

**FOOD SAFETY VICTORIA SMALL GRANTS
PROGRAM**

REPORT ON THE WASH HAND BASIN PROJECT

CITY OF YARRA

SWINBURNE UNIVERSITY OF TECHNOLOGY

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EXECUTIVE SUMMARY

The City of Yarra in conjunction with Swinburne University of Technology conducted a pilot project into the effectiveness of hand washing facilities in owner/operated retail food premises within the municipality of Yarra between March and October 2001.

The aim of the project was to investigate the hypothesis that there is no difference between the effectiveness of hands free wash basins and manual tap operated basins in reducing microbial flora on hands. The impact of the variables of the temperature of water supplied to the wash hand basin, number of food handling employees, types of food handled, time the sample was taken and approximate number of meals sold per hour was also investigated.

Thirteen premises with manual hand basins and a comparison random sample of nineteen premises with hands free basins were selected from the City of Yarra. Data collection involved the Environmental Health Officer visiting the premises, conducting a survey and swabbing the food handler's hands prior to and post washing.

Following plating onto non-selective media, the number of bacterial and fungal colonies from the pre to post samples for both the manual and hands free hand basins was calculated and used as the key variable for comparison of the hand basin types and other groupings. The distributions of the pre, post and percentage reduction of colonies were examined and all variables summarised.

The results indicated that the mean percentage reduction in the number of colonies compared for the manual and hands free hand basins showed no significant difference (Manual mean = 58%, Hands free mean = 79%, $p = 0.163$). If the three smallest percentage reductions (-50, 0 and 4.2), all from manual hand basins, are removed from the calculation then there is no difference in the percentage reductions (both about 79%).

Overall there was large variability in pre and post counts for both basins and considerable variability in the temperature of water to wash hand basins. No clear association however was found between the number of employees, temperature of wash hand basin, meals served or use of either facility and the percentage reduction in the microbial load.

This pilot has indicated that there was no difference between the use of either a manual or hands free wash hand basin taking into consideration a number of variables for a small group of food retailers in the City of Yarra. Consideration should be given to a range of factors which may have impacted on this study, including frequency of hand washing, types of foods handled, length of mechanical wash and number of manual wash hand basins available for the study. Education regarding the need to maintain the temperature of the wash hand basin water between 22-40 degrees should also be investigated amongst these food retailers as well as strategies for the correct washing of hands.

Overall the study provided a useful opportunity to investigate the effectiveness of the two hand basins in a realistic food setting and highlighted the challenges involved in conducting research of his nature and the need to encourage proper and thorough hand washing regardless of the type of facility available.

BACKGROUND

The City of Yarra in conjunction with Swinburne University of Technology conducted a pilot project into the effectiveness of hand washing facilities in owner/operated retail food premises within its municipality. The project was undertaken as a result of the Food Safety Small Grants Program which allocated funding to local government agencies to conduct projects which were proactive in improving food safety and can help protect the health of all consumers of food. The project was undertaken between March and October 2001.

INTRODUCTION

The Australian and New Zealand Food Standards Code, Food Hygiene Standard 3.2.3 no longer requires the provision of hands free wash hand facilities in food premises (Australian and New Zealand Food Authority, 2001).

In Victoria, hands free wash hand basins in food preparation areas were a regulatory requirement introduced under the 1984 Health (Eating House and Food Premises) Regulations. It continued to be required by local government authorities through the application of Construction Guidelines for Food Premises introduced in 1994 (Department of Human Services, 1994).

The food safety standards introduced in January 2001 replace existing State and Territory and local government food hygiene regulations. Thorough washing and drying of hands is acknowledged in the food safety standards as an important factor in the prevention of food borne illness. The standard specifies occasions when food handlers are obliged to wash and dry their hands. It also requires the provision of “basins or other facilities” that can be easily accessed by food handlers within areas where food handlers work if their hands are likely to be a source of contamination of food. However the provision of a “hands free wash hand basin” in food preparation areas is no longer prescribed as this is considered to present businesses with unnecessary cost and difficulties and cannot be justified in terms of public health and safety. (Australian and New Zealand Food Authority, 2001).

Limited published research is available regarding the effectiveness of hands free wash hand basins compared to manual wash hand basins in food preparation areas in reducing microbiological flora on the hands of food handlers.

