Translink

Effectiveness of Electrostatic Cleaning

November 2020

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Executive Summary

WYG have undertaken swab samples on Translink vehicles to identify the effectiveness of the electrostatic cleaning method with relation to concerns over corona virus (COVID-19). A number of swab samples were taken in six buses and a train in a variety of locations to identify whether this cleaning methodology was effective at reaching all areas. The swabs were analysed for bacteria and general virus populations which is indicative of how effective the electrostatic cleaning is for protection against corona viruses (including COVID-19).

The original scope of the investigation was to have a variety of vehicles that had a range of durations since they had been electrostatically cleaned, to determine whether the correlation between time since last clean and the levels of bacteria and viruses found within them. Due to the vehicles that were available on the day of monitoring, the swab samples were all taken from six different buses that had been electrostatically sprayed using Aktivora 5% disinfectant two days prior.

Once the swabs were taken, these were sent to a UKAS accredited laboratory for analysis. Following this analysis, it was identified on the train all colony count levels were low. On all six buses there were a number of swabs that came back with bacteria and virus colony counts between 46-260 cfu/m^3 and four swabs that contained over 260 cfu/m^3. These high levels of counts would suggest that the majority of the areas that are at higher heights such as hand rails or high level window handles, and areas which are less penetrable such as the drivers cabins, which have a protective screen surrounding them, are where the cfu/m^3 count levels are higher. As such these areas may have not been coated appropriately during the electrostatic cleaning process, as other similar high contact touch areas, especially at lower levels, have returned with lower count levels.

As such the swab test shows that electrostatic cleaning is generally an effective cleaning method for these vehicles, but the application process needs to be enhanced to ensure all areas are sanitised appropriately.

1. Introduction

WYG have undertaken swab samples on Translink vehicles to identify the effectiveness of the electrostatic cleaning method with relation to concerns over corona virus (COVID-19). A number of swab samples were taken in six buses and a train in a variety of locations to identify whether this cleaning methodology was effective at reaching all areas. The swabs were analysed for bacteria populations which is indicative of how effective the electrostatic cleaning is for protection against corona viruses (including COVID-19).

The original scope of the investigation was to have a variety of vehicles that had a range of durations since they had been electrostatically cleaned, to determine whether the correlation between time since last clean and the levels of bacteria/viruses found within them. Due to the vehicles that were available on the day of monitoring, the swab samples were all taken from six different buses that had been electrostatically sprayed using Aktivora 5% disinfectant two days prior.

The samples taken were sent to a UKAS accredited laboratory to identify the Total Viable Count measured in cfu/m3 which gives a quantitative estimate of the concentration numbers of bacteria and virus in a sample.

The results from the swab sample monitoring were used to determine the effectiveness of electrostatic cleaning on the Translink buses and trains.

2. Bacteria and Viruses

There are several different microorganisms that have the potential to be present on public transport such as buses and trains if not properly controlled. These include bacteria and viruses, many of which are harmless. Some bacteria and viruses are harmful and can cause disease, such as the COVID-19 Coronavirus, which an outbreak of is currently effecting the UK and Ireland. The swabs were analysed for bacteria and general virus populations (which will include both harmless and harmful bacteria) but is indicative of how effective the electrostatic cleaning is for protection against corona viruses (including COVID-19) as the treatment should kill all viruses and bacteria.

Viruses

Viruses are the smallest type of infectious disease. Viruses are extremely small (about 20 - 200 nanometres in diameter) and are largely round in shape. Viruses are known to infect nearly every type of organism. Novel Coronavirus (SARS-CoV-2) which causes COVID-19 is one such virus where transmission occurs much more commonly through respiratory droplets than through objects and surfaces, like doorknobs, countertops, etc. However, current evidence suggests that SARS-CoV-2 may remain viable for hours to days on surfaces made from a variety of materials.

Bacteria

Bacteria are approximately 10 to 100 times larger than viruses. They are typically 1 to 3 microns in length and are in the shape of a sphere or rod. Bacteria can live and multiply in the environment or surface they are present on while others are adapted to life within human or animal hosts. Some bacteria can double in number every fifteen minutes, while others take weeks or months to multiply

3. Cleaning Methodology

A report undertaken by Lamont Cleaning & Support Services titled "Sanitise Case Study" on behalf of Translink identified that the Electrostatic Spray cleaning method kept the counts of pathogens down for the longest period of time.

The report details that three cleaning methods were tested:

- Manual spray and clean
- Electrostatic, and
- Fogging

Electrostatic Cleaning Methodology

Electrostatic disinfecting is a way of quickly and evenly coating a surface with a disinfecting solution. This is done by using an electrostatic applicator that gives a negative charge to the disinfecting solution as it exits the nozzle. The charged molecules will repel each other, meaning they will be an even distance from each other, but will be attracted to the surface they are applied to. The charged particles have a charge strength greater than gravity allowing them to directionally target a selected surface very quickly providing near 360-degree coverage of surfaces. The disinfectant chemicals in the droplet then kill any unwanted bacteria, viruses, and other pathogens.

Fogging Cleaning Methodology

Fogging cleaning uses a machine which creates a fine mist which contains chemical disinfectants. This is then dispersed within the room or place that is required to be cleaned. Due to the fine particles that is created, these are easily applied to difficult areas. Fogging can also penetrate porous surfaces. Similar to electrostatic cleaning the disinfectant chemicals in the droplet then kill any unwanted bacteria, viruses, and other pathogens.

Along with the different testing methodologies, five different disinfectant where also teste:

- Aktivora 10%
- Aktivora 5%
- Zoona
- Crebisol
- DrySan Oxy

Tests were carried out in three areas of each place: train, bus and office. Swabs were taken one day before cleaning and one day after cleaning. The same areas were then also re-swabbed 24 hours, 72 hours, 7 days and 14 days after cleaning to determine the effectiveness of all cleaning methods and disinfectants used.

Following this testing is was concluded that Electrostatic cleaning was the most effective cleaning method as it keeps the counts down for the longest period. Additionally, all disinfectants are suitable to use with this method of cleaning.

4. Monitoring Equipment and Locations

4.1 Monitoring Equipment and Locations

Swab samples were taken at Newtownabbey Bus Depot, Belfast on six different buses. The bus types were a mixture of double decker, coach and minibuses for both city and school routes as can be seen in Table 4.1. Swab samples were also taken on a train that was located at Fortwilliam Train Depot, Belfast. Table 4.2 indicates where each sample was taken within the busses and train that were monitored and includes the samples ID reference given to each sample. Diagrams of monitoring locations within each bus and train can be found in Appendix A.

Table 4.1 Swab Sampling Monitoring Locations

Designation	Bus Number	Bus Type	Date Last Deep Clean	Date Last Electrostatic Spray
B1	2218	Double Decker	29/10/2020	03/11/2020
B2	2342	Double Decker	16/10/2020	03/11/2020
B3	2881	Double Decker	29/10/2020	03/11/2020
B4	2960	Double Decker – School Bus	25/10/2020	03/11/2020
B5	1684	Single Decker School Bus	05/10/2020	03/11/2020
B6	1965	Single Decker	30/10/2020	03/11/2020
T1	4019	3 Carriage Train	-	04/11/2020

Table 4.2 Swab Sample Locations within Buses & Train

Designation	Location	Sample ID
B1	Right hand side handrail	2218-1
	Drivers steering wheel	2218-2
	Ticket machine	2218-3
	Mid height luggage rail	2218-4
	Stop button on rail of staircase	2218-5
	Hanging hand support	2218-6
	Rail at disabled seat	2218-7
	Back of seat on lower level	2218-8
	Back of seat on higher level	2218-9
	Right hand side handrail up stairs	2218-10
	Left hand side of safety bar	2218-11
	Mid-level support bar at top of stairs	2218-12
	High level window handle	2218-13
	Stop button at top of stairs	2218-14
	Low level rail	2218-15
	High level rail	2218-16
	Low level rail	2218-17
	Back of seat	2218-18
	Control	2218-C
B2	Right hand side handrail	2342-1
	Drivers steering wheel	2432-2
	Ticket machine	2432-3

Designation	Location	Sample ID
	Mid height luggage rail	2432-4
	Stop button on rail of staircase	2432-5
	Hanging hand support	2432-6
	Rail at disabled seat	2432-7
	Back of seat on lower level	2432-8
	Back of seat on higher level	2432-9
	Right hand side handrail up stairs	2432-10
	Left hand side of safety bar	2432-11
	Mid-level support bar at top of stairs	2432-12
	High level window handle	2432-13
	Stop button at top of stairs	2432-14
	Low level rail	2432-15
	High level rail	2432-16
	Low level rail	2432-17
	Back of seat	2432-18
	Control	2432-C
B3	Right hand side handrail	2881-1
	Drivers steering wheel	2881-2
	Ticket machine	2881-3
	Mid height luggage rail	2881-4
	Stop button on rail of staircase	2881-5
	Hanging hand support	2881-6
	Rail at disabled seat	2881-7
	Back of seat on lower level	2881-8
	Back of seat on higher level	2881-9
	Right hand side handrail up stairs	2881-10
	Left hand side of safety bar	2881-11
	Mid-level support bar at top of stairs	2881-12
	High level window handle	2881-13
	Stop button at top of stairs	2881-14
	Low level rail	2881-15
	High level rail	2881-16
	Low level rail	2881-17
	Back of seat	2881-18
	Control	2881-C
B4	Right hand side handrail	2960-1
	Drivers steering wheel	2960-2
	Ticket machine	2960-3
	Mid height luggage rail	2960-4
	Stop button on rail of staircase	2960-5
	Hanging hand support	2960-6
	Rail at disabled seat	2960-7
	Back of seat on lower level	2960-8
	Back of seat on higher level	2960-9
	Right hand side handrail up stairs	2960-10
	Left hand side of safety bar	2960-11
	Mid-level support bar at top of stairs	2960-12
	High level window handle	2960-13
	Stop button at top of stairs	2960-14
	Low level rail	2960-15
	High level rail	2960-16
	Low level rail	2960-17
	Back of seat	2960-18
	Control	2960-C
B5	Right hand side, high handrail at door	1684-1

