Geosyntec consultants

924 Anacapa Street, Suite 4A
Santa Barbara, California 93101
PH 805.897.3800
FAX 805.899.8689
www.geosyntec.com

Memorandum

Date: October 31, 2019

From: Geosyntec Consultants, in support of the SSFL Surface Water Expert Panel: Dr. Robert Pitt (University of Alabama), Dr. Robert Gearheart (Humboldt State University), Dr. Michael Stenstrom (University of California Los Angeles), Dr. Michael Josselyn (WRA Environmental Consultants), and Jonathan Jones (Wright Water Engineers)

Subject: SSFL Stormwater Frequently Asked Questions

For more information, see the Expert Panel's Annual Report, located here.

Questions Related to the 2018 Woolsey Wildfire

1 How did the Woolsey wildfire affect stormwater runoff in the 2018/19 season?

Frequent storms and a greater than average total rainfall combined with burned watershed conditions from the Woolsey wildfire resulted in more runoff than previous years with similar rainfall. Post-wildfire conditions that increase the amount of runoff include less vegetative cover, increased hydrophobicity of soils, and reduced leaf litter. These conditions increased both the frequency and volume of runoff, especially for storms totaling less than 2 inches compared to previous years with no wildfires.

Table 1. Runoff Volume Effects Restricted to Small Events in Burned Watersheds

	Storm Size	
	<2 inches	**>2 inches**
Burned Watersheds	Significant increase (7x)	No significant difference
Unburned Watersheds	No significant difference	No significant difference

The wildfire also created new pollutant sources (e.g. burnt equipment, burned utility poles, burned pipes, ash) and increased pollutant mobilization. Mobilization was facilitated by an increased amount of runoff, the fire exposing more loose material (e.g. soils), and the fire breaking down material into smaller more mobile pieces (e.g. ash).

Geosyntec consultants

924 Anacapa Street, Suite 4A
Santa Barbara, California 93101
PH 805.897.3800
FAX 805.899.8689
www.geosyntec.com

2 What were the sources of the 2018/19 exceeding constituents?

As shown in Table 2, many of the sources of 2018-2019 exceeding pollutants are non-industrial and background sources that were more heavily mobilized with the increased runoff following the Woolsey wildfire. In some cases (lead, dioxins, and zinc), soils in RCRA Facility Investigation (RFI) areas could not be ruled out as a source and additional monitoring was recommended for further investigation. The full analysis conducted to determine these sources is presented in Appendix E of the 2019 Annual Report.

Table 2. Summary of 2018-2019 Exceeding Constituent Source Assessment

Exceeding Constituent	Likely Sources of Exceedances
Metals (arsenic, copper, iron, lead, manganese, nickel, selenium, zinc)	Natural background soils, pavement solids (lead only), vegetation ash (copper, manganese, and zinc)
Dioxins	Pavement solids, soils near treated wood (utility poles), and burned treated wood and pipes
Gross Alpha	Natural sources (only naturally occurring radionuclides detected)
Nitrate	Vegetation ash, groundwater
Sulfate	Groundwater
Cyanide	Possibly burned sampling equipment
pH	Treatment system (pH adjustment)

The Expert Panel evaluated a number of data sources (see Appendix E of the 2019 Annual Report) to determine which constituents were likely impacted by the wildfire and which sources most likely explain each exceeding constituent in the post-wildfire 2018-2019 stormwater dataset. In most cases, natural background soil exposed and mobilized following the wildfire was determined to be the likely source of the exceeding constituent found in stormwater.

The similarity of constituents with increased concentrations at SSFL compared to other post-wildfire studies in undeveloped watersheds in California, in conjunction with the spatial and temporal patterns seen at SSFL, suggests most of the elevated constituent concentrations in stormwater observed at SSFL this year are characteristic of natural burned areas elsewhere in California. Natural background soils are indicated as likely contributors to observed exceedances for many constituents. Increased erosion and transport of the soils are common effects associated with wildfires. However, since not all 2018/19 exceedances could be explained by the tested materials, and since impacted soils could not be ruled out as a potential source for lead and dioxin exceedances in Outfall 001 and 002 watersheds, a new subarea monitoring program was recommended to better understand sources of constituents within Outfall 001 and 002 watersheds.