A study involving image analysis to compare the hand washing effectiveness of manual hand washing to an automated system through the application of an oil based suspension to 65 food handlers found that manual handwashing was found to be decidedly superior to use of an automated system for the removal of oil-based soil on the hands. However, the study only focused on the removal of gross contamination and not of microbial removal, which is of more interest to the outcomes of this project (Turner et al.1994).

Another study, which evaluated manual hand wash procedures and automated handwashing procedures involving the application of a test organism found little difference in manual handwashing (if done correctly) and automated handwashing. However no great detail regarding the method is provided, making it difficult to draw any conclusions from the study (Paulson, 1992).

Other published studies involving automated hand washing practices have focused on hand washing practices and attitudes of health care staff. Two studies focused on the effects of replacing a manually operated wash hand basin with an electric wash hand basin and found that hands were washed significantly better but less often with an automated sink ($p < .001$) with staff expressing negative attitudes to the use of an automated sink. (Larson et al. 1991, Larson et al. 1997).

In an unpublished experimental laboratory based project, involving the comparison of the two facilities amongst students at Swinburne University, showed no significant difference between the use of the two facilities ($p=0.89$). However the study had a range of limitations including the need to control the type of soap and washing technique used in the experiment. Also being a laboratory based study, a more realist environment involving food handlers is required to provide results with greater validity to this project (Holt & Cannard 2001).

This pilot program was undertaken to explore the difference in effectiveness of the hands free basins and manual tap operated basins in reducing the microbial flora on the hands of food handlers. The following report provides an overview of the method, the results, discussion, conclusion and recommendations.

METHOD

The aim of the project was to investigate the hypothesis that there is no difference between the effectiveness of hands free wash basins and manual tap operated basins in reducing microbial flora on hands by:

- (i) using a realistic environment by targeting owner/operator retail food premises (class B2) in the City of Yarra
- (ii) investigating the impact of the variables of water temperature supplied to the wash hand basin, number of food handling employees, types of food handled, time sample was taken and approximate number of meals sold per hour.

Sample selection

As there were only 13 premises with manual hand basins in the City of Yarra all were included in the study. For comparison a random sample of 19 premises with hands free basins was selected from the City of Yarra food premises database. The total sample size of 32 was determined by keeping the hands free sample, for statistical reasons, to no more than double that of the manual hand basins. For the purposes of analysis the set of premises with a manual hand basin were considered to be a sample from a wider population (such as would have existed before hands free hand basins were introduced).

Data collection and microbiological analysis

All proprietors were invited to participate in the project by the City of Yarra Environmental Health Officer (EHO). Once recruited, the EHO visited the premises, conducted a survey and swabbed the food handler's hands prior to and post washing.

Prior to hand washing a sample was taken from the wrist to the middle finger of the food handler. The hands were swabbed using sterile cotton-tipped swabs moistened in ¼ strength peptone water (Oxoid Ltd., Basingstoke, UK).

The food handler was instructed on the method for hand washing and provided with a standard amount of liquid soap (5mL) for use during the procedure. The method involved the food handler wetting their hands, applying liquid soap, washing the entire surface then drying with a paper towel, as per Australian and New Zealand Food Safety Standard 3.2.2. 15 (4) (b). The liquid soap was provided to try and eliminate variability between different types of hand washing substances (Paulson, 1992).

After hand washing, the hands were dried using a disposable paper towel and a second sample of the ring finger of the same hand was taken using a fresh swab. All samples were promptly transported on ice to the microbiology laboratory, Swinburne University of Technology and plated onto Plate Count Agar (Oxoid Ltd.). Plates were incubated at 30C for 48 hours and the number of colonies arising was counted.

The Environmental Health Officer also conducted a survey on site. The officer collected data regarding the types of foods prepared, number of food handling employees, water temperature supplied to the hand basin and number of meals served per hour (See Appendix A).

The data collection instruments were pre tested before use. Both the survey and the hand washing procedure was trialed at a food premises, with pre testing for the detection of microbial flora on the hands using the finger swabbing technique also taking place.

Evaluation

A process evaluation was carried out with the project officers involved in the project (Hawe, 1990). This evaluation involved obtaining positive and negative feedback to the project development and implementation through the completion of a short questionnaire.

Data Analysis

In view of the small size of the dataset several variables were recoded into two categories in order to facilitate the analysis. These were time the swab was taken, number of employees, number of meals sold per hour and number of types of food.

The percentage reduction of the number of colonies from the pre to post samples for both the manual and hands free hand basins was calculated and used as the key variable for comparison of the hand basin types and other groupings. The distributions of the pre, post and percentage reduction were examined and all variables summarised (See Appendix B).

