Final Report to the

Agricultural Produce Commission

Pork Producers Committee

Validation of a range of cleaning protocols for improved industry truck wash biosecurity

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Technical summary

Truck washes at abattoirs have long been identified as an area where industry biosecurity is at risk. This project looked to gain an understanding of the effectiveness and consistency of the current truck washing practices at Linley Valley Pork (LVP). It aimed to provide a low-cost option to improve the effectiveness of truck washing at LVP and subsequently industry biosecurity.

The project consisted of three phases:

1. Phase 1: Determine the effectiveness of the existing truck wash at LVP.
2. Phase 2: Validate a range of cleaning protocols (in an experimental setting)
3. Phase 3: Compare 'best cleaning' practices with existing practices.

In Phase 1 swab samples were taken from 10 trucks pre and post wash to determine the effectiveness of hosing with water on the reduction in gram negative colony forming units (CFU) and total bacteria/fungi. Washing with water significantly reduced the number of gram negative CFU but had no effect on total bacteria/fungi growth.

In Phase 2 ten cleaning protocols were tested in a controlled laboratory setting to determine the effectiveness of the protocol in reducing gram negative CFU and total bacteria/fungi. The protocols utilised hose washing, detergent, hot and cold pressure washing and sanitiser and disinfectant in a variety of combinations. The two best protocols from the laboratory investigation were 1) hose wash → detergent → cold pressure wash → sanitise and 2) hose wash → detergent → hose wash.

In Phase 3 the aim was to test the two protocols identified in Phase 2 at the truck wash at LVP. Unfortunately, this was not possible as there was resistance from the truck drivers towards using a pressure washer. It also became apparent that it was not necessary to hose first before applying the detergent. In addition, due to the quantity of the detergent required and the perceived effectiveness of the detergent the detergent was applied at half the recommended concentration in the second protocol. The protocols ultimately used in Phase 3 were 1) detergent → hose wash and 2) half concentration detergent[1] → hose wash → sanitise.

The use of foaming detergent reduced the bacteria load compared to hosing with water only. It also reduced the time taken to clean the truck. To effectively remove nearly all bacteria the use of detergent followed by a sanitiser or disinfectant is required.

These protocols provide a low-cost option to improve the effectiveness of truck washing at LVP with each method costing approximately $28 to clean a B-train. It is recommended that washing with foaming detergent be implemented at LVP. The use of sanitiser/disinfectant should also be considered. Further investigation is required to determine the best way to apply the detergent and sanitiser/disinfectant to ensure they applied at the correct concentration and for ease of driver use.

Background

Truck washes at abattoirs have long been identified as an area where industry biosecurity is at risk. This risk is increased with the threat of exotic diseases such as foot and mouth disease and African Swine Fever (ASF). Pig transport is likely to be a contributor to the spread of ASF should it enter Australia. More than ninety percent of WA's pigs are processed through Linley Valley Pork's (LVP) abattoir and so this project focused on the truck wash facility at LVP.

This project looked to gain an understanding of the effectiveness and consistency of the current truck washing practices at Linley Valley Pork. If shown to be ineffective, it aimed to provide a low-cost option to improve the effectiveness of truck washing at LVP and subsequently industry biosecurity.

Aims

1. Assess the effectiveness of current truck wash facilities at WA's largest pork abattoir.
2. Validate low cost/capital options for improved truck wash effectiveness.
3. Provide a basis on which industry stakeholders can start to address truck wash availability and effectiveness in the WA pork industry.

Phase 1 – Determining the effectiveness of the existing truck wash at LVP

Phase 1 aimed to determine the effectiveness of the current truck wash protocols by taking swab samples pre and post wash to test for the presence and abundance of microbiological markers of faecal contamination.

Process

Observations were made of the current setup and use of the truck wash. Driver feedback on the truck wash was also noted.

Five swab samples were collected from 10 trucks pre and post wash (10 swabs per truck). A cotton swab was run along the following surfaces, prior to the wash down and post wash down:

1. Tyres
2. Bumper of the truck
3. Footwell and pedals in the truck cabin (this was discontinued after the 4th truck and another swab was taken on the tray).
4. Truck tray - lower level
5. Truck tray - mid level (and top)

The swaps were immediately placed on ice after being sampled.

The swab samples were tested for:

1. Gram negative bacteria - total colony forming units (CFU) of gram negative bacteria (on sheep blood agar) were measured using robotic machines. located at Murdoch University's Antimicrobial Resistance and Infectious Disease Laboratory.
2. Total bacteria/fungi. Rated as a scaled number (1-10) of total bacteria/fungi with 1 being no growth and 10 being very heavy growth.

It was envisaged that the presence of PCV2 would be determined as this is a robust virus which has a strong resistance to chemicals and temperatures and so would have provided a model to predict the effectiveness of existing cleaning practices against the ASF virus. However, after ten samples were processed this was abandoned as it proved impossible to determine if PCV2 was present or not.

An unbalanced analysis of variance was performed with the GENSTAT 21 program (VSN International Ltd, Hemel Hampstead, UK) to analyse the main effect pre vs post wash and sample location. Truck was used as a block in the analysis. The data was $\log_{10}$ transformed. A level of probability of less than 0.05 was used to determine statistical difference between the means.

Findings

Current Truck Wash

The truck wash at Linley Valley Pork consists of 3 wash bays (cold water taps + 2 hoses; Figure 1) located next to a high colour bond fence. Anecdotally the drivers do not use the third wash bay because there is insufficient pressure if the other bays are in use. The wash bays are situated adjacent to the unloading bays. Lights are on for night deliveries.