Geosyntec consultants

924 Anacapa Street, Suite 4A
Santa Barbara, California 93101
PH 805.897.3800
FAX 805.899.8689
www.geosyntec.com

3 Forty-four (44) of the 57 exceedances in the 2018/19 season occurred in areas without any treatment control BMPs. Are any recommendations being made here?

Yes, several recommendations including new subarea monitoring and erosion controls have been recommended. The full set of recommendations include:

- stockpiling erosion control materials to facilitate emergency response time;
- testing several hydromulch products to ensure that the selected product does not introduce potential pollutants to the site;
- installing BMPs around more treated wood utility poles and other treated wood (prioritizing those adjacent to pavement, storm drains, unpaved roads, and drainages) to prevent or reduce the mobilization of adjacent soils containing pollutants;
- assessing the condition of existing erosion and sediment controls and vegetation in the Outfall 008 watershed and repairing or supplementing where needed; and
- new subarea monitoring in the Outfall 001 and 002 watersheds to determine the extent to which these sources may contribute to future exceedances at the outfalls and where and how to control these sources.

4 How fast is water quality improvement being seen following the Woolsey Fire and should we expect continued exceedances in following years?

Based on the decreasing trend of stormwater concentrations after the initial elevated concentrations observed in the first storms following both the Topanga and Woolsey wildfires, concentrations are expected to continue to decrease back to typical levels for the site. For example, Figure 1 shows that the concentration of lead decreased across the site over the course of the 2018-2019 rainy season. Future storm discharge water quality will be closely monitored to determine if this decreasing trend continues into the next rainy seasons, and an update will be provided following the 2019/20 rainy season. Appendix F of the 2019 Annual Report shows the outfall stormwater concentrations for all exceeding constituents and TSS over the course of the 2018-2019 season.

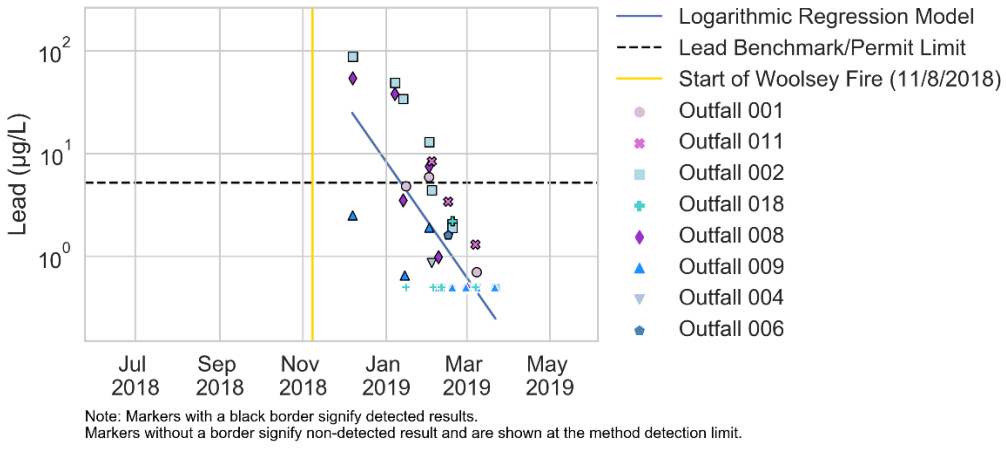

Figure 1. Timeseries of Lead Concentrations in 2018/19 Outfall Stormwater

Geosyntec consultants

924 Anacapa Street, Suite 4A
Santa Barbara, California 93101
PH 805.897.3800
FAX 805.899.8689
www.geosyntec.com

5 Ten exceedances occurred at Outfall 011 in 2018/19 season, are new recommendations being made here?

Yes, it was recommended that the SWTS at Outfall 011 be repaired and operational. Boeing completed repairs and made the SWTS operational before the 2019/2020 winter season.

Questions Related to the Outfall 009 Watershed

6 Are the distributed natural treatment BMPs in the Outfall 009 watershed reducing the concentrations and loads of lead, dioxin, and TSS?