The two hand basin types were compared on percentage reduction using a t-test. Linear regression was used to determine if any of the pre, post and percentage reduction was related to temperature. The two hand basin types were compared on the percentage reduction for the categories of the four recoded variables using a t-test.

RESULTS

The data as analysed is presented in Tables 1 and 2 below, separated into the manual and hands free wash basin groups.

The sampled premises with manual wash hand basins employed an average of 3 food handlers and sold a range of foods which have been categorised into either 4 or more types or 4 or less types with the majority, 77%, selling 4 or more types. Food premises mostly sold between 20-40 meals per hour (53%) followed by 0-20 per hour (30%) with 2 selling 40-60 meals and 0-20 per hour respectively.

Table 1 *Number of colonies from food handlers and variables measured in food premises containing manual wash hand basins in food preparation areas.*

Manual Wash Hand Basins								
Food Premise	Number of colonies		Variables measured					Percentage reduction in number of colonies (post-pre) %
N= 13	Pre washing	Post washing	Temp	Number of employees	Food Category*	Time taken: (between 10am and 2pm)	Meals per hour	
1	42	3	41	4	>4	10-11	20-40	92.9
2	1260	316	16	3	>4	10-11	20-40	74.9
3	67	2	22	3	>4	10-11	0-20	97.0
4	129	51	38	7	>4	11-12	20-40	60.5
5	53	0	35	2	>4	1-2	20-40	100
6	82	25	46	3	>4	11-12	0-20	69.5
7	112	31	46	4	≤4	11-12	40-60	72.3
8	24	23	32	1	≤4	11-12	0-20	4.2
9	736	70	43	2	>4	12-1	20-40	90.5
10	117	1	43	2	>4	12-1	0-20	99.1
11	0	0	40	2	>4	10-11	20-40	0
12	2	3	39	3	<4	10-11	20-40	- 50
13	13	8	29	2	>4	12-1	0-20	38.5

* *Category of food includes either 4 or more or 4 or less of the following groups: Cooked, cold; frozen; fruit and vegetables; meat, poultry and fish; sandwiches; cakes and pastries; coffee and teas; pasta and rice; small goods.*

The sampled premises with hands free wash hand basins employed an average of 3 food handlers and sold a range of foods which have been categorised into either 4 or more types or 4 or less types with the majority, 84%, selling 4 or more types. Food premises mostly sold between 20-40 meals per hour (59%) followed by 0-20 per hour (32%) with 1 premises selling 40-60 meals per hour.

Table 2 Number of colonies from food handlers and variables measured in food premises containing hands free wash hand basins in food preparation areas.

Hands free Wash Hand Basins								
Food Premise	Number of colonies		Variables measured					Percentage Reduction
N=19	Pre washing	Post washing	Temp	Number of employees	Food Category*	Time taken: (between 10am and 2pm)	Meals per hour	in number of colonies (post -pre) %
1	17	2	43	3	>4	10-11	0-20	88.2
2	44	21	31	2	>4	10-11	0-20	52.3
3	112	36	45	2	>4	10-11	0-20	67.9
4	5	4	44	3	>4	11-12	0-20	20.0
5	256	4	39	3	>4	10-11	20-40	98.4
6	33	23	15	2	>4	10-11	20-40	30.3
7	12	0	44	4	>4	12-1	20-40	100
8	2	0	31	2	>4	12-1	20-40	100
9	2	1	38	6	>4	10-11	20-40	50.0
10	18	1	34	2	>4	11-12	20-40	94.4
11	1008	28	44	3	>4	12-1	20-40	97.2
12	464	8	28	4	≤4	11-12	20-40	98.3
13	192	2	18	2	≤4	12-1	20-40	98.9
14	113	2	13	2	≤4	12-1	20-40	98.2
15	880	61	41	8	>4	10-11	40-60	93.1
16	12	7	20	4	>4	1-2	20-40	41.7
17	404	10	43	3	>4	10-11	0-20	97.5
18	496	140	22	2	>4	1-2	20-40	71.8
19.	18	1	34	2	>4	11-12	0-20	94.4

* Category of food includes either 5 or more or 4 or less of the following groups: Cooked, cold; frozen; fruit and vegetables; meat, poultry and fish; sandwiches; cakes and pastries; coffee and teas; pasta and rice; small goods.