Figure 1: Current truck wash facilities at Linley Valley Pork

Shortcomings with current truck wash facility

1. The unloading ramps (dirty areas) are in close proximity to the wash bays.
2. Wash bays are adjacent to each other creating a significant risk for cross contamination from water spray and airborne faecal matter etc. (there are no designated parking areas – so trailers may be parked for washing side by side; clean trucks next to dirty trucks)
3. Limited ability to effectively contain and treat potentially contaminated wastewater and run off. Wastewater was observed pooling at the opposite end to the runoff area.
4. Single entry and exit point for livestock trucks and other vehicles delivering livestock.
5. Some drivers use own hoses which if not effectively cleaned prior to leaving is a biosecurity risk.
6. No ability to wash under-truck carriage.

Observations

1. All drivers were observed to change boots when exiting truck. However, the location of the boot change varied between drivers with some doing it immediately upon exiting and others doing it towards the back of the truck. There is a risk of contamination with faecal matter.
2. Several trucks initially selected for the study do not use the wash down facilities at LVP. Trucks are either washed out at other public truck wash facilities or at their truck depot.
3. Discussions with several drivers indicated concerns with the quality of the water. Drivers uncoupled their cabs before washing out as they did not want the water to come into contact with the cab. The water was perceived to be salty by the drivers. The water used is a combination of scheme and ground.

Wash out time

The type of truck and the time taken to wash out was also recorded (Table 1). There was considerable variation in the time taken to wash out within and between types of trucks.

Table 1: The type of truck, time of day and time taken to wash out.

Truck	Type	Time of day	Time taken to wash out
1	B-train	Wash out at 8am	2 hours and 7 minutes
2	B-train	Wash out at 10am	1 hour and 20 minutes
3	Semi	Wash out at 10.50pm	1 hour and 1 minute
4	B-train	Wash out at 11pm	1 hour and 20 minutes
5	B-train	Wash out at 12.40am	1 hour and 32 minutes
6	Single level semi	Wash out at 6.28am	26 minutes
7	B-train	Wash out at 7am	1 hour and 23 minutes (2 people washing)
8	Semi	Wash out at 8am	1 hour and 30 minutes
9	Semi	Wash out at 9am	1 hour and 12 minutes
10	B-train	Wash out at 9.45am	1 hour and 15 minutes

Gram negative bacteria and total bacteria/fungi

Washing with water tended to reduce the log_{10} gram negative CFU on the tray lower and tray middle/top (P=0.094; Table 2). There was no difference in log_{10} gram negative CFU in the bumper pre and post wash while the gram negative CFU's on the tyres increased pre and post wash. There was a large variation between samples.

Gram negative CFU's were lower on the tyres, bumper and footwell compared to the lower tray and middle/top tray.

Washing with water had no effect on total bacteria/fungi growth. Total bacteria/fungi growth was reduced by approximately 11%, 12% and 8% for the bumper, lower tray and middle/top tray, respectively. The total bacteria/fungi growth on the tyres increased by 22% between pre and post wash.

Sample location also influenced total bacteria/fungi growth. Total bacteria/fungi growth was lower on the tyres and footwell compared to the bumper, lower tray and middle/top tray.

While the footwell showed differences pre and post wash this was due to sampling rather than the 'wash' as no washing was undertaken.

Table 2: Summary of results for gram negative colony forming units and non-selective media.

Location	Number of samples	Log_{10} Pre-wash gram negative CFU	Log_{10} Post-wash gram negative CFU	Pre-wash – total bacteria/fungi[1]	Post-wash - total bacteria/fungi [1]
Tyres	10	1.36	2.51	5 (2-10)	6.1 (2-10)
Bumper	10	2.67	2.55	7.4 (3-10)	6.6 (3-9)
Tray lower	Pre – 16 Post - 18	4.52	3.43	9.75 (9-10)	8.56 (8-10)
Tray middle/top	Pre - 10 Post - 9	3.69	2.91	8.56 (2-10)	7.9 (6-9)
Footwell[2]	Pre – 4 Post - 2	0.41	0	3.25 (1-6)	4 (2-6)
SED		0.748		0.693	
P-value					
Pre vs post wash		NS		NS	
Sample location		<0.001		<0.001	
Interaction		0.094		NS	

[1]Counted on a scale of 1 to 10; Numbers in brackets are the range of values obtained. [2]Footwell was not cleaned on the trucks examined.

Table 3: Difference between pre and post wash for total gram negative CFU and total bacteria/fungi.

	Gram negative CFU	Total bacteria/fungi
Tyres	-14.6%	+22%
Bumper	-71.4%	-10.8%
Tray lower	-84.8%	-12.2%
Tray middle/top	-96.7%	-7.7%
Footwell[1]	-100%	+23%

[1]Footwell was not cleaned on the trucks examined.

Summary

The high volume hosing which is currently used at the truck washing facility at LVP:

- Tended to reduce gram-negative bacteria on the trays
- Had no effect on total bacteria/fungi growth
- Increased total bacteria/fungi and gram negative bacteria on the tyres
- Removed most organic matter but there was still a considerable about of material lodged in the crevices of the stock crate and under the truck framework.

Phase 1 identified that there were shortcomings with the current washing protocol at LVP and so the project proceeded to Phase 2.

Phase 2 - Validate a range of cleaning protocols (experimental setting)

A range of cleaning protocols were tested in an experimental setting in the Isolation Animal House at Murdoch University to determine if they could further improve the reduction in gram negative CFU and total bacteria/fungi. The protocols were chosen based on information in the literature and processes used overseas.

