



Summary of post-remediation
contaminant monitoring from estuarine
sites located adjacent to the former
Fruitgrowers Chemical Company (FCC)
site, Mapua, Nelson (2018)

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Specialists in research, survey and monitoring

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1.0 Introduction

Following the completion of the remediation project, marine sediments and biota adjacent to the former Fruitgrowers Chemical Company (FCC) have been regularly sampled (Davidson *et al.*, 2010; 2011; 2012; 2016) with samples collected by TDC staff in 2013, 2014 and 2015. The present report presents a summary of data collected on the 28th May 2018 by Davidson Environmental Limited.

Data includes:

- Contaminant levels in sediments (shallow 0-2 cm, deep 6-10 cm);
- Contaminant levels in mollusc species (mudflat snail, topshell snail, cockle);

For background on the sample sites and methodologies used, refer to Davidson and Sheldon (2016).

2.0 Summary of results

2.1 Sediment contamination

Contaminant exceedances are shown in Tables 1 to 3.

ADL

Aside from the stream sites, all surface sediment sites were under the Soil Acceptance Criteria (SAC) for ADL (Aldrin, Dieldrin, Lindane) (Table 1). Several impact sites increased from 2015, however, the ADL values remained below SAC. Of the stream sites, West FCC stream 1 (lower) site slightly increased in value compared to 2015, while middle and upper stream sites decreased (Table 1).

Deep sediments exceeded SAC levels for ADL at two West FCC, one East FCC sites and all stream sites in 2018, however, only West FCC 84 site increased from 2015 levels (Table 2). The middle stream site continues to present the highest ADL levels in surface and deep samples but presented a decrease from 2015 levels (Tables 1 & 2).

DDX

The SAC for DDX was exceeded at all surface and deep impact sites in 2018, however, contaminant levels declined at most surface sites compared to 2015

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(Tables 1 & 2). Sediment surface samples from West FCC new1 (west) and East FCC (JME 086) were both above DDX SAC values and increased from 2015 (Table 1).

The majority of deep West FCC sediment samples showed an increase in DDX compared to 2015 samples, along with two East FCC sites and West FCC stream 2 (middle) (Table 2). Of note, are sites West FCC new 1 and 2 where the highest DDX values were recorded since 2009 (Table 2). DDX values at site West FCC (JME 084) have also gradually increased since 2009. DDX values at West FCC (JME082) and East FCC (JME087) and JME090 showed increases but remain well below historic levels.

The West FCC stream 2 (middle) site continues to show highest DDX levels for both depth strata, with an increase in the deeper sediment sample (Table 2). The West FCC stream 3 (upper) site remains above the DDX SAC, but levels were considerably lower compared to 2015 (Tables 1 & 2). West FCC stream 1 (lower) showed a decline in DDX for both depth strata (Table 1 & 2).

No elevated ADL or DDX values were recorded from control sites at either depth strata.

2.2 Shellfish and snail contaminant levels

In 2014 and 2015, ADL and DDX levels for cockles at the East FCC shore reached an all-time low. In 2018 ADL and DDX levels remained low (Table 3). Control site levels remained consistent (Table 3).

ADL and DDX levels in mudflat snails showed contamination as did samples collected from 2009 to 2015. Contaminant levels at East FCC dropped below control site levels in 2015, however, in 2018 ADL increased to 0.025 mg/kg but this was well below 2014 levels (Table 3). A similar pattern was recorded for DDX. At the West FCC site, ADL and DDX levels in mudflat snails decreased (Table 3).

In 2015, contaminants in topshell (*Diloma subrostrata*) reached the lowest level for the study. Results from the present survey show a small increase from 2015 levels, but contaminant levels remained low for this topshell (Table 3).

Table 1. Summary of shallow sediment ADL (Aldrin, Dieldrin, Lindane) and DDX, levels from surface samples collected at all sites in 2018 and status of increase (pink) and decline (green) compared to 2015 results. Orange cells highlight values exceeding Soil Acceptance Criteria (SAC)

SURFACE (0 - 2 cm)	West Control	West FCC JME 083	West FCC JME 081	West FCC JME 082	West FCC new1 (west)	West FCC new2 (middle)	West FCC new3 (east)	West FCC JME 084	East FCC JME 088	East FCC JME 087	East FCC JME 086	East FCC new1 (north)	East FCC new2 (south)	East FCC JME 090	East Control	West FCC Stream1 (low)	West FCC Stream2 (middle)	West FCC Stream3 (upper)
ADL	0.0015	0.0015	0.0015	0.0015	0.0038	0.003	0.0015	0.0053	0.0093	0.0015	0.0015	0.0024	0.0015	0.0026	0.0015	0.0141	0.062	0.0177
2015 to 2018	Decline	Decline	Decline	Increase	Increase	Decline	No change	Increase	Increase	Decline	Increase	Decline	Decline	Increase	No change	Increase	Decline	Decline
DDX	0.003	0.0515	0.0166	0.0139	0.0883	0.0816	0.0135	0.0239	0.0724	0.027	0.0245	0.1153	0.0429	0.1688	0.003	0.262	0.9064	0.1476
2015 to 2018	Decline	Decline	Decline	Decline	Increase	Decline	Decline	Decline	Decline	Decline	Decline	Increase	Decline	Decline	No change	Decline	Decline	Decline

