Best Practise Drinking Water Sampling for Microbial Testing

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ABSTRACT

Amid a series of false positive E. coli detections within a year, specifically originating from the sample tap, a thorough review of the drinking water sampling protocol for microbial testing uncovered two primary contributors to these inaccuracies. The first involved shortcomings in the sampling procedure, while the second stemmed from the conventional sample tap assembly situated at customer meters. Addressing these issues, we scrutinized and subsequently updated both the sampling methodology and the tap design, introducing a new sample tap dedicated to drinking water sampling at customer meters.
Following the implementation of these revised procedures and the integration of new taps, the incidents of false E. coli detections have been markedly reduced. This proactive measure not only mitigated inaccurate readings but also resulted in tangible benefits such as cost savings and the optimization of personnel time allocation.

1.0 INTRODUCTION

False positive E. coli detection in drinking water denotes a sample initially flagged as positive for E. coli but, upon deeper investigation, is deemed unrepresentative of the water provided to the customer due to external contamination. This contamination can occur at various stages: during sampling, transportation, storage, processing, or handling within the laboratory. The rise in occurrences of false E. coli detections has led to unnecessary alarms, placing a strain on resources and finances. This trend also poses the risk of fostering complacency in handling true positive detections over the long term.

Sampling procedures - Samples are likely to be contaminated at the point of sampling. Also, there exists a considerable risk of contaminating sample containers during the sampling process if proper aseptic techniques are not diligently followed while handling these containers and sampling taps. Therefore, ensuring thorough flushing, employing flame treatment or alcohol spraying, and adhering to stringent aseptic sampling techniques are pivotal in maintaining the integrity and accuracy of collected samples. In order to identify potential contamination points across the transport, sampling, and custody chain, a series of trial tests were conducted. These trials were instrumental in developing an optimized sampling procedure, considering the findings detailed in Table 1. This systematic approach aimed to enhance the reliability of the sampling process and minimize the probability of contamination throughout the entire chain-of-custody.

Sample tap assembly - The conventional sample taps installed at customer meters typically feature a push-in air fitting on a T-connection. These taps employ a gooseneck connection for sample collection, sealed with a plastic sleeve when not in use. While cost-effective in terms of installation and maintenance, these taps harbor significant risk factors associated with false E. coli detection and operational challenges:

- Accessibility to customer properties and notification may not always be feasible, hindering efficient sampling procedures.
- Taps are susceptible to damage or removal by customers without prior notice, necessitating samplers to seek alternative taps nearby. This increases the chance of consecutive sampling from a tap contravenes the Victorian Safe Drinking Water

Regulations 2015, resulting in additional costs and time constraints for samplers.

- Vegetation clearance around the taps is required to prevent external contamination. Presence of shrubs or bushes in proximity to the taps poses a heightened risk of contaminating samples, especially during inclement weather conditions like rain or strong winds.
- Protection against rain droplets washing off overhanging trees or structures is crucial. Contaminated rain droplets may compromise the sample integrity if they come into contact with the collection point.

Table 1: ***Sampling procedure general consideration.***

Was the sampler's training recently refreshed to ensure compliance with current protocols and best practices?
Were containers with preservatives not rinsed prior to sampling to maintain the integrity of the sample?
Were containers without preservatives rinsed before sampling to prevent contamination?
Was the sampling tap properly sterilized before usage to minimize contamination risk?
Was the microbiological sample collected as the initial sample to maintain accuracy?
Was the lid and inside of the sample bottle kept sterile during microbial sampling to prevent contact with other surfaces?
Were potable water samples segregated from other sample types (e.g., recycled water) by storing them separately in eskies or fridges?
If the cover of the connection was damaged/absent, was it cleaned before sampling, and were notes added to the Chain of Custody?
Did the sampler wear food-handling gloves or use hand sanitizer during the sampling process?
Were both the tap and sample container covered during sampling in case of rain to prevent contamination?
Have field instruments been calibrated within the last 12 months to ensure accuracy?
Was the sample tap fitting inspected and cleaned if necessary before sampling?
Was the **tap** flushed for the appropriate duration (2 minutes for short side service, 7 minutes for long side service) before sampling?
Was a 10cm length from the end of the gooseneck flamed for at least 30 seconds before sampling?
If it was a Total Fire Ban Day, was a disinfection agent used and allowed to sit for 2 minutes before sampling instead of flaming?
Was a steady stream from the gooseneck allowed for 5-10 seconds before actual sampling?
Was the plastic sleeve replaced on the sample tap fitting if visible damage or contamination was observed?
If the sampling point was overgrown, inaccessible, or prone to contamination, was the sample tap photographed and reported?