A metal surface (similar to that used on a truck tray) was smeared with 100 g of faeces sourced from a commercial piggery (Figure 2). The tray was left for 3 hours before being cleaned with one of the following cleaning protocols:

1) Hose wash with cold water (current protocol at LVP)
2) Hose wash with cold water, detergent, rinse with cold pressure wash
3) Hose wash with cold water, sanitise
4) Hose wash with cold water, cold pressure wash, sanitise
5) Hose wash with cold water, detergent, rinse with cold pressure wash, sanitise
6) Hose wash with cold water, detergent, rinse with cold pressure wash, disinfect
7) Hose wash with cold water, detergent, rinse with hot pressure wash, sanitise
8) Hose wash with cold water, hot pressure wash, sanitise
9) Hose wash with cold water, detergent, rinse with hot pressure wash, disinfect
10) Hose wash with cold water, detergent, hose wash with cold water.

Figure 2: Mock truck tray floor after being smeared with 100 g of faeces.

Each of the stages was standardised as follows:

1. Initial hose wash: 4 passes of the hose across the tray and 2 passes up and down.
2. Detergent: 200 mL of solution of Active D.O.T was poured onto the tray. The ratio was 1 mL detergent to 50 mL of water.
3. Pressure wash hot and cold: 1 pass of the pressure wand across the tray and one pass up and down. The hot water pressure wash was set at 90˚C.
4. Sanitise: Ablesan Sanitiser was used in a ratio of 1 mL concentrated sanitiser to 9 mL water. The sanitiser was applied with a pack sprayer with 1 pass across and 1 pass up and down. The sanitiser was left for 30 minutes before swab samples were taken.
5. Disinfect: Virkon S. Solution was made up as per label with 10g/L of Virkon S. 100 mL was poured onto the tray and left for 30 minutes before swab samples were taken.

Two swab samples were taken prewash and two post wash to determine the presence of gram negative bacteria and total bacteria/fungi as per Phase 1. Photos of the truck wash trays pre and post cleaning protocol are in Appendix A.

Table 4 provides the pre-wash and post wash results for the gram negative CFU and the total bacteria/fungi. It is suspected that the faeces were left for too long before the pre-wash swabs were taken and so the faeces dried which affected the ability of the swab to collect the faeces when sampled. If this were to be undertaken again the pre-swab samples would be taken immediately after the faeces were added to the trays.

Table 4: Summary of results for gram negative colony forming units and non-selective media for 10 different cleaning protocols.

Protocol	Pre-wash $\log_{10}$ gram negative CFU	Post-wash $\log_{10}$ gram negative CFU	Pre-wash $\log_{10}$ E coli	Post wash $\log_{10}$ E coli	Pre-wash – total bacteria/fungi[1]	Post-wash - total bacteria/fungi [1]
1	4.49	4.88	5.10	5.79	7	8.5
2	3.85	4.69	2.64	5.40	6	7.5
3	4.16	4.54	5.07	5.29	8.5	8.5
4	4.54	4.50	2.99	5.31	6.5	8.5
5	4.32	2.83	4.59	3.94	6.5	5
6	3.39	4.12	2.36	4.98	6	7.5
7	3.75	4.14	4.28	5.12	6.5	8.5
8	4.23	4.45	2.83	2.94	6.5	6.5
9	5.10	3.58	5.47	4.42	7.5	6.5
10	3.78	3.21	2.60	4.33	6.5	8

[1]Counted on a scale of 1 to 10, numbers in brackets are the values obtained

Due to the issue with the pre-wash sampling, we have focused on the post-wash results and ranked the cleaning protocols on their effectiveness based on the amount of gram negative CFU, *E coli* CFU and total bacteria/fungi (Table 5). This is a valid comparison as the same amount of faeces were added to each tray.

Table 5: Ranking by post wash for gram negative CFU and total bacteria/fungi.

Protocol	Log_{10} Gram negative CFU	Protocol	Log_{10} E coli CFU	Protocol	Total bacteria/fungi
5	2.83	8	2.94	5	5
10	3.21	5	3.94	9	6.5
9	3.58	10	4.33	8	6.5
6	4.12	9	4.42	6	7.5
7	4.14	6	4.98	2	7.5
8	4.45	7	5.12	10	8
4	4.50	3	5.29	7	8.5
3	4.54	4	5.31	4	8.5
2	4.69	2	5.40	3	8.5
1	4.88	1	5.80	1	8.5

The two best protocols from the laboratory investigation were:

1. Hose wash → detergent → cold pressure wash → sanitise
2. Hose wash → detergent → hose wash.

Phase 3 – Compare 'best cleaning' protocols with existing practices

The purpose of phase 3 was to determine if the two best protocols determined in the laboratory were able to be implemented and were effective at the truck washing facility at Linley Valley Pork.

Unfortunately, it was not possible to replicate the best protocols from Phase 2 in Phase 3 as there was resistance from the truck drivers towards using a pressure washer. Therefore, the cold pressure wash was replaced by hosing only and a modification with the hoses and nozzle used at LVP.

After the first truck it also became apparent that it was not necessary to hose first before applying the detergent. Therefore, the detergent was applied directly and then hosed off. In addition, due to the quantity of the detergent required and the perceived effectiveness of the detergent the detergent was applied at half the recommended concentration in the second protocol.

Following comments from several of the truck drivers in Phase 1, new hoses were purchased with an increased diameter (1 inch) than were currently in use at LVP. Several nozzles were trialled and a nozzle was identified which the truck drivers were happy with and which increased the water pressure.

Therefore, the protocols used in Phase 3 were:

1. Detergent[1] → hose wash (detergent)
2. Half concentration detergent[1] → hose wash → sanitise[2] (1/2 strength detergent and sanitiser)

[1]Hercules – HD Food Area Detergent; [2]Ablesan Sanitiser (Able Westchem),

The detergent was applied with a foaming gun attached to the hose (Figure 1). The detergent was applied as per the recommended label concentration in the detergent protocol and at half the recommended concentration in the ½ strength detergent and sanitiser protocol. The sanitiser was applied as per the recommended label concentration (1 mL concentrated sanitiser to 9 mL water).