There was wide variation in the water temperature as supplied to the basins. For the manual wash hand basins the range was 16- 46 Celsius and for the hands free 13-45 Celsius. A plot of the pre count, post count and percentage reduction in the number of colonies against temperature showed no connection whatever between these three variables and temperature. This showed that the pre count, post count and percentage reduction in the number of colonies are not related to water temperature.

The mean percentage reduction for the recoded categories of time, number of employees, number of meals served and number of foods served showed no significant difference between the two

types of hand basin on all four of these variables. Thus there was no overall difference in the percentage reduction in the number of colonies for the two hand basin types when compared at the two times (10-12 and 12-2), for the two employee sizes (1, 2 and 3 or more), for the number of meals served (0-20 and 20-60) and for the number of different types of food (4 or less and 5 or more).

It can be seen in Tables 1 and 2 that the pre and post counts are extremely variable. The large pre counts (>100) are fairly evenly distributed over the numbers of employees variable showing that size of the enterprise had no bearing on the size of the (large) pre counts. The mean number of employees for large pre counts at 3.36 is greater than that for small pre counts at 2.78 but the difference is not significant (p=0.33). Similarly there was no clear association between large pre counts and the time of swab.

The data showed some tendency for the larger pre counts to be associated with more than 20 meals served per hour but the association is not significant (p=0.13).

The percentage reduction variable is probably only useful for non-trivial pre counts. Its values for both types of basin are shown in Figure 1. Ignoring the five pre counts less than 10 however still shows a wide range of values of the percentage reduction with 4 out of 27 less than 50% and 11 out of 27 $\leq 75\%$. The efficacy of the hand washing is clearly not adequate to produce more desirable reductions such as none < 95%.

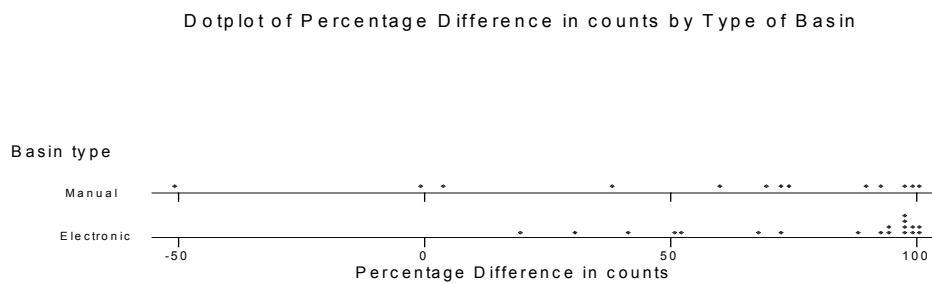


Figure 1: Percentage difference in microbial counts for the manual and electronic hand basins.

The mean percentage reduction in the number of colonies was compared for the manual and hands free using a t-test. This showed no significant difference in the mean percentage reduction (Manual mean = 58%, Hands free mean=79%, p=0.163). Although the difference in these two percentages (21 percentage points) may seem fairly large the non-significance is due to both the fairly small sample sizes and the wide variation in the percentage reductions. In addition if the three smallest values are removed, namely -50, 0 and 4.2, all from the manual hand basins, the difference between the two types of hand basins disappears. Thus apart from three particular hand basins there is no noticeable difference between the two types.

Evaluation

Overall the evaluation results raised a number of positive aspects including general satisfaction with the planning, coordination and implementation of the project, with the EHOs perceiving the opportunity to be involved in research as favourable, particularly developing a partnership with

Swinburne University. Negative issues included concerns that some proprietors had regarding the sort of outcomes the project would achieve and “poor” English skills of some proprietors making it difficult to explain the project. Other negative issues included time constraints of both Swinburne University and City of Yarra staff, which extended the time line for the project completion longer than anticipated. A copy of the evaluation results is contained in Appendix C.

Discussion

The aim of the project was to investigate the hypothesis that there is no difference between the effectiveness of hands free wash basins and manual tap operated basins in reducing microbial flora on hands.

The study has shown that no significant difference was found between the use of a manual or hands free wash hand basin and the range of variables tested had no significant effect on reducing the microbial load through the use of either a manual or hands free wash hand basin. The results of this project are in accord with the hypothesis for a small group of food retailers in the City of Yarra. However given the nature of the pilot project it may not be appropriate to conclude that this is the outcome for all food settings and consideration needs to be given to a number of factors.

Limitations of the study included the small number of manual wash hand basins available for the project, particular differences in hand washing techniques and the difficulty of controlling the level of contamination of the hands through either preparation of foods or other food handler activities prior to washing.