Yes, as shown in Table 3 and Table 4, lead and dioxins reductions are observed for all BMP types, based on the percent of paired influent and effluent samples greater than the Permit limits; the percent of influent samples greater than the Outfall Permit limit is less than the percent of effluent samples greater than the Permit limits for both lead and dioxins for all BMPs, indicating an improvement in water quality between influent and effluent. Performance analysis results (Appendix D) indicate that statistically significant ($p<0.05$) lead and TCDD TEQ (no DNQ) concentration reductions are occurring between influent and effluent samples at the B-1 media filter, CM-9, CM-1, and upper lot media filter (grouped analyses for these similar controls), along with the detention bioswales, and the ELV treatment BMP. Statistically significant pollutant concentration reductions between influent and effluent samples were also observed for dioxins at the lower lot biofilter.

Table 3. Summary of TCDD TEQ (no DNQ) BMP Performance Stormwater Monitoring Results, Since Construction

BMP	Statistically Significant Removal?	Median % Change between Influent and Effluent[1]	% of Sample Concentrations Greater than Outfall Permit Limit	
			Influent	Effluent
B-1	Yes (grouped dataset)	-67% (grouped dataset)	85%	68%
CM-1			76%	55%
CM-9			50%	24%
Upper Lot Media Filter			71%	29%
Lower Lot Biofilter	Yes	-99.7%	92%	11%
ELV Treatment BMP	Yes	-98%	30%	7.7%
Detention Bioswales	Yes	-99.7%	76%	13%

[1] Percent change was calculated using the median influent and effluent concentrations before rounding. Negative values indicate a reduction in effluent concentrations compared to influent sample concentrations.

Geosyntec consultants

924 Anacapa Street, Suite 4A
Santa Barbara, California 93101
PH 805.897.3800
FAX 805.899.8689
www.geosyntec.com

Table 4. Summary of Lead BMP Performance Stormwater Monitoring Results, Since Construction

BMP	Statistically Significant Removal?	Median % Change between Influent and Effluent[1]	% Greater than Outfall Permit Limit	
			Influent	Effluent
B-1	Yes (grouped dataset)	-44% (grouped dataset)	35%	8.7%
CM-1			39%	19%
CM-9			41%	26%
Upper Lot Media Filter			7.1%	0%
Lower Lot Biofilter	No[2]	15%	12%	3.6%
ELV Treatment BMP	Yes	-49%	20%	0%
Detention Bioswales	Yes	-49%	34%	0%

[1] Percent change was calculated using the median influent and effluent concentrations before rounding.

[2] Can likely be attributed to the much lower influent lead concentrations to the lower lot biofilter in recent years. Although the percent change as reflected by the median influent and effluent concentrations was found to increase, a decrease between influent and effluent was observed for the average results.

Figure 2 and Figure 3 present summaries of influent and effluent monitoring results by BMP group.