Figure 3: Foaming gun and electric sprayer.

Figure 4 shows a driver applying the detergent using the foaming gun and the truck post hose wash.

Figure 4: Applying foam detergent (left) and after hosing (right).

Five swab samples were collected from same 5 trucks per protocol pre and post wash (10 swabs per truck). A cotton swab was run along the following surfaces, prior to the wash down and post wash down:

1. Tyres
2. Bumper of the truck
3. Tray (locations varied between trucks).

Total colony forming units (CFU) of *Escherichia coli* (from CHROMagar ECC agar), *Enterococcus* (from Slanetx & Bartley agar) and general bacteria (from Plate Count agar) were measured using robotic machines located at Murdoch University's Antimicrobial Resistance and Infectious Disease Laboratory.

An unbalanced analysis of variance was performed with the GENSTAT 22 program (VSN International Ltd, Hemel Hampstead, UK) to analyse the main effect of protocol, pre vs post wash and location. Truck was used as a block in the analysis. The data was $\log_{10}$ transformed. A level of probability of less than 0.05 was used to determine statistical difference between the means.

Findings

Post-wash *E. coli* was less than pre-wash ($P<0.001$, Table 6). The bumper and tray had more *E. coli* than the tray ($P<0.001$). There was an interaction with the pre vs. post wash and protocol where the ½ detergent and sanitiser protocol reduced *E. coli* more than the detergent protocol post wash ($P=0.024$).

Table 6: Log_{10} *E. coli* colony forming units for pre and post wash for 2 washing protocols at several sampling locations.

Location	Number of samples	Detergent		½ Detergent and sanitiser	
		Prewash	Post wash	Prewash	Post wash
Tyres	38	2.026	0.35	2.168	0.112
Bumper	20	3.430	1.395	3.187	0.225
Tray	42	3.892	1.789	3.956	0.243
SED			0.579		
P-value					
Pre vs post wash			<0.001		
Location			<0.001		
Protocol			0.034		
Pre vs post wash x location			0.126		
Pre vs post wash x protocol			0.024		
Location x protocol			0.396		
Pre vs post wash x location x protocol			0.525		

Enterococcus was reduced post wash compared to pre-wash (P<0.001; Table 7). There was a trend for the bumper and tray to have increased *Enterococcus* compared to the tyres (P=0.055). There was also a trend for ½ detergent and sanitiser to have lower *Enterococcus* post wash than the detergent protocol (P=0.086).

Table 7: Log_{10} *Enterococcus* colony forming units for pre and post wash for 2 washing protocols at several sampling locations.

Location	Number of samples	Detergent		½ Detergent and sanitiser	
		Prewash	Post wash	Prewash	Post wash
Tyres	38	1.59	0.55	1.90	0.51
Bumper	20	2.46	1.45	2.57	0.43
Tray	42	2.30	0.94	2.52	0.44
SED			0.490		
P-value					
Pre vs post wash			<0.001		
Location			0.055		
Protocol			0.593		
Pre vs post wash x location			0.531		
Pre vs post wash x protocol			0.086		
Location x protocol			0.532		
Pre vs post wash x location x protocol			0.753		

Post wash general bacteria were less than pre-wash (P<0.001, Table 8). The bumper and tray had higher general bacteria *t*han the tray (P=0.003). The detergent protocol had higher general bacteria than the ½ detergent and sanitiser protocol (P=0.047). Prewash the tyres had lower general bacteria than the bumper and tray while post wash there was no difference in general bacteria between sampling locations (P=0.003). There was no difference in general bacteria CFU's on the tyres for the protocols however the general bacteria on the bumper and tray were reduced for the ½ strength detergent and sanitiser compared to detergent only (P=0.028).

Table 8: Log_{10} General bacteria colony forming units for pre and post wash for 2 washing protocols at several sampling locations.

Location	**Number of samples**	**Detergent**		**½ Detergent and sanitiser**	
		Prewash	**Post wash**	**Prewash**	**Post wash**
Tyres	38	2.87	1.59	3.12	1.20
Bumper	20	4.84	2.67	4.22	0.87
Tray	42	4.57	2.37	4.50	1.92
SED			0.541		
P-value					
Pre vs post wash			<0.001		
Location			0.003		
Protocol			0.047		
Pre vs post wash x location			0.003		
Pre vs post wash x protocol			0.151		
Location x protocol			0.028		
Pre vs post wash x location x protocol			0.388		

Overall, the ½ detergent and sanitiser effectively reduced general bacteria, *E. coli* and *Enterococcus* at all sample locations (Table 9). Detergent was less effective on the tyres for general bacteria and *E. coli* and less effective at all sample locations for *Enterococcus*.

Table 9: Difference between pre and post wash for general bacteria CFU, *E* coli CFU and *Enterococcus* CFU.

	Detergent	**½ Detergent and sanitiser**
General bacteria		
Bumper	-98.6%	-99.6%
Tyres	-48.2%	-98.1%
Tray	-92.2%	-99.7%
Overall	-95%	-99.5%
E coli		
Bumper	-97.5%	-99.98%
Tyres	-71.8%	-99.9%
Tray	-99.1%	-99.9%
Overall	-98%	-99.9%
Enterococcus		
Bumper	-55.5%	-99.0%
Tyres	-44.6%	-98.5%
Tray	-90.1%	-98.2%
Overall	-79%	-99%

Costs and time taken

Both methods used were of a similar cost when only assessing the products required. To clean a B-Train truck using the detergent protocol was $28.17 compared to $27.96 for the ½ detergent and sanitiser protocol (Table 10). Compared to using hosing with water only, detergent reduced the time to clean all trucks while the ½ strength + sanitiser protocol was similar or slightly longer.