Designation	Location	Sample ID
	Left hand side, mid handrail on steps	1684-2
	Steering Wheel	1684-3
	Ticket machine	1684-4
	Left hand side, bumper on front seat	1684-5
	Right hand side, third row back of seat	1684-6
	Left hand side, luggage rail	1684-7
	Right hand side light switch	1684-8
	Left hand side, back of seat	1684-9
	Right hand side, luggage rail	1684-10
	Handle of emergency exit	1684-11
	Right hand side, back of rear seat	1684-12
	Left hand side, seat belt	1684-13
	Left hand side, seat belt	1684-14
	Right hand side, luggage rail	1684-15
	Right hand side, bumper on front seat	1684-16
	Control	1684-C
B6	Right hand side, high handrail at door	1965-1
	Steering Wheel	1965-2
	Ticket machine	1965-3
	Handrail and stop button near door	1965-4
	High level handrail	1965-5
	Mid-level stop button	1965-6
	Handle of window	1965-7
	Arm rest of left-hand side, first row	1965-8
	Handrail of right-hand side, second row	1965-9
	Handrail of left-hand side, third row	1965-10
	Handrail of right-hand side, rear row	1965-11
	Back of left-hand side, front row seat	1965-12
	Back of left-hand side, rear row seat	1965-13
	Mid rail at luggage store / disabled seat	1965-14
	Emergency exit handle	1965-15
	Handle of window	1965-16
	Control	1965-C
T1	Carriage (4315) front open button	Train-1
	Carriage (4315) bollard on left hand side, third row	Train-2
	Carriage (4315) bollard on right hand side, third to last row	Train-3
	Carriage (4315) mid-level handrail	Train-4
	Carriage (4315) drivers' throttle	Train-5
	Carriage (4315) drivers' intercom	Train-6
	Carriage (4315) drivers exit / entrance handrail	Train-7
	Carriage (4515) mid handrail	Train-8
	Carriage (4515) bollard at left hand side table	Train-9
	Carriage (4515) left hand side open door button	Train-10
	Carriage (4515) toilet open button	Train-11
	Carriage (4415) rear open button	Train-12
	Carriage (4415) bollard on right hand side, third to last row	Train-13
	Carriage (4415) bollard on left hand side, third row	Train-14
	Carriage (4415) mid-level handrail	Train-15
	Carriage (4415) drivers' throttle	Train-16
	Carriage (4415) drivers' intercom	Train-17

Designation	Location	Sample ID
	Carriage (4415) drivers exit / entrance handrail	Train-18

4.2 Monitoring Methodology

Swab Sampling Methodology

Each of the swab samples consisted of a sterile viscose swab pre-dosed with a neutralising solution to remove any virus and bacteria microorganisms from the swab itself. The swab was tapped near the surface of its container to remove any excess solution. The swab was then taken across a 5cm x 5cm area of the test surface moving horizontally and the vertically to ensure the whole test area is covered. The swab was then returned to the sterile sheath, labelled and then sent to Biosearch which is an UKAS accredited laboratory to identify the Total Viable Count measured in cfu/m^3 which gives a quantitative estimate of the concentration of virus and bacteria microorganisms in a sample. This process is repeated for each individual swap sample. A control swab that hasn't left the sterile sheath is also sent to the lab for each vehicle that is monitored to verify the results.

Laboratory Methodology

Here the swab was vortexed in sterile diluent and subbed onto an agar plate of a selective and non-selective growth medium which allows all aerobic mesophilic organisms to grow. The agar plates were incubated for 30°C ± 1°C for 72 hours ± 3 hours.

5. Monitoring Results

The results from the swab samples taken on the buses and train on the 5th November 2020 are included in Table 5.2 below and the laboratory report included in Appendix B. The results are referenced in the following 'traffic light' approach.

Table 5.1 Swab Results Interpretation

Monitoring Levels	Interpretation	Results (cfu/m³)
Red	Very Contaminated	>260
Amber	Contaminated	46 - 260
Green	Clean	<45

Table 5.2 Swab Survey Results

Designation	Location	Sample ID	Results (cfu/m³)	Interpretation
B1	Right hand side handrail	2218-1	0	Clean
	Drivers steering wheel	2218-2	68	Contaminated
	Ticket machine	2218-3	>300	Very Contaminated
	Mid height luggage rail	2218-4	15	Clean
	Stop button on rail of staircase	2218-5	7	Clean
	Hanging hand support	2218-6	33	Clean
	Rail at disabled seat	2218-7	48	Contaminated
	Back of seat on lower level	2218-8	9	Clean
	Back of seat on higher level	2218-9	36	Clean
	Right hand side handrail up stairs	2218-10	0	Clean
	Left hand side of safety bar	2218-11	144	Contaminated
	Mid-level support bar at top of stairs	2218-12	3	Clean
	High level window handle	2218-13	92	Contaminated
	Stop button at top of stairs	2218-14	8	Clean
	Low level rail	2218-15	35	Clean
	High level rail	2218-16	72	Contaminated
	Low level rail	2218-17	16	Clean
	Back of seat	2218-18	10	Clean
	Control	2218-C	0	Clean
B2	Right hand side handrail	2342-1	28	Clean
	Drivers steering wheel	2432-2	23	Clean
	Ticket machine	2432-3	26	Clean
	Mid height luggage rail	2432-4	33	Clean
	Stop button on rail of staircase	2432-5	58	Contaminated
	Hanging hand support	2432-6	>300	Very Contaminated
	Rail at disabled seat	2432-7	34	Clean
	Back of seat on lower level	2432-8	2	Clean
	Back of seat on higher level	2432-9	12	Clean
	Right hand side handrail up stairs	2432-10	15	Clean
	Left hand side of safety bar	2432-11	17	Clean
	Mid-level support bar at top of stairs	2432-12	27	Clean
	High level window handle	2432-13	>300	Very Contaminated
	Stop button at top of stairs	2432-14	33	Clean