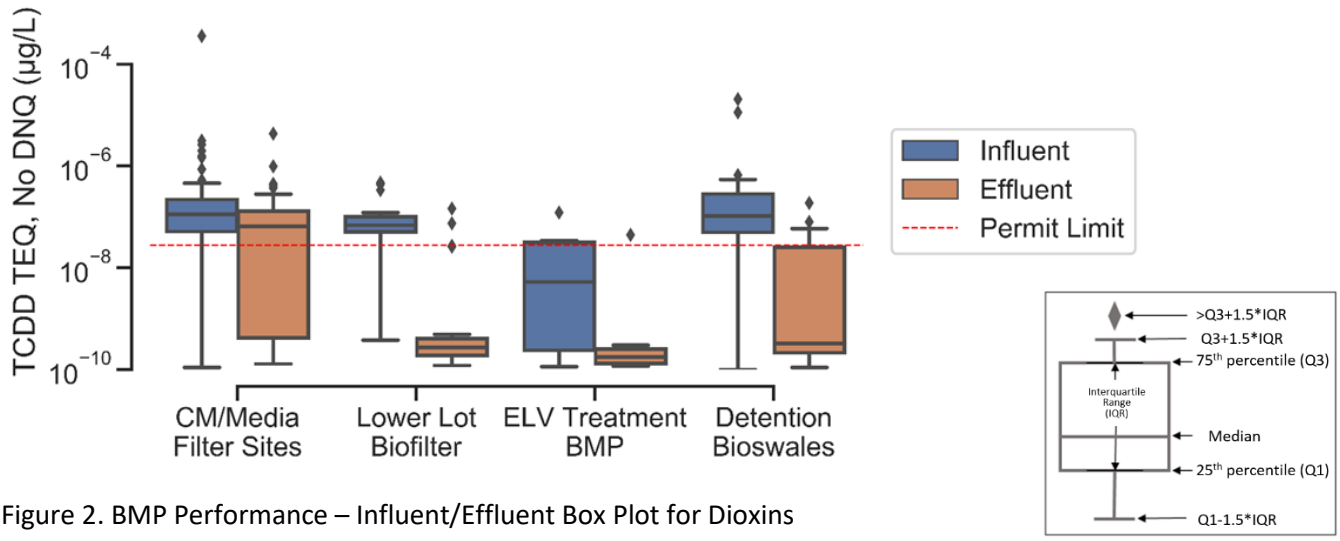

Figure 2. BMP Performance – Influent/Effluent Box Plot for Dioxins

Geosyntec consultants

924 Anacapa Street, Suite 4A
Santa Barbara, California 93101
PH 805.897.3800
FAX 805.899.8689
www.geosyntec.com

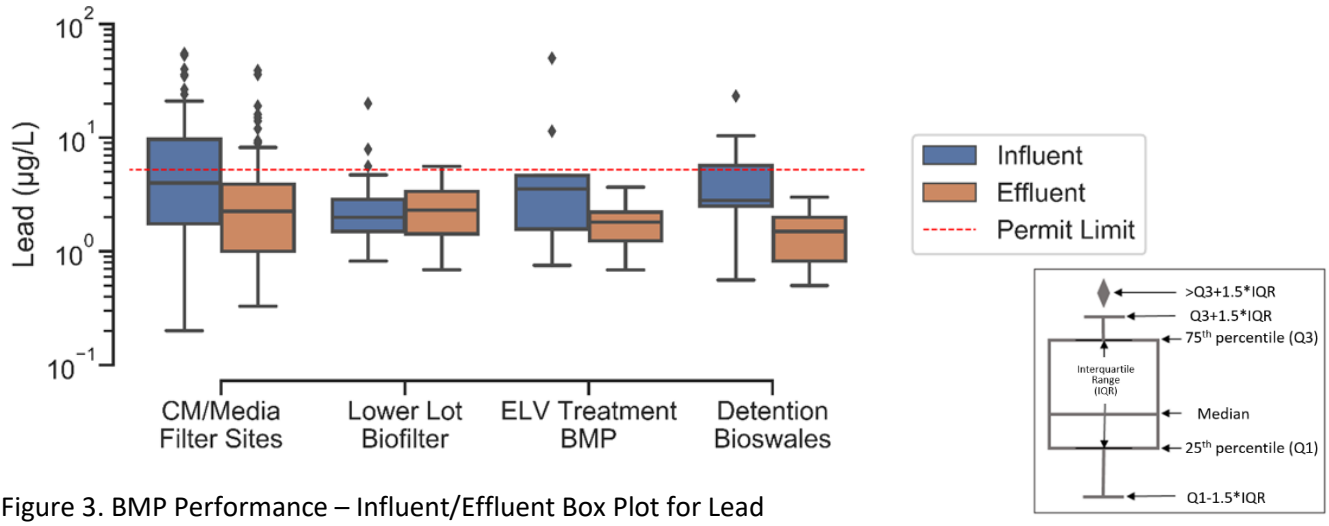

Figure 3. BMP Performance – Influent/Effluent Box Plot for Lead

Constituent loads are also being reduced, both because concentrations are being reduced, and because runoff volumes are being reduced by upstream pavement and building removal and stormwater storage in BMPs.