Table 10: Cost of detergent and sanitiser to clean a B-train.

Product	Detergent	½ Detergent and sanitiser
Detergent	$28.17	$9.39
Sanitiser	-	$18.57
Total	$28.17	$27.96

Driver comments

We received the following feedback from the truck drivers involved in this project:

- Liked the new 1-inch hoses and nozzles
  - LVP currently has ¾ inch hoses and no nozzles which reduces the water pressure
  - The new hoses had higher water flow and pressure
  - The cost of the new hoses and associated equipment was $250.
- Detergent helped to remove faeces and stains from the crate.
  - Felt that detergent sped up the hose down process.
- Liked the sanitizer spray for the outside of the truck but would not use it inside as they would have to move the panels around again.

Phase 1 compared to Phase 3

The presence of *E. coli* was also compared for the protocol used in Phase 1 and Phase 3 (Table 11). The same 5 trucks were used to compare across all protocols. Unfortunately, due to differences in the agar used between phases it was not possible to compare general bacteria and *Enterococcus* between phases 1 and 3. The tray and bumper had significantly higher CFU's of *E. coli* compared to the tyres ($P<0.001$). Post wash there was significantly lower *E. coli* compared to prewash ($P<0.001$). There was an interaction between pre vs. post wash and location ($P=0.002$). *E. coli* was significantly higher post wash for the tyres compared to the bumper and tray. There was also an interaction between pre vs post wash and protocol ($P=0.001$) where there was no difference between protocols prewash but post wash *E. coli* was higher for the hose protocol compared to the detergent protocol and in turn the ½ detergent and sanitiser protocol.

Table 11: Comparison of Phase 1 and 3 protocols for *E. coli*.

Location	Number of samples	Hose		Detergent		½ Detergent and sanitiser	
		Prewash	Post wash	Prewash	Post wash	Prewash	Post wash
Tyres		1.71	2.67	2.00	0.41	1.72	0.11
Bumper		4.17	3.20	3.43	1.39	3.84	0.22
Tray		5.80	4.05	3.91	1.81	4.07	0.24

SED	0.662
P-value	
Pre vs post wash	<0.001
Location	<0.001
Protocol	<0.001
Pre vs post wash x location	0.002
Pre vs post wash x protocol	0.001
Location x protocol	0.140
Pre vs post wash x location x protocol	0.391

Box plots of Log_{10} bacteria counts for all phases is given in Appendix 2.

Summary

- The truck wash at Linley Valley Pork currently has shortcomings in its design, hoses and current wash down procedure.
- The use of foaming detergent further reduced bacteria load compared to hosing with water only. It also reduced the time taken to clean the truck.
- To effectively remove all bacteria the use of detergent followed by a sanitiser or disinfectant is required.
- The use of a combined detergent and disinfectant could be considered to potentially save time however the active ingredients would need to be carefully evaluated. Factors to consider include accreditation in a food operating abattoir, occupational health and safety and any impact (for example, corrosiveness) on the structure of the truck.
- In an Emergency Animal Disease response the truck drivers will be required to follow the details in the AUSVETPLAN operation manual for decontamination.

Recommendations

- **Truck wash procedure**
  - Supply and encourage the use of foaming detergent which can be applied directly to the truck before any hosing.
  - An automatic dosing system should be installed to ensure the correct dosing concentration is used and for easy application by the truck drivers.
  - After application of the detergent trucks to be washed out to remove all faecal material.
  - To effectively remove general bacteria, *Enterococcus* and *E coli* the use of a sanitiser/disinfectant is recommended. Further consideration is required on the most effective way to apply the sanitiser/disinfectant (for example, fogging).

- **Minimising cross contamination of trucks**
  - Improve existing drainage to avoid cross contamination between trucks.
  - Improve water pressure or change design to ensure the 3rd wash bay can be used. This would create the potential to increase the distance between trucks washing out and help to avoid cross contamination between trucks.

- **Truck driver biosecurity**
  - Ensure all drivers change into clean boots and wear overalls to unload.
    - NB. The majority of drivers were observed to be undertaking best practice biosecurity procedures including the changing into overalls and changing footwear.
  - Increase monitoring of the truck wash area to ensure drivers are following best practice biosecurity procedures.
  - Ensure truck drivers do not enter the lairage.

- **Miscellaneous**
  - Ensure sufficient hoses are available of ¾ inch and the associated nozzle. This will aid in washing out the trucks.
  - There were some issues with water pressure at times. Ensure these are rectified as soon as possible after awareness of the issue.

Whilst these recommendations will improve the short-term effectiveness and biosecurity of the truck wash at LVP ultimately consideration should be given to constructing a purpose-built facility which can:

- Ensure separation between truck arrival and departure.
- Adequately clean the truck undercarriage.
- Ensure separation between trucks so crossover contamination cannot occur.
- Ensure disinfection can be undertaken appropriately when required.

Acknowledgements

We would like to acknowledge the willingness of the truck drivers from the Western Australian pork industry to participate in this project. Your feedback was considered and forms the basis of some of the recommendations and outcomes.

We would also like to thank Linley Valley Pork, Samantha Sterndale and John Sterndale for their assistance.