As the legislative requirement to provide “hands free” wash hand basins has been in effect since 1985, the pilot study found it difficult to source manual wash hand basins to use as a comparison. Therefore a small sample size was only available which has affected the ability to provide greater validity to the study. However, as a pilot it has provided some base data and suggested some other issues for consideration which will be useful in planning further studies surrounding the washing of hands by food handlers.

The results particularly indicated that there was great variability in the microbial loads in the pre and post samples. Other studies involving hand washing found reduction with pre and post washing in a controlled environment of approximately 99% (Canard & Holt, 2000, Paulson, D.S. 1992). Whereas in this study the reduction ranged from 4.2% to 100%. This could be attributed to differences in level of dryness of hands, pre and post washing, frequency of washing by the food handler prior to the washing of hands and the amount of mechanical pressure exerted during washing.

Hands which have greater residual moisture have been shown to transfer a greater load of bacteria thus variance in the amount of moisture remaining on hands after drying, depending on the techniques of the food handlers could impact on the result (Patrick et al 1997). More frequent washing has been shown to result in a reduced bacterial load (Restaino, L and Wind, C.E, 1990. Troller, J.A.1983) and other studies have found that the immediate microbial effectiveness depends upon the amount of time spent washing hands, the mechanical pressure and friction

exerted in the washing and the temperature of the water (Paulson, D, 1996). These factors may have impacted on the mean percentage of either of the two types of hand basins.

Even though this pilot attempted to address these issues through the instruction in washing technique given to each food handler, the results indicate that more rigorous techniques need to be put in place to control for these factors. This would include timing the length of hand washing, developing indicators to account for frequency of washing prior to swabbing as well as measuring the level of hand dryness pre and post washing. The evaluation also highlighted that some proprietors had difficulty in understanding the procedures for hand washing due to language difficulties, which is another consideration in this type of research.

Even though it was outside the scope of the study, it would be useful to further explore the types of bacteria remaining on the food handlers hands post washing. The results did indicate the presence of Gram negative bacteria, and even though the loads were considerably reduced in some cases it would be useful to investigate the relationship between hand washing technique and the types of remaining bacteria. One study found that even though “normal” washing of hands resulted in a lower number of transient micro-organisms, it did not influence as effectively organisms such as *Staphylococcus aureus* (de Wit, J.C. and Kampelmacher, E.H., 1984).

It is also interesting to note that the mean percentage reduction for the hands free hand basin was slightly more than that of the manual hand basin. Even though this was not a significant reduction, the above factors may also impact on this.

While the pilot project was not specifically exploring the operating conditions of the WHB it is worthwhile to note that there were large temperature variations in the provision of water to the wash hand basins. Standard 3.2.3 of the Australian and New Zealand Food Standards Code, 15(4)(b) recommends the use of warm running water at around 40 C and not below 22 C to assist in the removal of grease and encourage food handlers to wash their hands. The results indicate that in 16% of premises hand basins were not operating within this temperature, and even though the variation did not impact on the effectiveness of either of the two facilities further exploration into the impact of temperature on the use of either facilities may be worthwhile.

The purpose of the research was to investigate the effectiveness of the two wash hand basins in a realistic environment, and has explored a number of variables, which may have impacted, on the study. The study revealed that there was great variability in the reduced microbial loads both pre and post washing for both types of wash hand basins. Without access to a greater number of manual wash hand basins and the provision of a more controlled experiment (which would have greater resource implications), this pilot has highlighted that regardless of the type of basin available, strategies to promote proper hand washing techniques, including frequency of washing and the proper drying of hands should be explored. The message of proper and frequent hand washing regardless of the type of facility should be strongly promoted.

Recommendations for further studies of this nature include addressing issues such as:

- (i) the availability of manual wash hand basins in food preparation areas to enable an increase in the study population
- (ii) investigating methods of controlling the frequency of hand washing and types of foods handled prior to the swabbing of hands, length of time of hand washing and amount of residual water left on hands post drying
- (iii) develop strategies for the education of food handlers on the correct temperature of the water for wash hand basins
- (iv) investigating the types of micro-organisms that remain after washing.

CONCLUSION

The results of this pilot indicated that there was no difference between the use of either a manual or hands free wash hand basin taking into consideration a number of variables for a small group of food retailers in the City of Yarra. Consideration should be given to a range of factors which may have impacted on this study, including frequency of hand washing, types of foods handled, length of mechanical wash and the number of manual wash hand basins available for the study. Education regarding the need to maintain the temperature of the wash hand basin water between 22-40 °C should also be investigated amongst these food retailers as well as strategies for the correct washing of hands.