7 Are the distributed treatment controls aiding in compliance with NPDES Permit limits at Outfall 009?

Yes, the treatment controls are exhibiting BMP-specific water quality improvement (see Table 12 and Table 13) which are expected to also support NPDES compliance at Outfall 009. This past reporting year, all BMP-constituent combinations had the same or fewer effluent concentration results above Permit Limits compared to the influent concentrations. Historically, most grouped BMP-constituent combinations also showed lower average and maximum exceedance ratios (i.e., exceeding sample concentrations divided by the Permit Limit) for effluent results compared to the influent results. For example, average influent exceedance ratios for CM-9 were 24 and 34 times higher than average Outfall 009 concentrations for lead and dioxins, respectively, while the average effluent exceedance ratios were reduced to 3.1 and 0.049 for lead and dioxins, respectively, during this same time period. This not only demonstrates that the treatment controls are effectively reducing NPDES constituent concentrations in stormwater above Outfall 009, but also that the treatment control drainage areas (which include paved roads) are pollutant generating source areas that, without treatment, would have worsened water quality at the downstream NPDES compliance location.

There were no lead exceedances at Outfall 009 in 2018/19, and only three of the results were measured above the detection limit. This demonstrates a marked improvement over previous years, even with the Woolsey wildfire affecting the southern fringes of the watershed.

Geosyntec consultants

924 Anacapa Street, Suite 4A
Santa Barbara, California 93101
PH 805.897.3800
FAX 805.899.8689
www.geosyntec.com

8 Is the lower lot biofilter in the outfall 009 watershed preventing untreated stormwater runoff from discharging to the Northern Drainage?

Yes, flow monitoring data at the lower lot biofilter examined in the *BMP Performance Analysis* (Appendix D of the Annual Report) indicates the low flow diversion is able to prevent smaller storms from discharging to the Northern Drainage without first being treated. As shown in Figure 15, the diversion to the lower lot biofilter successfully prevented just over half of all storms less than or equal to one inch (event total) from discharging to the Northern Drainage.

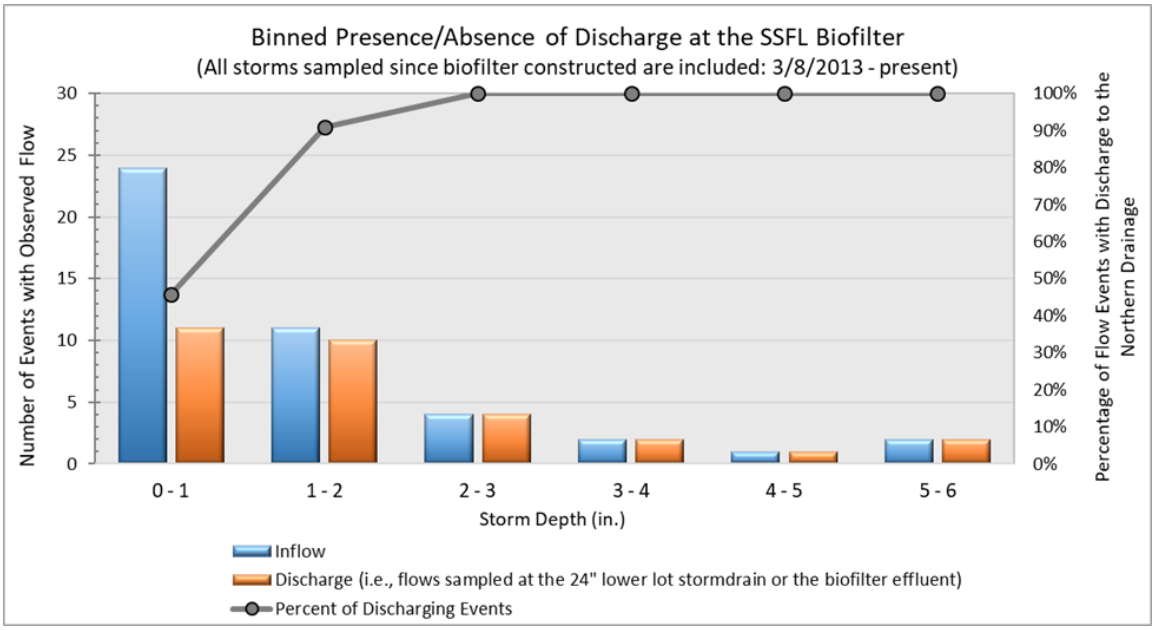

Figure 4. Binned Presence/Absence of Discharge at the SSFL Biofilter, 2013 to 2019