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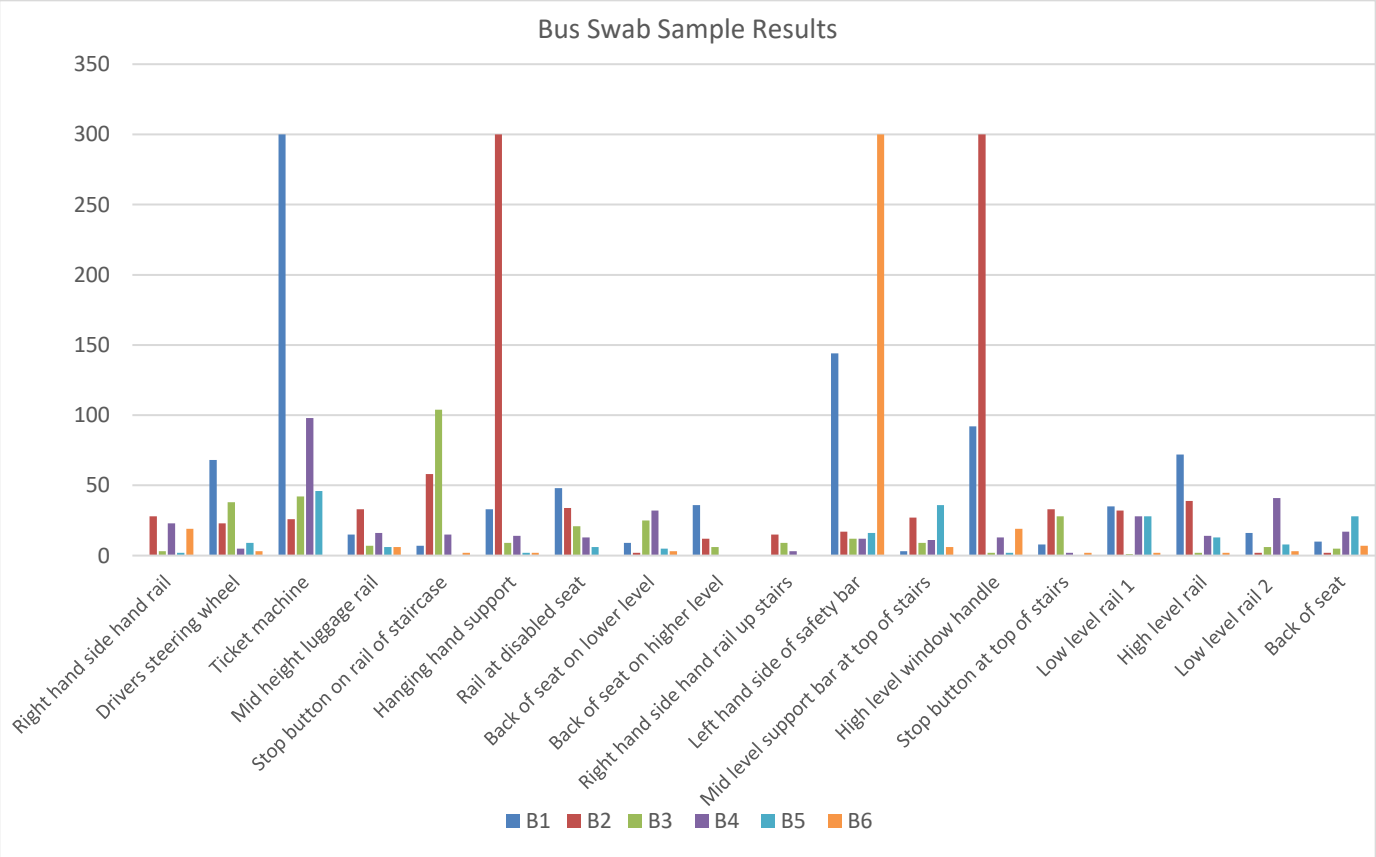
Designation	Location	Sample ID	Results (cfu/m^3)	Interpretation
	Low level rail	2432-15	32	Clean
	High level rail	2432-16	39	Clean
	Low level rail	2432-17	2	Clean
	Back of seat	2432-18	2	Clean
	Control	2432-C	2	Clean
B3	Right hand side handrail	2881-1	3	Clean
	Drivers steering wheel	2881-2	38	Clean
	Ticket machine	2881-3	42	Clean
	Mid height luggage rail	2881-4	7	Clean
	Stop button on rail of staircase	2881-5	104	Contaminated
	Hanging hand support	2881-6	9	Clean
	Rail at disabled seat	2881-7	21	Clean
	Back of seat on lower level	2881-8	25	Clean
	Back of seat on higher level	2881-9	6	Clean
	Right hand side handrail up stairs	2881-10	9	Clean
	Left hand side of safety bar	2881-11	12	Clean
	Mid-level support bar at top of stairs	2881-12	9	Clean
	High level window handle	2881-13	2	Clean
	Stop button at top of stairs	2881-14	28	Clean
	Low level rail	2881-15	1	Clean
	High level rail	2881-16	2	Clean
	Low level rail	2881-17	6	Clean
	Back of seat	2881-18	5	Clean
	Control	2881-C	0	Clean
B4	Right hand side handrail	2960-1	23	Clean
	Drivers steering wheel	2960-2	5	Clean
	Ticket machine	2960-3	98	Contaminated
	Mid height luggage rail	2960-4	16	Clean
	Stop button on rail of staircase	2960-5	15	Clean
	Hanging hand support	2960-6	14	Clean
	Rail at disabled seat	2960-7	13	Clean
	Back of seat on lower level	2960-8	32	Clean
	Back of seat on higher level	2960-9	0	Clean
	Right hand side handrail up stairs	2960-10	3	Clean
	Left hand side of safety bar	2960-11	12	Clean
	Mid-level support bar at top of stairs	2960-12	11	Clean
	High level window handle	2960-13	13	Clean
	Stop button at top of stairs	2960-14	2	Clean
	Low level rail	2960-15	28	Clean
	High level rail	2960-16	14	Clean
	Low level rail	2960-17	41	Clean
	Back of seat	2960-18	17	Clean
	Control	2960-C	0	Clean
B5	Right hand side, high handrail at door	1684-1	2	Clean
	Left hand side, mid handrail on steps	1684-2	36	Clean
	Steering Wheel	1684-3	9	Clean
	Ticket machine	1684-4	46	Contaminated
	Left hand side, bumper on front seat	1684-5	58	Contaminated
	Right hand side, third row back of seat	1684-6	10	Clean
	Left hand side, luggage rail	1684-7	28	Clean
	Right hand side light switch	1684-8	3	Clean
	Left hand side, back of seat	1684-9	5	Clean
	Right hand side, luggage rail	1684-10	6	Clean
	Handle of emergency exit	1684-11	16	Clean
	Right hand side, back of rear seat	1684-12	28	Clean

Designation	Location	Sample ID	Results (cfu/m^3)	Interpretation
	Left hand side, seat belt	1684-13	32	Clean
	Left hand side, seat belt	1684-14	3	Clean
	Right hand side, luggage rail	1684-15	13	Clean
	Right hand side, bumper on front seat	1684-16	2	Clean
	Control	1684-C	0	Clean
B6	Right hand side, high handrail at door	1965-1	19	Clean
	Steering Wheel	1965-2	3	Clean
	Ticket machine	1965-3	0	Clean
	Handrail and stop button near door	1965-4	2	Clean
	High level handrail	1965-5	2	Clean
	Mid-level stop button	1965-6	0	Clean
	Handle of window	1965-7	1	Clean
	Arm rest of left-hand side, first row	1965-8	6	Clean
	Handrail of right-hand side, second row	1965-9	8	Clean
	Handrail of left-hand side, third row	1965-10	8	Clean
	Handrail of right-hand side, rear row	1965-11	4	Clean
	Back of left-hand side, front row seat	1965-12	3	Clean
	Back of left-hand side, rear row seat	1965-13	7	Clean
	Mid rail at luggage store / disabled seat	1965-14	6	Clean
	Emergency exit handle	1965-15	>300	Very Contaminated
	Handle of window	1965-16	6	Clean
	Control	1965-C	0	Clean
T1	Carriage (4315) front open button	Train-1	0	Clean
	Carriage (4315) bollard on left hand side, third row	Train-2	9	Clean
	Carriage (4315) bollard on right hand side, third to last row	Train-3	15	Clean
	Carriage (4315) mid-level handrail	Train-4	0	Clean
	Carriage (4315) drivers' throttle	Train-5	0	Clean
	Carriage (4315) drivers' intercom	Train-6	2	Clean
	Carriage (4315) drivers exit / entrance handrail	Train-7	0	Clean
	Carriage (4515) mid handrail	Train-8	1	Clean
	Carriage (4515) bollard at left hand side table	Train-9	26	Clean
	Carriage (4515) left hand side open door button	Train-10	2	Clean
	Carriage (4515) toilet open button	Train-11	0	Clean
	Carriage (4415) rear open button	Train-12	0	Clean
	Carriage (4415) bollard on right hand side, third to last row	Train-13	28	Clean
	Carriage (4415) bollard on left hand side, third row	Train-14	6	Clean
	Carriage (4415) mid-level handrail	Train-15	4	Clean
	Carriage (4415) drivers' throttle	Train-16	8	Clean
	Carriage (4415) drivers' intercom	Train-17	1	Clean
	Carriage (4415) drivers exit / entrance handrail	Train-18	1	Clean

5.1.1 Discussion

The six buses have all been electrostatically sprayed using Aktivora 5% disinfectant on the 3rd November 2020 which was 2 days prior to the undertaking of the swab sample survey. The results in Table 5.2 above show that there were a number of swabs that had a count between 46-260 cfu/m^3 and four swabs that contained over 260 cfu/m^3 counts. The results in Table 5.2 have been included in the below graph to determine if there are any similarities in areas that returned higher counts. As B5 & B6 were single decker buses the results for similar or equivalent locations have been incorporated into the graph.

Figure 5.1 Graph of Bus Swab Sample Results



The results indicate that the majority of areas tested on the six buses fall within the "clean" threshold. Areas that have high cfu/m^3 count levels include the ticket machine, hanging hand support, left hand side of safety bar and high-level window handle. The high levels of counts in these areas would suggest that the majority of the areas that are at higher heights such as hand rails or high level window handles, and areas which are less penetrable such as the drivers cabins, which have a protect screen up surrounding them, are where the cfu/m^3 count levels are higher. As such these areas may have not been coated appropriately during the electrostatic cleaning process, as other similar high contact touch areas, especially at lower levels, have returned with lower count levels, which include many of the handrails and seating areas.

The 18 results from the swab testing on the 3-carriage train that has been electrostatically cleaned the night prior to testing retuned levels that all fell with the "clean" threshold. This indicates that the electrostatic cleaning process on the train was more successful in keeping the levels of bacteria and viruses low than for the buses.