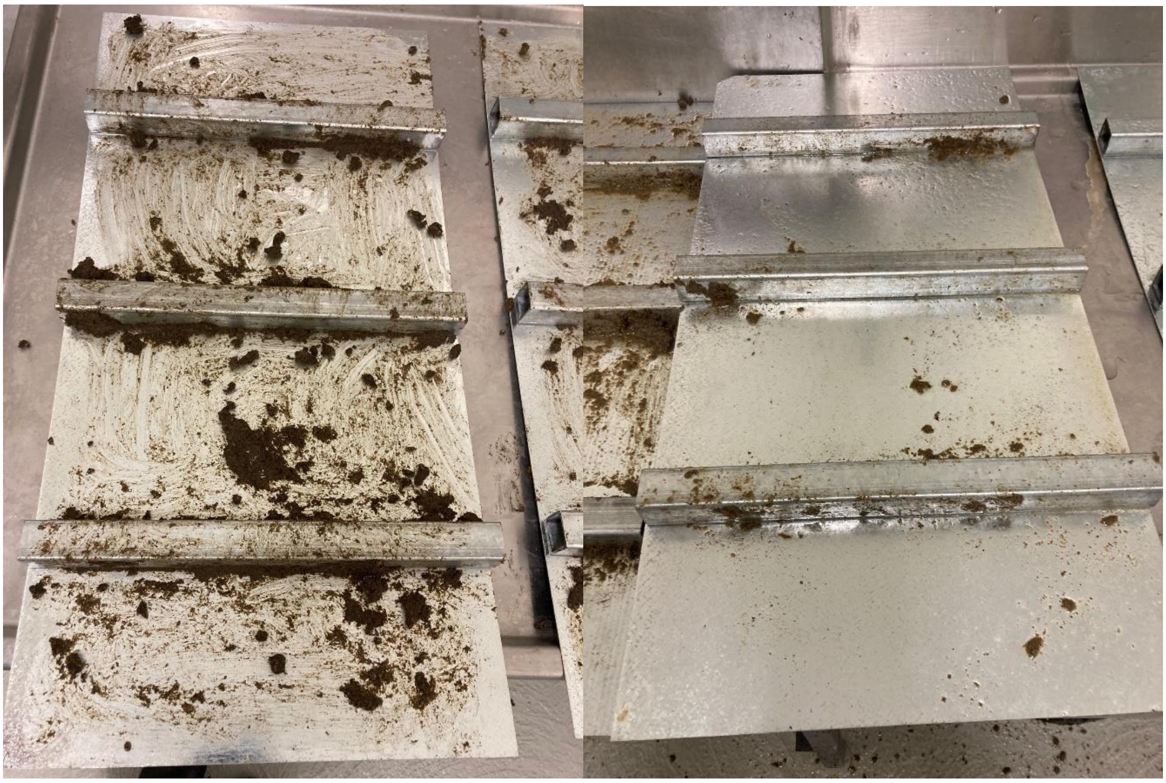
Appendix A

Pictures of track trays pre and post cleaning protocols.