Table 2. Summary of deep sediment ADL (Aldrin, Dieldrin, Lindane) and DDX, levels from surface samples collected at all sites in 2018 and status of increase (pink) and decline (green) compared to 2015 results. Orange cells highlight values exceeding Soil Acceptance Criteria (SAC)

DEEP (6 - 10 cm)	West Control	West FCC JME 083	West FCC JME 081	West FCC JME 082	West FCC new1 (west)	West FCC new2 (middle)	West FCC new3 (east)	West FCC JME 084	East FCC JME 088	East FCC JME 087	East FCC JME 086	East FCC new1 (north)	East FCC new2 (south)	East FCC JME 090	East Control	West FCC Stream1 (low)	West FCC Stream2 (middle)	West FCC Stream3 (upper)
ADL	0.0015	0.0154	0.0049	0.0015	0.0029	0.0024	0.0015	0.0119	0.0039	0.0015	0.0045	0.0039	0.0449	0.0029	0.0015	0.0121	0.1446	0.07
2015 to 2018	Decline	Decline	Decline	Increase	Increase	Increase	Increase	Increase	Decline	Decline	Decline	Increase	Decline	Decline	No change	Decline	Decline	Decline
DDX	0.0045	0.4401	0.1226	0.011	0.0985	0.1096	0.0106	0.2634	0.1379	0.0486	0.0256	0.2458	1.0983	0.1905	0.003	0.3267	5.98	0.7175
2015 to 2018	Decline	Decline	Decline	Increase	Increase	Increase	Increase	Increase	Decline	Increase	Decline	Decline	Decline	Increase	No change	Decline	Increase	Decline

Table 3. ADL and DDX concentrations in mollusc species sampled from impact and control sites in 2018 and status of increase (pink), decline (green) and no change (blue) compared to 2015 results.

Location Site	West Control	West FCC JME 084	East FCC Composite	East FCC new2 (south)	East FCC New 2	East Control
Species	Amphibola	Amphibola	Amphibola	Diloma	Cockle	Cockle
Substrata	Soft	Soft	Soft	Soft	Soft	Soft
ADL (aldrin, dieldrin, lindane)	0.00105	0.00835	0.025	0.0026	0.00085	0.00075
DDX	0.01705	0.7589	0.227	0.0177	0.00195	0.0015

3.0 Patterns of contamination

3.1 Sediment

In the 2009 auditor's report, it was stated that the SAC for DDX and ADL in estuarine sediments was not met (Pattle Delamore, 2009). By 2018 most of the shallow and deep sediments (excluding the West FCC stream, JME 083, 084 and East FCC new 2) meet the SAC for ADL. DDX levels, however, remain above the SAC at all impact sites, however, levels for most sites are dramatically lower compared to previous years.

Based on results and trends, there remains two areas of concern:

- Increasing DDX values across numerous deep sediment sites, particularly West FCC new 1, 2 and JM084 sites where the highest values were recorded since the start of the study;
- High contamination levels at stream sites.

The reason or reasons for the increase in deep sediment DDX contamination at West FCC sites in 2018 is unknown. A smaller increase at one of these sites also occurred in the surface sediment (West FCC new 1). Further sampling of these sites will confirm if contamination of these deep sediments will remain at these elevated levels.

At the stream sites, sediment recontamination has occurred in previous years and has probably come from a "hot spot" in the adjacent land (Davidson and Sheldon, 2016). Some comfort is provided by the considerable decline in ADL and DDX at West FCC stream 3 (upper) from 2015 to 2018. Based on 2015 results, Davidson and Sheldon (2016) suggested, "new contaminants have ceased and the "hotspot" source may have stabilized as the auditor suggested (Pattle Delamore, 2011)." The small increase in ADL at the surface lower stream site and DDX at the deep middle stream site during the present survey, suggests the source may have stabilized, but elevated levels of contamination are still present.

Several East FCC sites also presented increased DDX levels above SAC in 2018, however, values remain below historic contaminant levels.

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3.2 Biota

ADL in cockles at the East FCC shore were very low in 2018. DDX and ADL levels in cockles remain at slightly elevated levels compared to the control site.

ADL and DDX in mudflat snails at the West FCC site, were low in 2018, but remained above controls levels. For mudflat snails, ADL and DDX values have historically been very high. For example, at West FCC (JME084), DDX values declined from 51.14 mg/kg in 2007 to 0.7589 mg/kg in 2018. DDX levels from mudflat snails at both impact sites remain elevated compared to the control site.

ADL and DDX in mudflat snails showed a spike in the East FCC sample in 2018. The concentrations of ADL and DDX in mudflat snails at East FCC were notably higher than 2015 values, but still lower than historic levels, reflecting the highly variable DDX levels noted by Davidson *et al.*, (2012).

DDX and ADL levels from topshells living on East FCC soft sediment showed slight increases from 2015, however, remain lower than historic levels. This coincides with the elevated contamination recorded in mudflat snails at the East FCC site over the same period.

3.0 Recommendations

Overall, many of the sites have exhibited a reduction in contamination over the duration of the study. DDX remains widespread and represents the dominant contaminant in sediment and shellfish. Previously, collection of deep and shallow contaminant data has indicated a decline in variability between years, however, several deep sediment DDX levels fluctuated in 2018.

Areas of concern remain at the West FCC stream and DDX contaminant elevation at deep sediment sites. It is therefore recommended that annual monitoring of contaminants from all sites be continued.

Based on the variability of sediment and shellfish contaminants, and the elevated contamination in some estuarine and stream sediments, it is recommended that biota sampling be continued.

References

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