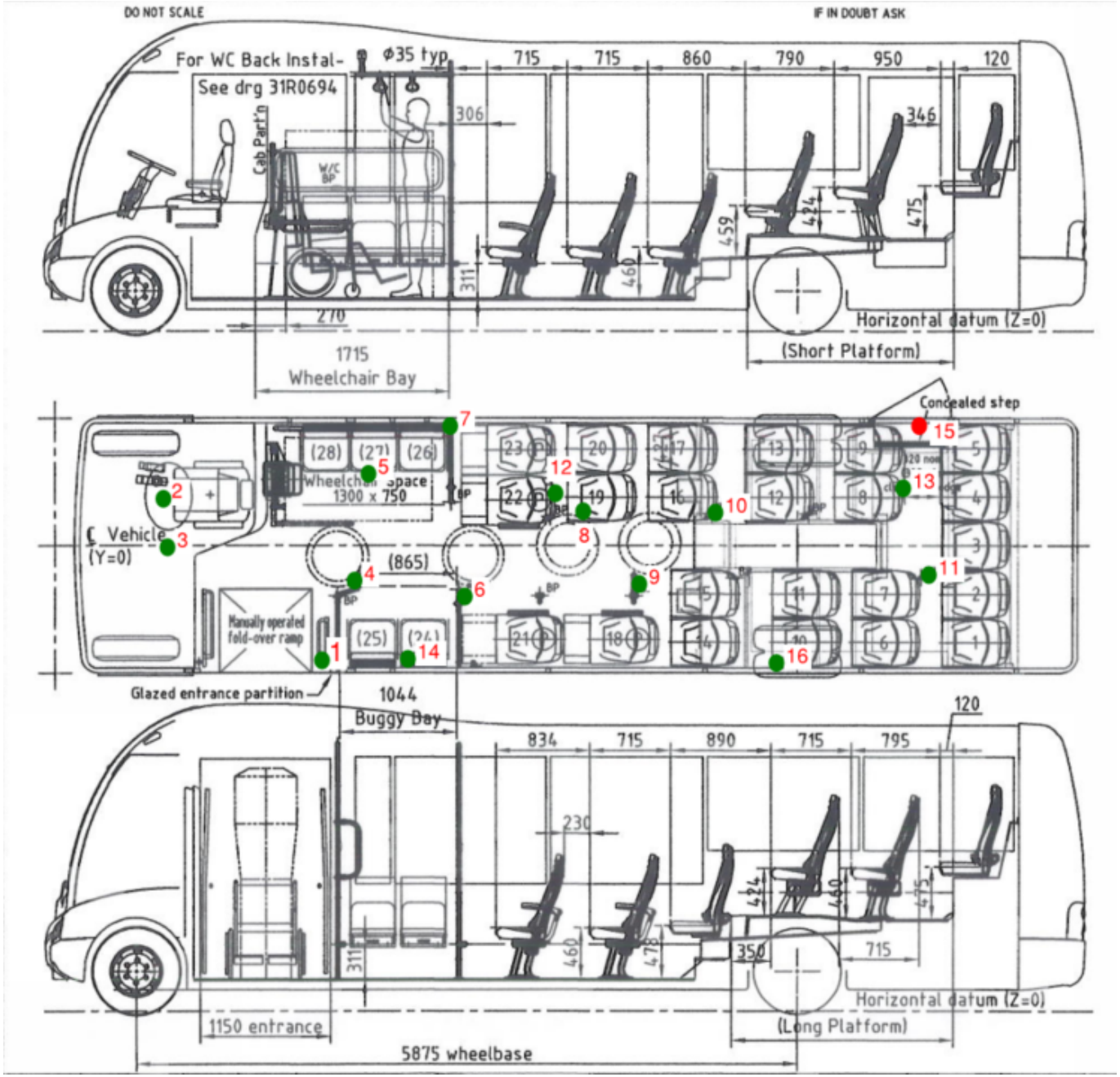
6. Conclusions

The purpose of this report was to identify the effectiveness of electrostatic cleaning that is used on the Translink vehicles. Swab samples were taken in multiple locations on 6 different buses and a train and sent to a laboratory for analysis.

Following the analysis, the results identify that there were some areas that had a count between 46-260cfu/m3 and four areas where the 260 cfu/m3 was exceeded. On analysis of these results show that areas with a high cfu/m3 count levels include the ticket machine, hanging hand support, left hand side of safety bar and high-level window handle. These high levels of counts would suggest that the majority of the areas that are at higher heights such as hand rails or high level window handles, and areas which are less penetrable such as the drivers cabins, which have a protective screen surrounding them, are where the cfu/m3 count levels are higher. As such these areas may have not been coated appropriately during the electrostatic cleaning process, as other similar high contact touch areas, especially at lower levels, have returned with lower count levels. All counts from the swabs on the train came back low.

As such the swab test shows that electrostatic cleaning using Aktivora 5% disinfectant is an effective cleaning method for these vehicles, but the application process needs to improve to reduce levels of bacteria and viruses within the vehicles.

Appendix A Swab Sample Monitoring Locations



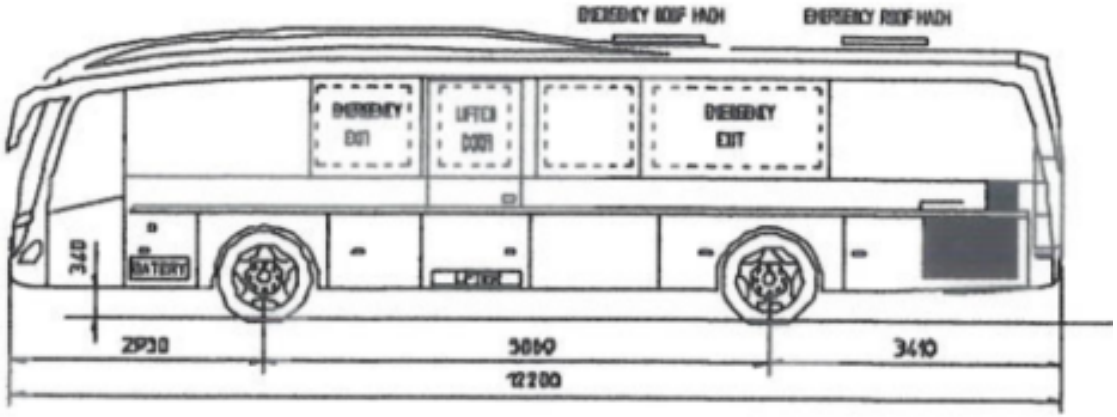
Bus 1965 - Single Decker

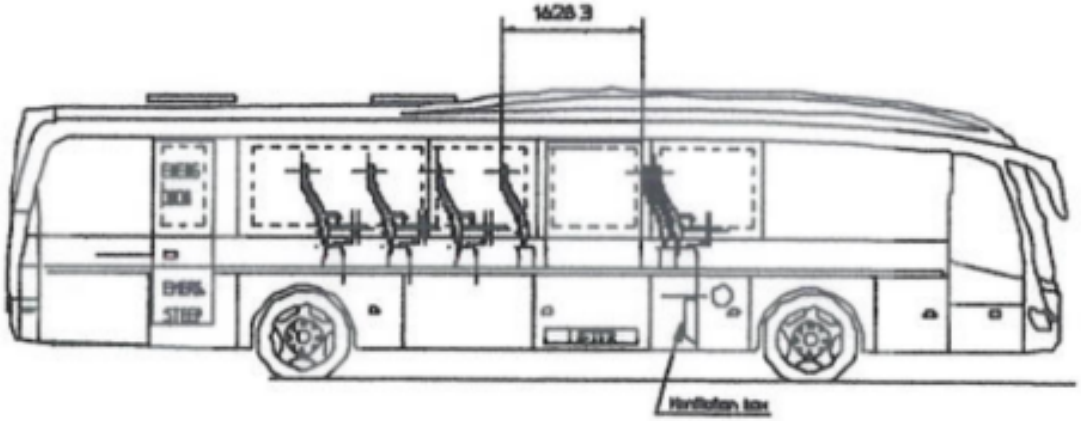
Date of Sampling: 05 November 2020

Date of last deep clean: 30 October 2020

Date of last spray: 03 November 2020

- Sample Location: Result below 45cfu/1ml
- Sample Location: Result between 45 and 260cfu/1ml
- Sample Location: Result above 260cfu/1ml