Protocol 1 – pre and post wash

Protocol 2 – pre and post wash

Protocol 3 – pre and post wash

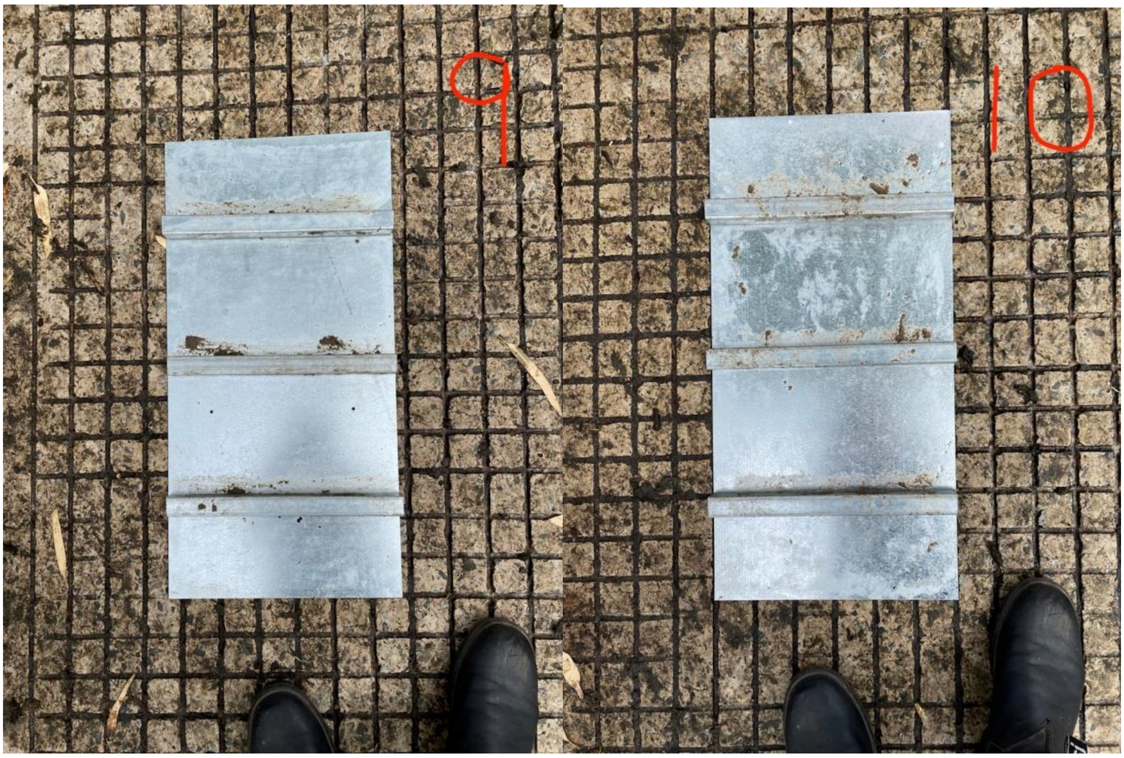


Protocol 4 – pre and post wash

Protocol 5 – pre and post wash

Protocols 6-10 prewash

Protocol 7 and 8 post wash



Protocol 9 and 10 post wash

Appendix 2

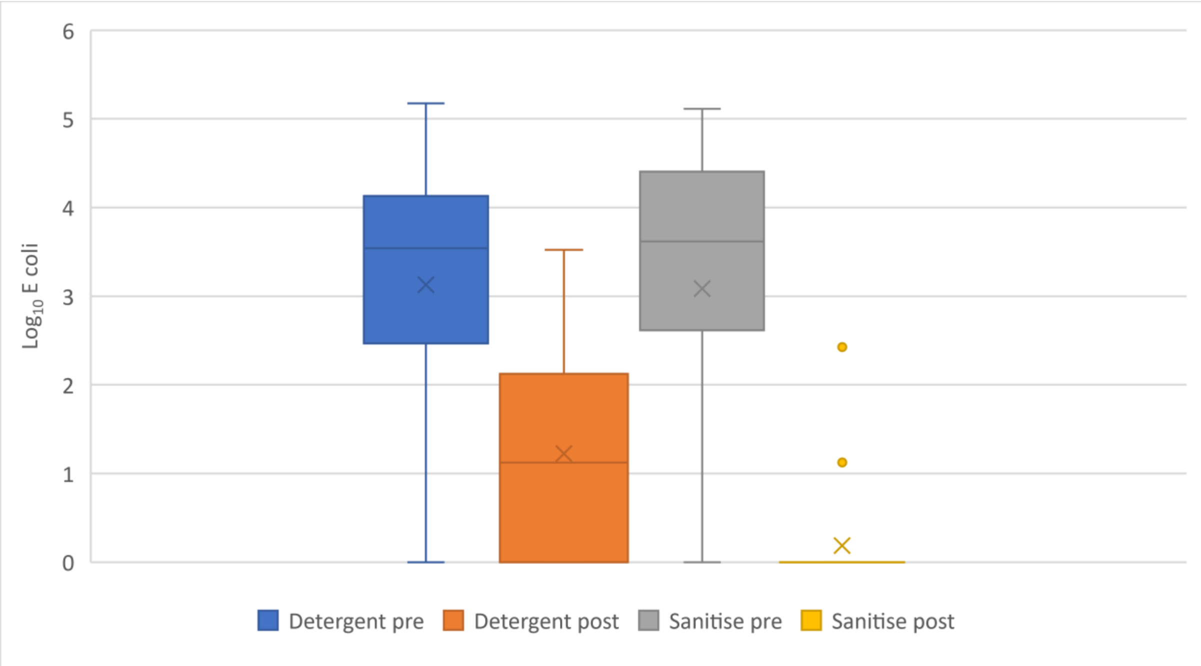


Figure 5: Box plots of $\log_{10}$ *E coli* for each washing protocol in Phase 3.

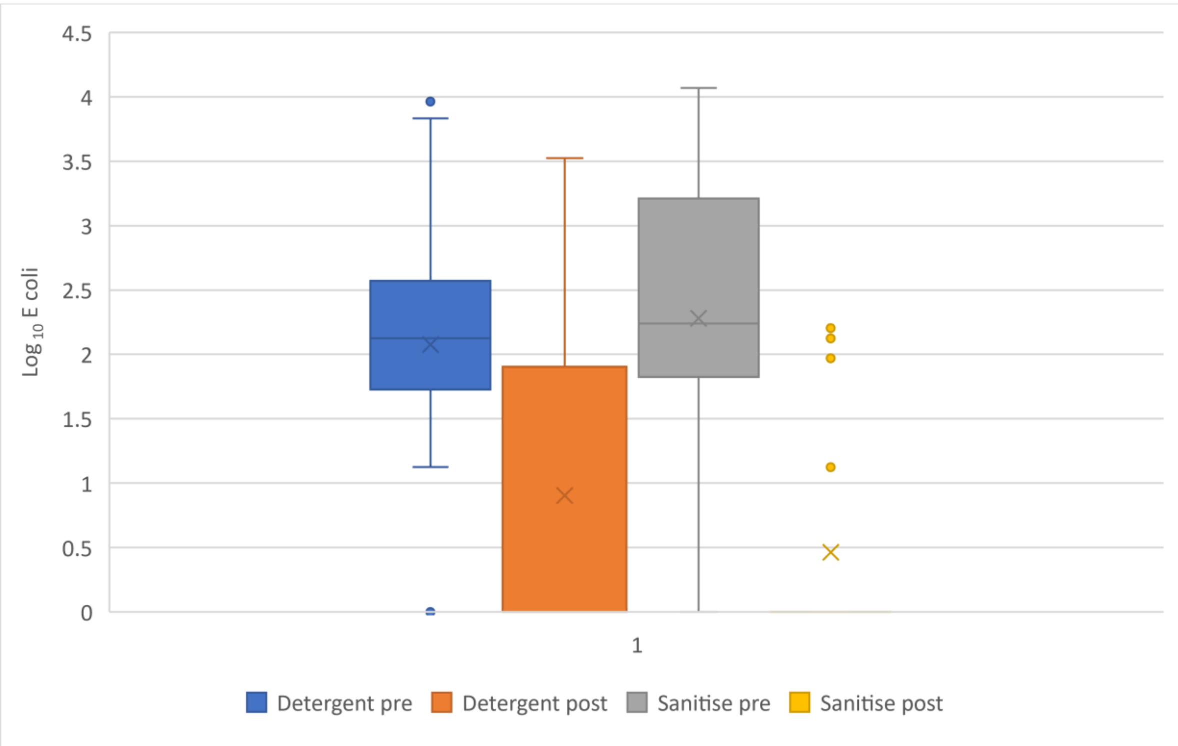


Figure 6: Box plots of $\log_{10}$ *Enterococcus* for each washing protocol in Phase 3.