Overall the study provided a useful opportunity to investigate the effectiveness of the two hand basins in a realistic food setting and highlighted the challenges involved in conducting research of this nature and the need to encourage proper and thorough hand washing regardless of the facility available.

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Appendix B : Data Summaries.

Frequency tables of the variables: Number of employees (No.emps) and Time of swab (Time) plus these variables grouped into two classes (Empgp and Timegp).

No.emps	Count	Percent	Empgp	Count	Percent
1	1	3	1,2	15	47
2	14	44	>2	17	53
3	9	28	N=	32	
4	5	16			
6	1	3			
7	1	3			
8	1	3			
N=		32			

Time	Count	Percent	Timegp	Count	Percent
10-11	12	38	10-12	21	66
11-12	9	28	12-2	11	34
12-1	8	25	N=	32	
1-2	3	10			
N=		32			

Frequency tables of the grouped variables: Number of meals served (No.meals) and Number of food types (Nfdtypes).

No.meals	Count	Percent	Nfdtypes	Count	Percent
0-20	11	34	1-4	8	25
20-60	21	65	5-9	24	75
N=		32	N=		32

Summary statistics for the pre count, post count, percentage reduction, temperature and Number of employees.

Variables	N	Mean	Media	StDev	Minimum	Maximum	Q1	Q3
pre	32	210.2	60.0	327.4	0.0	1260.0	14.0	240.0
post	32	27.6	5.5	60.0	0.0	316.0	1.3	27.3
percdiff	32	70.1	89.4	37.0	-50.0	100.0	50.6	98.0
temp	32	34.0	38.0	10.2	13.0	46.0	28.3	43.0
nemps	32	3.03	3.0	1.53	1.0	8.0	2.0	3.75

pre: pre count
 post: post count
 percdiff: percentage difference between post and pre counts
 temp: hand basin water temperature
 nemps: number of employees

Note: Q1 is the lower quartile and Q3 is the upper quartile.

Appendix C : Evaluation results

WHB PROJECT

EVALUATION

ASPECT	POSITIVE	NEGATIVE
Project inception/design (Planning project, sampling strategy)etc,	Swinburne was extremely helpful in the planning of the project. EHO's are not known for their research skills, therefore advice from persons experienced in this area, that were able to set clear parameters, was beneficial.	Time delays in defining the scope of the project. The funding was originally to be given to AIEH but due to statistical reasons the project had to be greatly narrowed down.
Proprietor recruitment	This task was fairly straightforward as Council's data base could be used.	Some proprietors, raised concerns, as to what sort of outcomes the project might achieve. Some proprietors grasp of English was so poor that the project brief could not be satisfactorily explained.
Equipment/materials used (swaps, suvery etc)	Equipment required to conduct the surveys was inexpensive and readily available. Survey form was easy to use.	
On site data collection (Access, easy of method, availability etc)	Data collection was straight-forward.	A number of proprietors indicated that they would participate in the project on the proviso that I would not visit them during their busiest periods.
Sample delivery	The sample delivery point was nearby.	It was difficult on occasions to get parking near the drop-off point at the end of the day, on the way home due to Burwood Road being a clearway at that hour.
Other – comments suggestions for improvements	The project has given me some insight into further research opportunities that I may wish to explore. Have built a valuable partnership between City of Yarra and Swinburne.	The project has dragged out for more that I would have originally liked. This is probably attributed to time constraints from but the City of Yarra as well as staff at Swinburne.

WHB PROJECT

EVALUATION

ASPECT	POSITIVE	NEGATIVE
Project inception/design (Planning project, sampling strategy)etc,	Well coordinated and easy to undertake	None
Proprietor recruitment	Very Good	Some premises were difficult to get in to due to the hours of operation
Equipment/materials used (swaps, suvery etc)	Excellent, all equipment was used and satisfactory	None
On site data collection (Access, easy of method, availability etc)	Excellent	None
Sample delivery	On the way home therefore easy to deliver.	Burwood road becomes a clearway in the afternoons which means one has to park at a distance from the lab.
Other – comments suggestions for improvements	None	Rather than designating specific premises to swab it would be far easier to swab premises of any routine inspections by all EHO's. This would spread the workload, get random samples and have minimum disruption to individual EHO's.