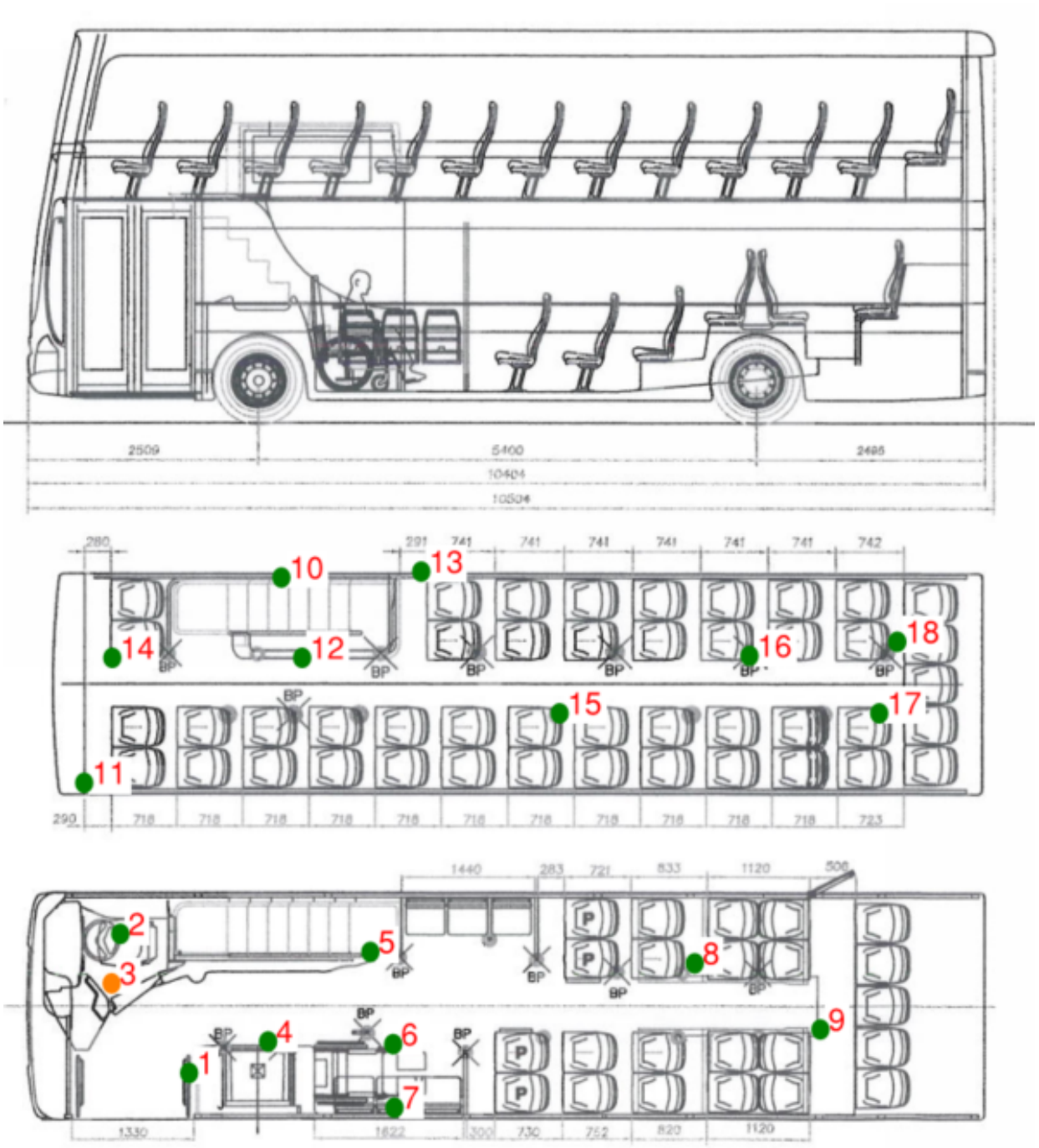
Bus 1684 - Single Decker

Date of Sampling: 05 November 2020

Date of last deep clean: Unknown

Date of last spray: 03 November 2020

- Sample Location: Result below 45cfu/1ml
- Sample Location: Result between 45 and 260cfu/1ml
- Sample Location: Result above 260cfu/1ml



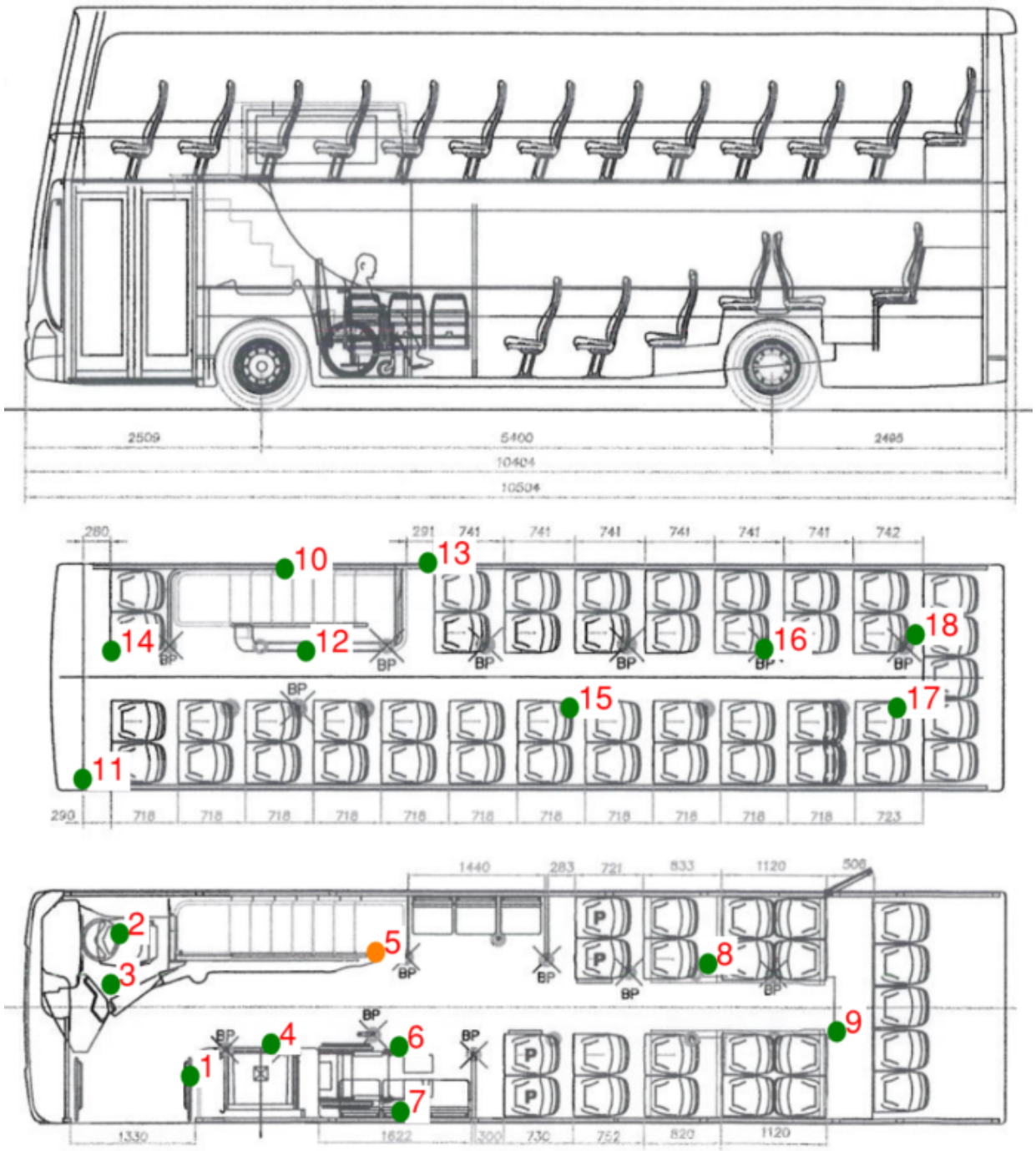
Bus 2960 - Double Decker

Date of Sampling: 05 November 2020

Date of last deep clean: 25 October 2020

Date of last spray: 03 November 2020

- Sample Location: Result below 45cfu/1ml
- Sample Location: Result between 45 and 260cfu/1ml
- Sample Location: Result above 260cfu/1ml