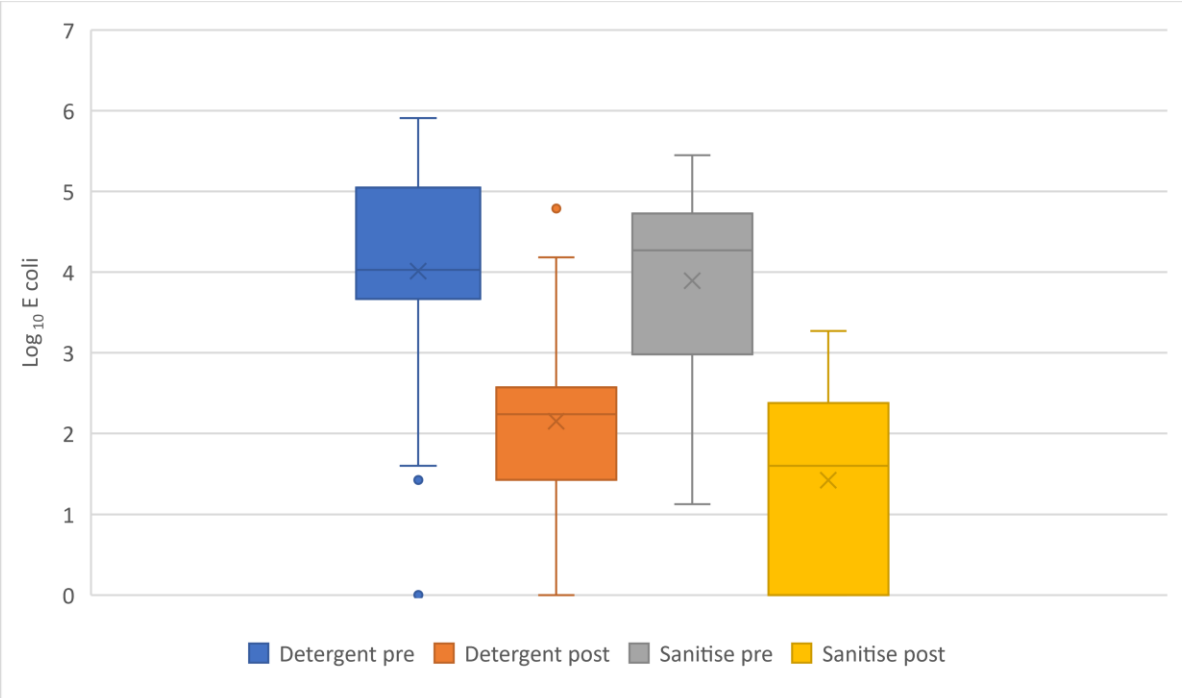


Figure 7: Box plots of log_{10} general bacteria for each washing protocol in Phase 3.

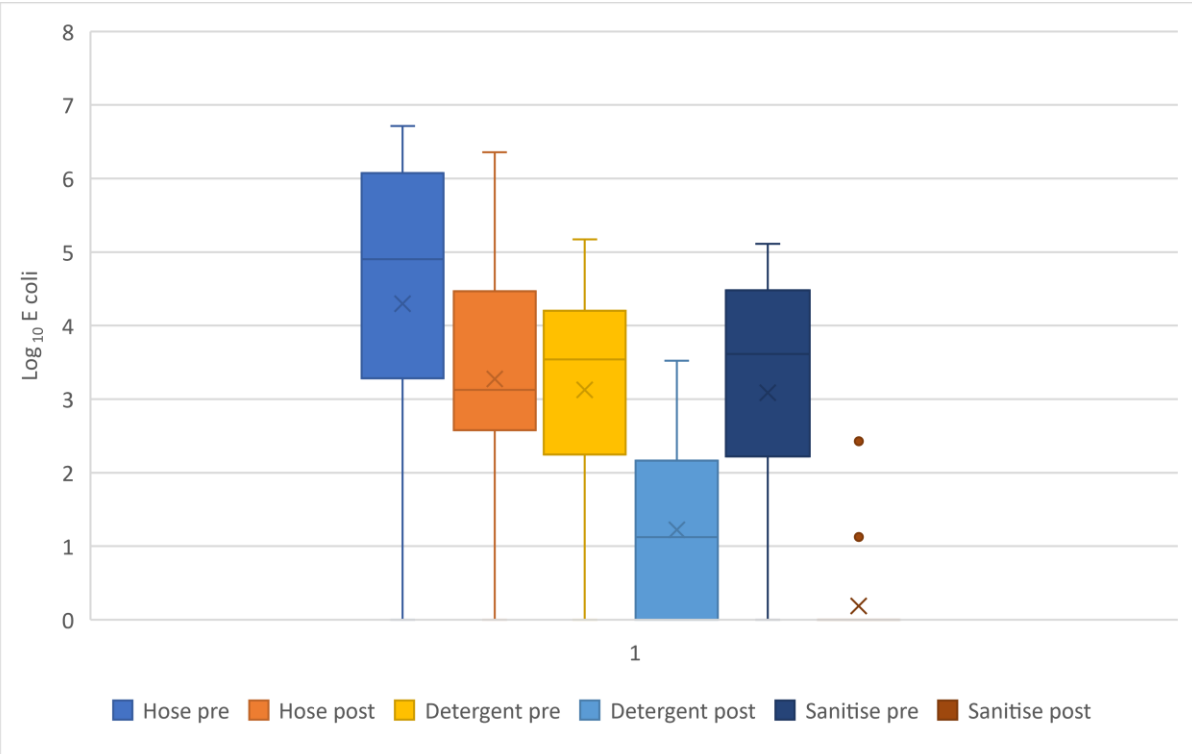


Figure 8: Box plots of log_{10} of *E coli* for all washing protocols.