2.0 DISCUSSION

Addressing these issues associated with conventional sample taps is imperative to ensure the accuracy and integrity of drinking water sampling, mitigating false E. coli detections and optimizing operational efficiency.

To identify an appropriate location for a sample tap near a customer meter, specific criteria are meticulously considered to circumvent the aforementioned issues. These criteria include ensuring that the meter is positioned at least 10 cm above ground level, free from any overhanging trees or structures, devoid of obstructions within a 30 cm radius around the tap, and without the presence of dogs on the property, among other factors. However, in densely vegetated areas, meeting all these stipulations can be exceptionally challenging and sometimes unfeasible.

In such heavily wooded environments, locating a spot that adheres strictly to all the criteria becomes arduous and, at times, unattainable. Consequently, instances of false positive E. coli detections, primarily prevalent in bushy locales, have been linked to external contamination, such as water splashes. This issue prompted the initiation of a case study wherein we trialed a new variant of a customer sample tap. The objective was to significantly diminish the likelihood of false E. coli detections by minimizing susceptibility to external contaminations, especially in densely vegetated areas.

The design of the new tap encompasses several essential features aimed at fortifying its functionality and reliability. Notably, it boasts a 1-meter-tall lockable stainless-steel bollard cover, serving as protection against potential animal interference, overgrown

grasses, or shrubs. This protective cover also acts as a deterrent against unauthorized usage, enhancing security measures.
Additionally, the tap design incorporates a rain cover or rain hat, safeguarding the sampling process from rain droplets during inclement weather conditions, thereby ensuring the integrity of the collected samples. Moreover, the inclusion of a fixed gooseneck simplifies and enhances the sampling procedure, facilitating easier and more reliable flaming by samplers before collecting samples (refer to Figures 1). Crucially, this tap installation strategy focuses on situating the tap on a service pipe within the nature strip outside the customer's property, effectively circumventing potential access issues.

<u>Figure 1:</u> ***New bollard sample taps.***

Upon rigorous testing, particularly on a rainy day, the results yielded no evidence of E. coli contamination in the sampled water (refer to Table 1). Furthermore, an assessment of the water retained in the tap over a period showed no alterations in the metal content of the sample, confirming the absence of water contamination attributable to the tap design (see Table 2). Notably, a total of 10 taps of this nature have been strategically installed and utilized within our network, consistently yielding negative microbial results and garnering no customer complaints.

Table 2: ***Typical water quality verification test results.***

Sample No	Site Code	Site Description	Sample Type	Sampled Date/Time
8669021	L580-0883-21		WATER	18/08/23 12:13
8669022	L580-0883-21	- 5 minutes	WATER	18/08/23 12:20
8669023	L580-0883-21	- 10 minutes	WATER	18/08/23 12:34

Analysis - Analyte	*Sample No.* *Site Code* *Units*	**8669021 L580-0883-21**	**8669022 L580-0883-21**	**8669023 L580-0883-21**
Field Cl2 - Free Chlorine (Field)	mg/L	0.89	1.0	1.1
Field Cl2 - Total Chlorine (Field)	mg/L	0.97	1.2	1.2
Turbidity - Turbidity, NTU	NTU	0.6	0.6	0.6
E.coli, Coliforms - Coliforms	cfu/100mL	0	0	0
E.coli, Coliforms - E.coli	cfu/100mL	0	0	0
MS Total Metals - Aluminium	mg/L	0.05	0.05	0.06
MS Total Metals - Antimony	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Arsenic	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Barium	mg/L	0.012	0.012	0.012
MS Total Metals - Beryllium	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Boron	mg/L	<0.02	<0.02	<0.02
MS Total Metals - Cadmium	mg/L	<0.0002	<0.0002	<0.0002
MS Total Metals - Chromium	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Cobalt	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Copper	mg/L	0.009	0.007	0.008
MS Total Metals - Iron	mg/L	0.06	0.06	0.06
MS Total Metals - Lead	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Manganese	mg/L	0.003	0.003	0.004
MS Total Metals - Mercury	mg/L	<0.0001	<0.0001	<0.0001
MS Total Metals - Molybdenum	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Nickel	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Selenium	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Silver	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Strontium	mg/L	0.021	0.021	0.021
MS Total Metals - Thallium	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Tin	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Titanium	mg/L	0.001	0.001	0.001
MS Total Metals - Vanadium	mg/L	<0.001	<0.001	<0.001
MS Total Metals - Zinc	mg/L	0.003	0.003	0.003
Plate Count - Plate Count 36°C	cfu/mL	0	0	0

3.0 CONCLUSION

This successful implementation and operational performance validate the efficacy of this new tap design and testing procedure, demonstrating its ability to mitigate potential contamination risks while ensuring reliable and accurate water sampling.

4.0 ACKNOWLEDGEMENTS

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5.0 REFERENCES

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