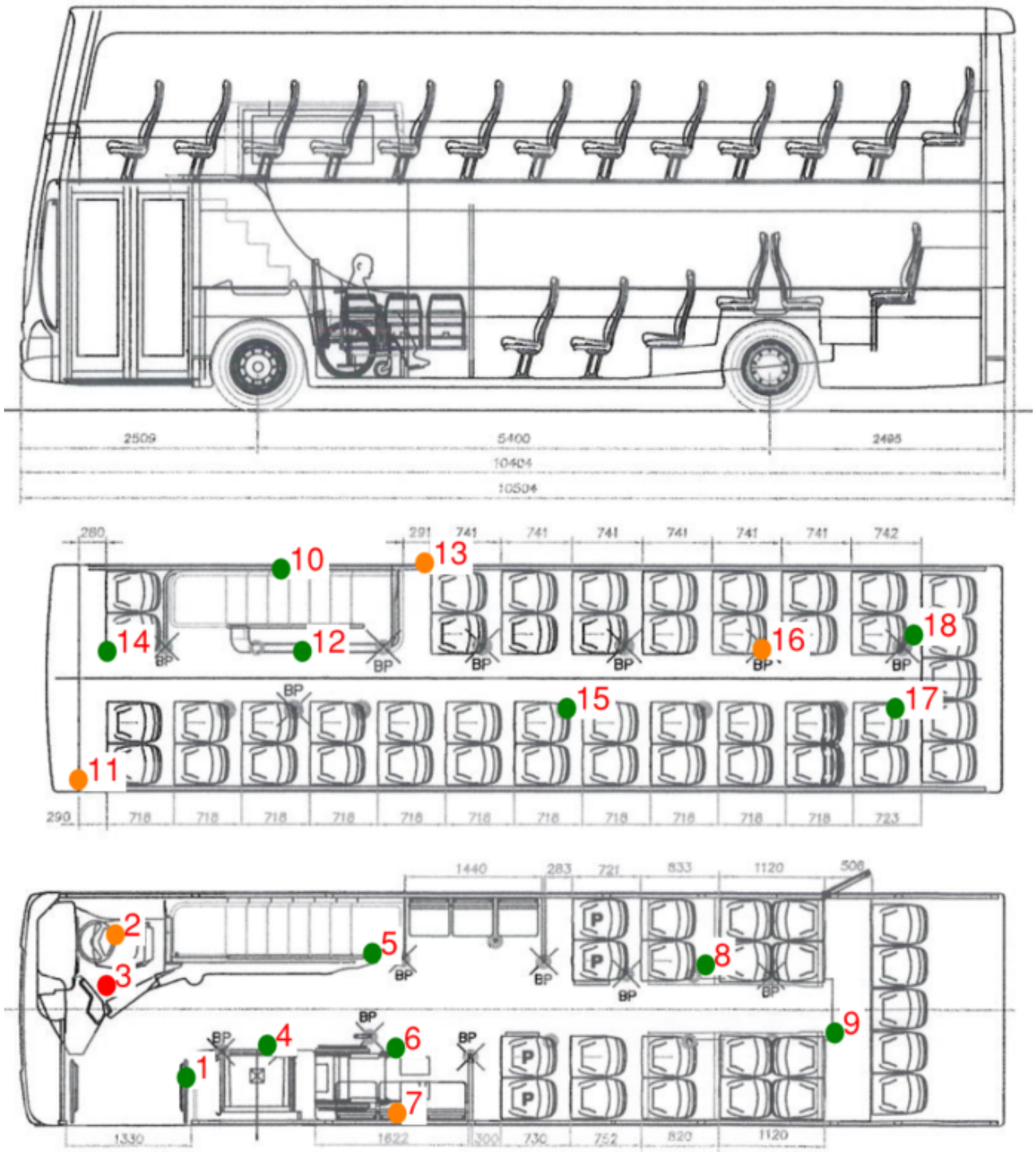
Bus 2881 - Double Decker

Date of Sampling: 05 November 2020

Date of last deep clean: 29 October 2020

Date of last spray: 03 November 2020

- Sample Location: Result below 45cfu/1ml
- Sample Location: Result between 45 and 260cfu/1ml
- Sample Location: Result above 260cfu/1ml



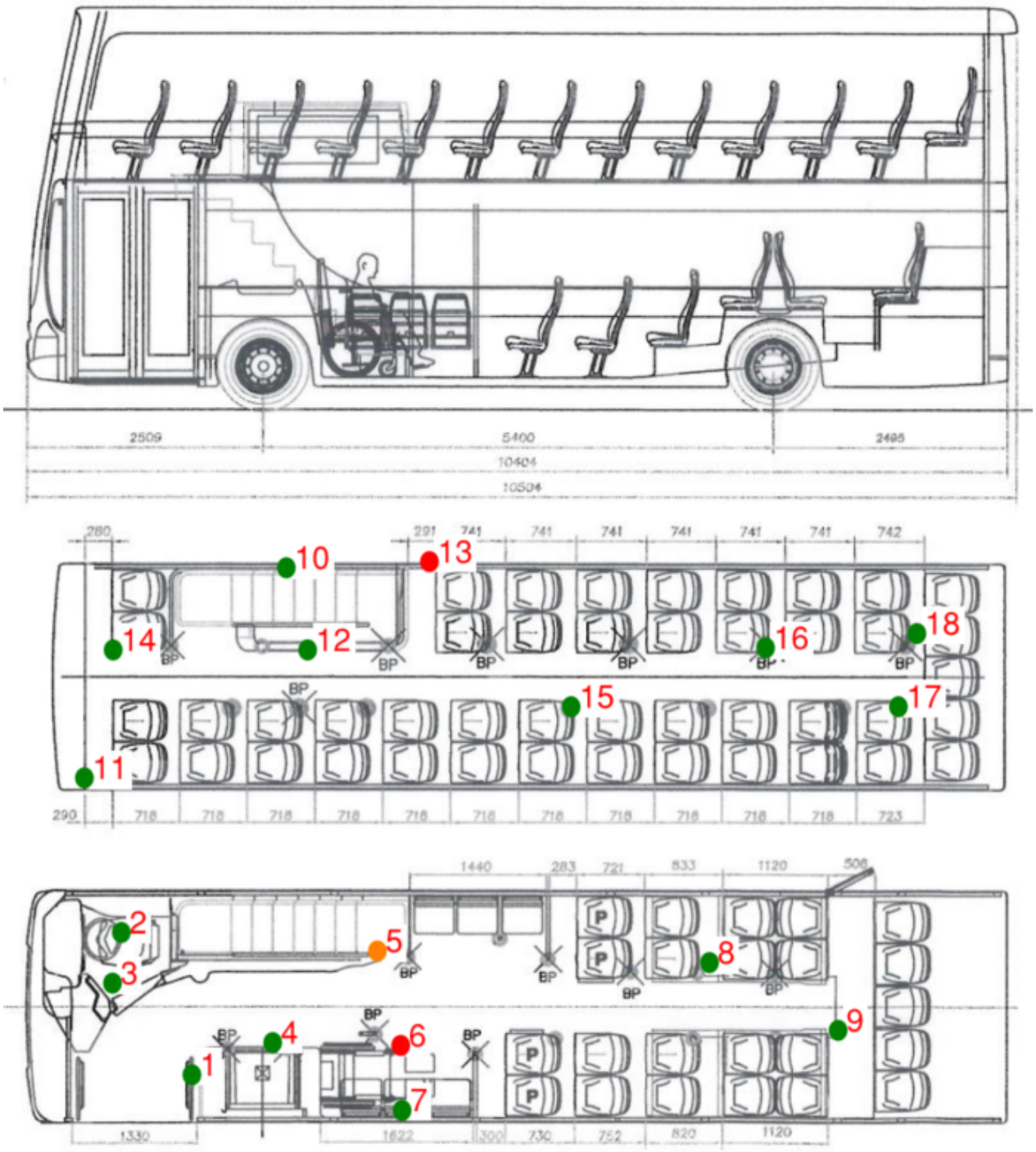
Bus 2218 - Double Decker

Date of Sampling: 05 November 2020

Date of last deep clean: 29 October 2020

Date of last spray: 03 November 2020

- Sample Location: Result below 45cfu/1ml
- Sample Location: Result between 45 and 260cfu/1ml
- Sample Location: Result above 260cfu/1ml



Bus 2342 - Double Decker

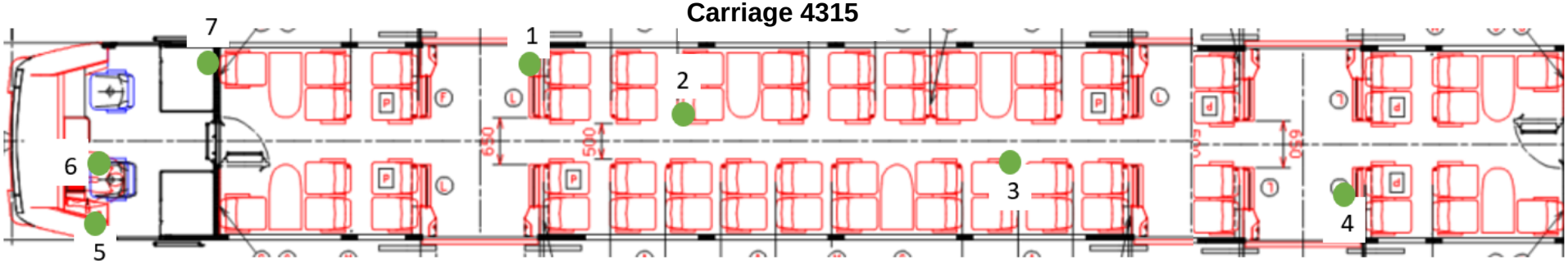
Date of Sampling: 05 November 2020

Date of last deep clean: 22 October 2020

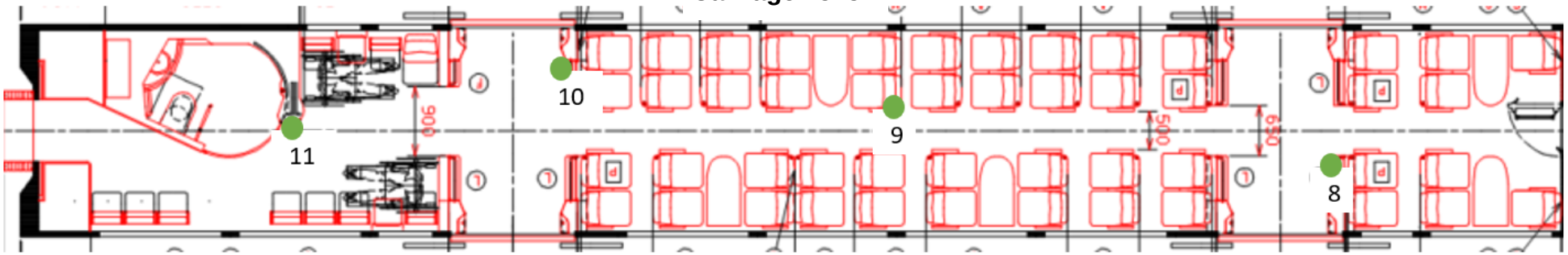
Date of last spray: 03 November 2020

- Sample Location: Result below 45cfu/1ml
- Sample Location: Result between 45 and 260cfu/1ml
- Sample Location: Result above 260cfu/1ml