Questions Related to the Stormwater Human Health Risk Assessment

9 Human Health Risk Assessment (HHRA)

The HHRA Report documented a HHRA of surface water runoff exiting the SSFL via Outfalls 001, 002, 008, 009, 011, 018, and 019, as described in the California Water Code section 13383 Order (Order) from the Los Angeles Regional Water Quality Control Board (LARWQCB) dated June 24, 2015. The Order was proposed by the LARWQCB in response to health concerns expressed by members of the public regarding exposure to NPDES discharges in the drainages near the SSFL. The HHRA Report provides a quantitative assessment of potential risks and hazards associated with contact with surface water discharges from the SSFL to downstream populations. In accordance with the Order, the analysis used conceptual exposure scenarios that are representative of realistic (but conservative) exposures that may occur immediately downstream of the SSFL property boundary over the long-term. This analysis was performed using SSFL stormwater quality data collected prior to the Woolsey fire.

Geosyntec consultants

924 Anacapa Street, Suite 4A
Santa Barbara, California 93101
PH 805.897.3800
FAX 805.899.8689
www.geosyntec.com

The cumulative cancer risk and noncancer hazard index posed by the presence of all constituents of potential concern (COPCs) detected in surface water at a given outfall were estimated. Wherever possible, the assumptions used in estimating risk and hazard were generally health-protective and conservative in nature. Consequently, the calculated cancer risk and noncancer hazard indices presented in this HHRA are biased high and will over-estimate potential risks. All cumulative cancer risk estimates and cumulative noncancer hazard index (HI) estimates were below the de minimis risk level of 1 x 10-6 and noncancer HI of 1. In addition, lead exposure point concentrations (EPC) for all outfalls were less than the recreator health-protective concentration of 31.8 µg/L (with the highest lead EPC being 13 µg/L).

In addition, an evaluation was conducted to assess the completeness of the aquatic plant and fish consumption pathway. Edible fish are not present in the drainages near the Outfalls and, therefore, the fish consumption pathway does not exist. While the fish consumption pathway is considered incomplete near the outfalls, there could be the potential for fishing and fish consumption at offsite locations farther downstream of SSFL where water is present in sufficient quantity year-round. An evaluation of the potential contribution of water flow and constituent concentrations to these locations was conducted. The evaluation indicates that potential exposure to SSFL's relatively minor contributions to the water volume and constituent mass in those larger downstream flows through this pathway would be de minimis.

Limited potentially edible plants are present within the drainage bottom and these may come in contact with surface water runoff during rain events or flow from the Groundwater Extraction and Treatment System (GETS) discharge. However, given the lack of accessibility due to more rugged terrain, low concentrations detected in surface water runoff (for many COPCs, concentrations are below the regulatory Maximum Contaminant Level [MCL] used for potable water supplies), the limited potential of COPC uptake into the edible portions of plants, and the minimal consumption that would occur in the unlikely event an individual were to occasionally harvest a plant, this pathway is considered insignificant, and any potential risks would be correspondingly low (i.e., well below the de minimis risk level).

The results of this HHRA indicate that, potential recreational exposures to COPCs in surface water runoff exiting the SSFL via Outfalls 001, 002, 008, 009, 011, 018, and 019 are below levels of concern as established by the California Environmental Protection Agency and the United States Environmental Protection Agency. This includes those COPCs that have had NPDES permit limit exceedances including lead and dioxins.

Geosyntec consultants

924 Anacapa Street, Suite 4A
Santa Barbara, California 93101
PH 805.897.3800
FAX 805.899.8689
www.geosyntec.com

References

Stormwater Expert Panel, 2019. *Santa Susana Field Laboratory Site-Wide Stormwater Annual Report 2018/19 Reporting Year.* http://www.boeing.com/assets/pdf/aboutus/environment/santa_susana/water_quality/tech_reports/Expert_Panel_Annual_Report_2019.pdf

Geosyntec, 2017. *Final Human Health Risk Assessment: Surface Water Outfalls Santa Susana Field Laboratory, Ventura County, CA.* https://www.waterboards.ca.gov/losangeles/public_notices/Boeing/2017/16.FinalHHRAforSurfaceWaterRunoffExitingSSFLviatheSouthernOutfalls-October30,20017.pdf