may be different from a scenario that could be encountered in concrete-lined channels. In some situations, eroded sediment and cobble from an upstream source may be deposited in a previously barren concrete channel. Over time, vegetation may become established and, what was once a very poor substrate for BMI colonization becomes habitat of a much higher quality, given suitable hydrology. Channel maintenance activities that remove the sediment and vegetation would likely have a greater and more long-lasting impact on the BMI community than in a more natural streambed.

Summary

Based on the results of BMI pre- and post-disturbance monitoring in Forrester Creek and the other examples noted above, storm water maintenance carried out in accordance with the proposed Master Program would result in short-term impacts to BMI. However, these impacts would not be considered significant because the evidence indicates that BMI are adept at recovering after disturbance in urban environments. Re-colonization (presumably from upstream BMI populations and aerial adults) has been documented in a number of sites in San Diego County where monitoring was performed in conjunction with restoration projects, BMP effectiveness studies, and point-source spills (e.g., sewage and diesel fuel). In addition, as noted above, none of the facilities to be maintained are expected to support sensitive or high quality BMI communities.

Sincerely,
Bill Isham
Senior Scientist, Weston Solutions, Inc.



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References

- Ode P.R., A.C. Rehn, and J.T. May. 2005. A quantitative tool for assessing the integrity of Southern Coastal California streams. *Environmental management*, 35 (1): 1-13.
- Project Clean Water (PCW). 2011. On-line source for information regarding the San Diego County Co-permittees Monitoring Workgroups: Studies, Information, & Work Products. Available at: http://www.projectcleanwater.org/html/wg_monitoring.html
- Walsh , C.J., A.H. Roy, J.W. Feminella, P.D. Cottingham, P.M. Groffman, R.P. Morgan. 2005. The urban stream syndrome: current knowledge and the search for a cure. *J.N. Am. Benthol. Soc.*, 2005, 24(3): 706-723
- Weston Solutions, Inc. 2006. Woodside Basin
- Weston Solutions, Inc. 2007. Bioassessment monitoring of the upper Sulpher Creek restoration project. Final Report. Prepared for the City of Laguna Niguel, Orange County, California. November 2007.
- Weston Solutions, Inc. 2008 Bioassessment and photo-documentation for the Narco Channel restoration project. Final Report. Prepared for the City of Laguna Niguel, Orange County, California. January 2008.
- Weston Solutions, Inc. 2010a. San Diego County Municipal Copermittees 2007-2008 urban runoff monitoring. Prepared for the County of San Diego. January, 2010.
- Weston Solutions, Inc. 2010b. Tijeras Creek sewage spill, April 2010 Study. Prepared for Dudek and Associates, Encinitas, California. May 2010.