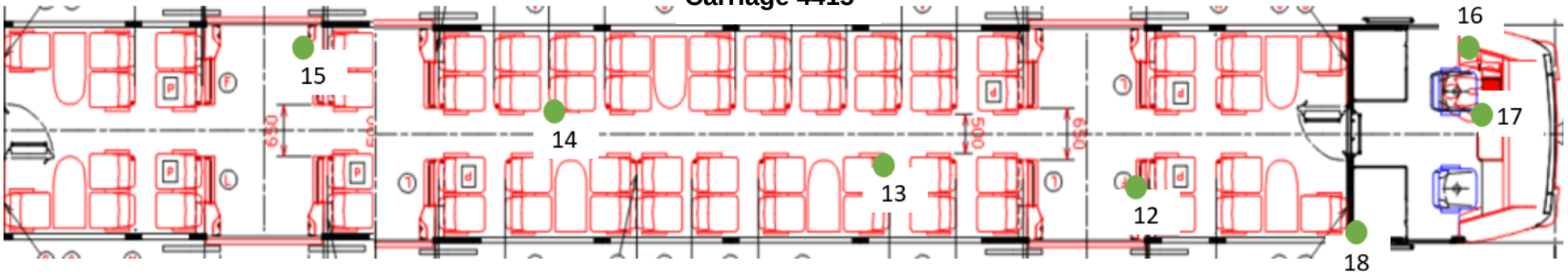
Carriage 4315



Carriage 4515



Carriage 4415



Train 4019 - Train

Date of Sampling: 05 November 2020

Date of last deep clean: 29 October 2020

Date of last spray: 01 November 2020

Sample Location: Result below 45cfu/1ml

Sample Location: Result between 45 and 260cfu/1ml

Sample Location: Result above 260cfu/1ml

Appendix B Laboratory Report

Conor Lydon
White Young Green
WYG Environment Planning (NI) Limited
Purchase Ledger
P O Box 364
Leeds

TEST REPORT

Date Samples Received:	05/11/2020	Date of Issue:	13/11/2020
Date Analysis Commenced:	05/11/2020	Test Report Ref:	11200528
Date Analysis Completed:	08/11/2020	Customer O/No:	7000169

T LINK

SAMPLE DESCRIPTION	RESULT	METHOD	SAMPLE DATE	LAB REF
2218 - 1			05/11/2020 11:21	112002119
Total Viable Count (cfu/swab)	0	TM1		
2218 - 2			05/11/2020 11:23	112002120
Total Viable Count (cfu/swab)	68	TM1		
2218 - 3			05/11/2020 11:24	112002121
Total Viable Count (cfu/swab)	>300	TM1		
2218-4			05/11/2020 11:26	112002122
Total Viable Count (cfu/swab)	15	TM1		
2218-5			05/11/2020 11:27	112002123
Total Viable Count (cfu/swab)	7	TM1		
2218-6			05/11/2020 11:28	112002124
Total Viable Count (cfu/swab)	33	TM1		
2218-7			05/11/2020 11:29	112002125
Total Viable Count (cfu/swab)	48	TM1		
2218-8			05/11/2020 11:30	112002126
Total Viable Count (cfu/swab)	9	TM1		
2218-9			05/11/2020 11:30	112002127
Total Viable Count (cfu/swab)	36	TM1		
2218-10			05/11/2020 11:32	112002128
Total Viable Count (cfu/swab)	0	TM1		
2218-11			05/11/2020 11:36	112002129
Total Viable Count (cfu/swab)	144	TM1		
2218-12			05/11/2020 11:37	112002130
Total Viable Count (cfu/swab)	3	TM1		

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SAMPLE DESCRIPTION	RESULT	METHOD	SAMPLE DATE	LAB REF
2218-13			05/11/2020 11:38	112002131
Total Viable Count (cfu/swab)	92	TM1		
2218-14			05/11/2020 11:39	112002132
Total Viable Count (cfu/swab)	8	TM1		
2218-15			05/11/2020 11:41	112002133
Total Viable Count (cfu/swab)	35	TM1		
2218-16			05/11/2020 11:42	112002134
Total Viable Count (cfu/swab)	72	TM1		
2218-17			05/11/2020 11:43	112002135
Total Viable Count (cfu/swab)	16	TM1		
2218-18			05/11/2020 11:44	112002136
Total Viable Count (cfu/swab)	10	TM1		
2218-C			05/11/2020 11:44	112002137
Total Viable Count (cfu/swab)	0	TM1		
2342-1			05/11/2020 12:44	112002138
Total Viable Count (cfu/swab)	28	TM1		
2342-2			05/11/2020 12:44	112002139
Total Viable Count (cfu/swab)	23	TM1		
2342-3			05/11/2020 12:45	112002140
Total Viable Count (cfu/swab)	26	TM1		
2342-4			05/11/2020 12:45	112002141
Total Viable Count (cfu/swab)	33	TM1		
2342-5			05/11/2020 12:46	112002142
Total Viable Count (cfu/swab)	58	TM1		
2342-6			05/11/2020 12:46	112002143
Total Viable Count (cfu/swab)	>300	TM1		
2342-7			05/11/2020 12:47	112002144
Total Viable Count (cfu/swab)	34	TM1		
234128			05/11/2020 12:47	112002145
Total Viable Count (cfu/swab)	2	TM1		
2342-9			05/11/2020 12:48	112002146
Total Viable Count (cfu/swab)	12	TM1		

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SAMPLE DESCRIPTION	RESULT	METHOD	SAMPLE DATE	LAB REF
2342-10			05/11/2020 12:49	112002147
Total Viable Count (cfu/swab)	15	TM1		
2342-11			05/11/2020 12:49	112002148
Total Viable Count (cfu/swab)	17	TM1		
2342-12			05/11/2020 12:50	112002149
Total Viable Count (cfu/swab)	27	TM1		
2342-13			05/11/2020 12:50	112002150
Total Viable Count (cfu/swab)	>300	TM1		
2342-14			05/11/2020 12:51	112002151
Total Viable Count (cfu/swab)	33	TM1		
2342-15			05/11/2020 12:52	112002152
Total Viable Count (cfu/swab)	32	TM1		
2342-16			05/11/2020 12:53	112002153
Total Viable Count (cfu/swab)	39	TM1		
2342-17			05/11/2020 12:54	112002154
Total Viable Count (cfu/swab)	2	TM1		
2342-18			05/11/2020 12:55	112002155
Total Viable Count (cfu/swab)	2	TM1		
2342-C			05/11/2020 12:55	112002156
Total Viable Count (cfu/swab)	2	TM1		
2881-1			05/11/2020 12:24	112002157
Total Viable Count (cfu/swab)	3	TM1		
2881-2			05/11/2020 12:25	112002158
Total Viable Count (cfu/swab)	38	TM1		
2881-3			05/11/2020 12:26	112002159
Total Viable Count (cfu/swab)	42	TM1		
2881-4			05/11/2020 12:27	112002160
Total Viable Count (cfu/swab)	7	TM1		
2881-5			05/11/2020 12:28	112002161
Total Viable Count (cfu/swab)	104	TM1		
2881-6			05/11/2020 12:29	112002162
Total Viable Count (cfu/swab)	9	TM1		

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SAMPLE DESCRIPTION	RESULT	METHOD	SAMPLE DATE	LAB REF
2881-7			05/11/2020 12:30	112002163
Total Viable Count (cfu/swab)	21	TM1		
2881-8			05/11/2020 12:31	112002164
Total Viable Count (cfu/swab)	25	TM1		
2881-9			05/11/2020 12:32	112002165
Total Viable Count (cfu/swab)	6	TM1		
2881-10			05/11/2020 12:33	112002166
Total Viable Count (cfu/swab)	9	TM1		
2881-11			05/11/2020 12:34	112002167
Total Viable Count (cfu/swab)	12	TM1		
2881-12			05/11/2020 12:35	112002168
Total Viable Count (cfu/swab)	9	TM1		
2881-13			05/11/2020 12:36	112002169
Total Viable Count (cfu/swab)	2	TM1		
2881-14			05/11/2020 12:37	112002170
Total Viable Count (cfu/swab)	28	TM1		
2881-15			05/11/2020 12:38	112002171
Total Viable Count (cfu/swab)	1	TM1		
2881-16			05/11/2020 12:39	112002172
Total Viable Count (cfu/swab)	2	TM1		
2881-17			05/11/2020 12:40	112002173
Total Viable Count (cfu/swab)	6	TM1		
2881-18			05/11/2020 12:41	112002174
Total Viable Count (cfu/swab)	5	TM1		
2881-C			05/11/2020 12:41	112002175
Total Viable Count (cfu/swab)	0	TM1		
2960-1			05/11/2020 11:57	112002176
Total Viable Count (cfu/swab)	23	TM1		
2960-2			05/11/2020 11:58	112002177
Total Viable Count (cfu/swab)	5	TM1		
2960-3			05/11/2020 11:59	112002178
Total Viable Count (cfu/swab)	98	TM1		

