Manaaki Whenua
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Amberley tyre fire: assessing the effects of particle deposition on food crops. A short report on the results of testing undertaken by Environment Canterbury

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Purpose

A tyre fire occurred at Amberley, North Canterbury, on 29 January 2021 in which approximately 160,000 stored tyres were burned. As a result there is public concern about the human health risk associated with the deposition of ash (and associated contaminants) from the fire onto surrounding crops. Environment Canterbury previously sought advice[1] on what sampling should be undertaken to assess this risk. This short report provides a summary of the results from that sampling.

Methods

Sampling was undertaken by Environment Canterbury staff on 5 February 2021 at six locations: four sites that were anticipated to fall within the main plume of the fire and were located in a north-northwesterly direction from the fire (two near and two far), and two sites that were anticipated to be outside the plume, which were located to the south of the fire. The distance of the sites from the fire is shown in Table 1.

Duplicate samples were taken from an impervious surface (typically a horizontal surface on a plastic water tank, or plastic-covered hay bales) by wiping a 47 mm Teflon filter back and forth five to six times over a 150 mm x 150 mm area (approximate). Clean gloves were used for each sampling, and the filters were stored in clean plastic Petri dishes before and after sampling. Photos of the sampling sites were provided by Environment Canterbury staff.

Table 1. Summary of sites and distance from fire

Site	Sample description	Distance from fire (m)
1	Plume – near	1,820
2	Plume – near	2,004
3	Plume – far	4,869
4	Plume – far	4,079
5	Outside plume	4,209
6	Outside plume	3,340

The filters were couriered to GNS in Wellington, where black carbon and elemental analyses were carried out. Analyses for black carbon were undertaken via reflectance, using an M43D Digital Smoke Stain Reflectometer, and elemental analyses were undertaken via X-ray fluorescence spectroscopy (XRF) using a PANalytical Epsilon 5 spectrometer.

[1] J. Cavanagh. Preliminary advice for Environment Canterbury: Amberley tyre fire – assessing the effects of particle deposition on food crops, 4 February 2021.

Findings

It was anticipated that material collected on the swabs would be a mix of soil dust, any deposited combustion particles or ash, and biological materials such as pollen. Differing amounts of material were collected on the individual swabs, as shown by the elemental sum concentrations in Table 2, so the relative contribution of two indicator elements was used to assess the potential contribution of fire-derived materials to the collected materials.

The first indicator element is black carbon, which provides an indication of incompletely combusted material and is an indicator of smoke particulate deposition. The second is zinc, which was found to be significantly elevated in ash generated from a previous tyre fire at the site,[2] and so provides an indicator for re-entrained ash. It should be noted that the tyre fire is not a unique source of these elements, and that black carbon may be emitted from any combustion process, including diesel generators and vehicles. Zinc may also be present in these emissions, and is also naturally occurring in soils. A third indicator element, titanium, is commonly used as an indicator for soil[3] and provides information on the contribution of soil particles.

The relative contribution of black carbon ranged from 2.3% to 7.5% for individual duplicate samples, although there was no clear trend in relation to the proximity of sampling sites to the fire. The greatest contributions occurred in the duplicate samples from site 3 (Plume – far, 7.3–7.5%). This site was located just to the east of State Highway 1, and so the increased black carbon content could be attributable to vehicle emissions.

Table 2. Total elemental concentration (ng/cm^2) and relative contributions of black carbon and zinc to the total elemental concentration for each sample

Site	Sample	Elemental sum (ng/cm^2)	% contribution black carbon	% contribution Zn
1	a	7,796	5.6	0.4
1	b	6,657	6.5	0.3
2	a	40,278	2.9	0.2
2	b	39,500	2.9	0.1
3	a	18,276	7.3	0.1
3	b	10,244	7.5	0.1
4	a	28,506	4.1	0.2
4	b	26,653	3.5	0.2
5	a	13,535	4.6	0.2
5	b	11,055	5.1	0.4
6	a	4,911	2.3	0.2
6	b	6,219	5.0	0.1

The next greatest contributions were in the duplicate samples from site 1 (5.6–6.5%), located closest to the fire, which contrasts with the contributions from site 2 (both 2.9%), also located close to the fire (Table 2). The latter may be attributable to a 'dilution' effect arising from the greater absolute amount of collected material, shown as 'Elemental sum (ng/cm^2)' in Table 2. These greater sample masses were

[2] C. Parker 2018. Environment Canterbury Memorandum – Material sampling results for disposal options: 122 Racecourse Road, Amberley. 22 March 2018. Ref : IN7C/1880

[3] E.g. Cook et al. 2009. Titanium as an indicator of residual soil on arid-land plants. Journal of Environmental Quality 38: 188–199.

predominantly associated with soil particles, as indicated by the linear relationship between titanium and total element concentrations shown in Figure 1. Site 2 is located to the north of an unsealed road, which may have contributed to the higher particulate loading at this site. Site 5, which is anticipated to be outside the plume, was located within the township of Amberley, and so vehicle emissions may have contributed to black carbon concentrations at this site.

The relative contribution of zinc to the total element load was very low, and there was minimal variation in the relative contribution across all sites, which ranged from 0.1 to 0.4%. The greatest contributions came from individual duplicate samples at site 1a (plume – near) and site 5 (outside plume).

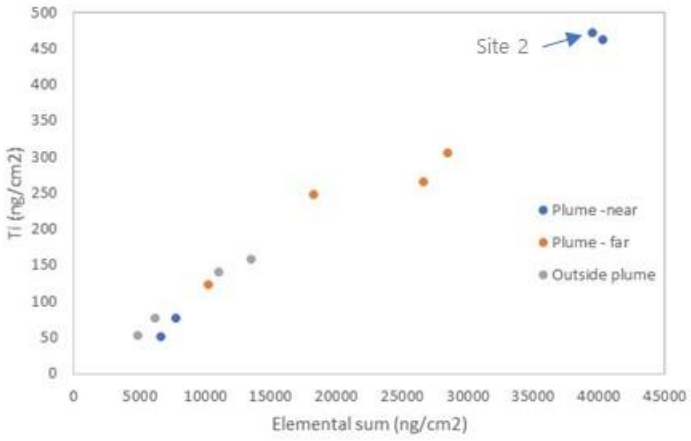

Figure 1. Relationship between titanium (indicator for soil particles) and total elemental sum measured (indicator for total particulate mass collected), showing an approximately linear relationship between total mass and contribution from soil particles. Note the high contribution from soil particles at site 2.

Conclusions

Based on the measurement of black carbon, there is marginal evidence for a contribution of deposited smoke particles arising from the Amberley tyre fire at site 1, located closest to the fire. However, this contribution appears to be no greater than contributions likely to have arisen from vehicular emissions from traffic on State Highway 1, as shown by the relative concentrations of black carbon at site 3. There is no evidence of a contribution from re-entrained ash (as indicated by the relative concentration of zinc) in any of the collected samples.

These results are not surprising given the challenges associated with detecting an influence of particles deposited from the fire, which are likely to have been widely dispersed and deposited in a thin film. However, they support the conclusion that there was no significant impact from particles and any associated contaminants deposited from the fire.