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SAMPLE DESCRIPTION	RESULT	METHOD	SAMPLE DATE	LAB REF
2960-4			05/11/2020 12:00	112002179
Total Viable Count (cfu/swab)	16	TM1		
2960-5			05/11/2020 12:01	112002180
Total Viable Count (cfu/swab)	15	TM1		
2960-6			05/11/2020 12:02	112002181
Total Viable Count (cfu/swab)	14	TM1		
2960-7			05/11/2020 12:03	112002182
Total Viable Count (cfu/swab)	13	TM1		
2960-8			05/11/2020 12:04	112002183
Total Viable Count (cfu/swab)	32	TM1		
2960-9			05/11/2020 12:05	112002184
Total Viable Count (cfu/swab)	0	TM1		
2690-10			05/11/2020 12:06	112002185
Total Viable Count (cfu/swab)	3	TM1		
2960-11			05/11/2020 12:07	112002186
Total Viable Count (cfu/swab)	12	TM1		
2960-12			05/11/2020 12:08	112002187
Total Viable Count (cfu/swab)	11	TM1		
2960-13			05/11/2020 12:09	112002188
Total Viable Count (cfu/swab)	13	TM1		
2960-14			05/11/2020 12:11	112002189
Total Viable Count (cfu/swab)	2	TM1		
2960-15			05/11/2020 12:12	112002190
Total Viable Count (cfu/swab)	28	TM1		
2960-16			05/11/2020 12:14	112002191
Total Viable Count (cfu/swab)	14	TM1		
2960-17			05/11/2020 12:16	112002192
Total Viable Count (cfu/swab)	41	TM1		
2960-18			05/11/2020 12:16	112002193
Total Viable Count (cfu/swab)	17	TM1		
2960-C			05/11/2020 13:23	112002194
Total Viable Count (cfu/swab)	0	TM1		

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SAMPLE DESCRIPTION	RESULT	METHOD	SAMPLE DATE	LAB REF
1684-1			05/11/2020 13:24	112002195
Total Viable Count (cfu/swab)	2	TM1		
1684-2			05/11/2020 13:25	112002196
Total Viable Count (cfu/swab)	36	TM1		
1684-3			05/11/2020 13:26	112002197
Total Viable Count (cfu/swab)	9	TM1		
1684-4			05/11/2020 13:27	112002198
Total Viable Count (cfu/swab)	46	TM1		
1684-5			05/11/2020 13:28	112002199
Total Viable Count (cfu/swab)	58	TM1		
1684-6			05/11/2020 13:29	112002200
Total Viable Count (cfu/swab)	10	TM1		
1684-7			05/11/2020 13:30	112002201
Total Viable Count (cfu/swab)	28	TM1		
1684-8			05/11/2020 13:31	112002202
Total Viable Count (cfu/swab)	3	TM1		
1684-9			05/11/2020 13:32	112002203
Total Viable Count (cfu/swab)	5	TM1		
1684-10			05/11/2020 13:33	112002204
Total Viable Count (cfu/swab)	6	TM1		
1684-11			05/11/2020 13:34	112002205
Total Viable Count (cfu/swab)	16	TM1		
1684-12			05/11/2020 13:35	112002206
Total Viable Count (cfu/swab)	28	TM1		
1684-13			05/11/2020 13:36	112002207
Total Viable Count (cfu/swab)	32	TM1		
1684-14			05/11/2020 13:37	112002208
Total Viable Count (cfu/swab)	3	TM1		
1684-15			05/11/2020 13:38	112002209
Total Viable Count (cfu/swab)	13	TM1		
1684-16			05/11/2020 13:39	112002210
Total Viable Count (cfu/swab)	2	TM1		

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SAMPLE DESCRIPTION	RESULT	METHOD	SAMPLE DATE	LAB REF
1684-C			05/11/2020 13:43	112002211
Total Viable Count (cfu/swab)	0	TM1		
1965-1			05/11/2020 13:44	112002212
Total Viable Count (cfu/swab)	19	TM1		
1965-2			05/11/2020 13:44	112002213
Total Viable Count (cfu/swab)	3	TM1		
1965-3			05/11/2020 13:45	112002214
Total Viable Count (cfu/swab)	0	TM1		
1965-4			05/11/2020 13:46	112002215
Total Viable Count (cfu/swab)	2	TM1		
1965-5			05/11/2020 13:47	112002216
Total Viable Count (cfu/swab)	2	TM1		
1965-6			05/11/2020 13:48	112002217
Total Viable Count (cfu/swab)	0	TM1		
1965-7			05/11/2020 13:49	112002218
Total Viable Count (cfu/swab)	1	TM1		
1965-8			05/11/2020 13:50	112002219
Total Viable Count (cfu/swab)	6	TM1		
1965-9			05/11/2020 13:51	112002220
Total Viable Count (cfu/swab)	8	TM1		
1965-10			05/11/2020 13:52	112002221
Total Viable Count (cfu/swab)	8	TM1		
1965-11			05/11/2020 13:53	112002222
Total Viable Count (cfu/swab)	4	TM1		
1965-12			05/11/2020 13:54	112002223
Total Viable Count (cfu/swab)	3	TM1		
1965-13			05/11/2020 13:55	112002224
Total Viable Count (cfu/swab)	7	TM1		
1965-14			05/11/2020 13:56	112002225
Total Viable Count (cfu/swab)	6	TM1		
1965-15			05/11/2020 13:57	112002226
Total Viable Count (cfu/swab)	>300	TM1		

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SAMPLE DESCRIPTION	RESULT	METHOD	SAMPLE DATE	LAB REF
1965-16			05/11/2020 13:58	112002227
Total Viable Count (cfu/swab)	6	TM1		
1965-C			05/11/2020 14:00	112002228
Total Viable Count (cfu/swab)	0	TM1		
Train-1			05/11/2020 10:12	112002229
Total Viable Count (cfu/swab)	0	TM1		
Train-2			05/11/2020 10:13	112002230
Total Viable Count (cfu/swab)	9	TM1		
Train-3			05/11/2020 10:14	112002231
Total Viable Count (cfu/swab)	15	TM1		
Train-4			05/11/2020 10:16	112002232
Total Viable Count (cfu/swab)	0	TM1		
Train-5			05/11/2020 10:19	112002233
Total Viable Count (cfu/swab)	0	TM1		
Train-6			05/11/2020 10:20	112002234
Total Viable Count (cfu/swab)	2	TM1		
Train-7			05/11/2020 10:21	112002235
Total Viable Count (cfu/swab)	0	TM1		
Train-8			05/11/2020 10:24	112002236
Total Viable Count (cfu/swab)	1	TM1		
Train-9			05/11/2020 10:25	112002237
Total Viable Count (cfu/swab)	26	TM1		
Train-10			05/11/2020 10:27	112002238
Total Viable Count (cfu/swab)	2	TM1		
Train-11			05/11/2020 10:28	112002239
Total Viable Count (cfu/swab)	0	TM1		
Train-12			05/11/2020 10:30	112002240
Total Viable Count (cfu/swab)	0	TM1		
Train-13			05/11/2020 10:31	112002241
Total Viable Count (cfu/swab)	28	TM1		
Train-14			05/11/2020 10:32	112002242
Total Viable Count (cfu/swab)	6	TM1		

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SAMPLE DESCRIPTION	RESULT	METHOD	SAMPLE DATE	LAB REF
Train-15			05/11/2020 10:33	112002243
Total Viable Count (cfu/swab)	4	TM1		
Train-16			05/11/2020 10:34	112002244
Total Viable Count (cfu/swab)	8	TM1		
Train-17			05/11/2020 10:34	112002245
Total Viable Count (cfu/swab)	1	TM1		
Train-18			05/11/2020 10:35	112002246
Total Viable Count (cfu/swab)	1	TM1		
Train-C			05/11/2020 10:35	112002247
Total Viable Count (cfu/swab)	1	TM1		

D. Arthur

DEBY ARTHUR (QUALITY MANAGER)

Results of analysis relate only to samples as received and tested on the date(s) detailed above
Condition of all samples on receipt was satisfactory, unless otherwise indicated.

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Appendix C Report Conditions

This Report has been prepared using reasonable skill and care for the sole benefit of Translink ("the Client") for the proposed uses stated in the report by [WYG Environment Planning Transport Limited] ("WYG"). WYG exclude all liability for any other uses and to any other party. The report must not be relied on or reproduced in whole or in part by any other party without the copyright holder's permission.

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The report refers, within the limitations stated, to the environment of the site in the context of the surrounding area at the time of the inspections'. Environmental conditions can vary and no warranty is given as to the possibility of changes in the environment of the site and surrounding area at differing times. No investigative method can eliminate the possibility of obtaining partially imprecise, incomplete or not fully representative information. Any monitoring or survey work undertaken as part of the commission will have been subject to limitations, including for example timescale, seasonal and weather-related conditions. Actual environmental conditions are typically more complex and variable than the investigative, predictive and modelling approaches indicate in practice, and the output of such approaches cannot be relied upon as a comprehensive or accurate indicator of future conditions. The "shelf life" of the Report will be determined by a number of factors including; its original purpose, the Client's instructions, passage of time, advances in technology and techniques, changes in legislation etc. and therefore may require future re-assessment.

The whole of the report must be read as other sections of the report may contain information which puts into context the findings in any executive summary.

The performance of environmental protection measures and of buildings and other structures in relation to acoustics, vibration, noise mitigation and other environmental issues is influenced to a large extent by the degree to which the relevant environmental considerations are incorporated into the final design and specifications and the quality of workmanship and compliance with the specifications on site during construction. WYG accept no liability for issues with performance arising from such factors.