SQIDEP independent evaluators joint report:

Atlan FlowFilter

DesignFlow & Manly Hydraulic Laboratory

August 2024

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1 INTRODUCTION

This document reports on the independent evaluation of an application by Atlan (formerly known as SPEL) for performance verification of the FlowFilter device by Stormwater Australia. The independent evaluation has been undertaken following the requirements of the Stormwater Quality Improvement Device Evaluation Protocol (SQIDEP) V1.3 (Stormwater Australia, 2019).

Atlan have requested evaluation under the 'Body of Evidence' pathway set out by SQIDEP. It is noted that the actual field monitoring data relied on for the application commenced in April 2022 and therefore the 'Field Evaluation' pathway could have been followed and is the preferred pathway to avoid assessment issues.

1.1 Evaluators Declaration of Independence

It is declared that the evaluators, Shaun Leinster and Andrew Judge, are completely independent and have no conflict of interest with respect to this engagement. They have not, nor have they ever been employed or commissioned by the Applicant, Atlan.

They have not been involved in the design or development or monitoring of the FlowFilter. They have undertaken this assessment without prejudice and in good faith.

Shaun Leinster

Andrew Judge

1.2 Quality assurance project plan

Not provided and hence not assessed

2 DEVICE UNDER ASSESSMENT

The Atlan Flowfilter (see Figure 1) is a treatment device provides treatment of gross pollutants, sediment and nutrients. It is a proprietary system built around a cartridge filter system that may be scaled with the addition of cartridges to allow treatment of a range of flow volumes.

A bypass weir is incorporated into the centre of the unit, consisting of a vertical pipe that allows flows to bypass the filters in case of a high flow event or blinding of the filters. The lower chamber can be accessed via the central overflow pipe to allow for cleaning of the lower chamber. Flow rates where the water level in the bypass pipe is at the crest of the pipe, but not overflowing, is called the treatment flow rate. The treatment flow rate may change depending on flow conditions, sediment loading, and the condition of the filters.

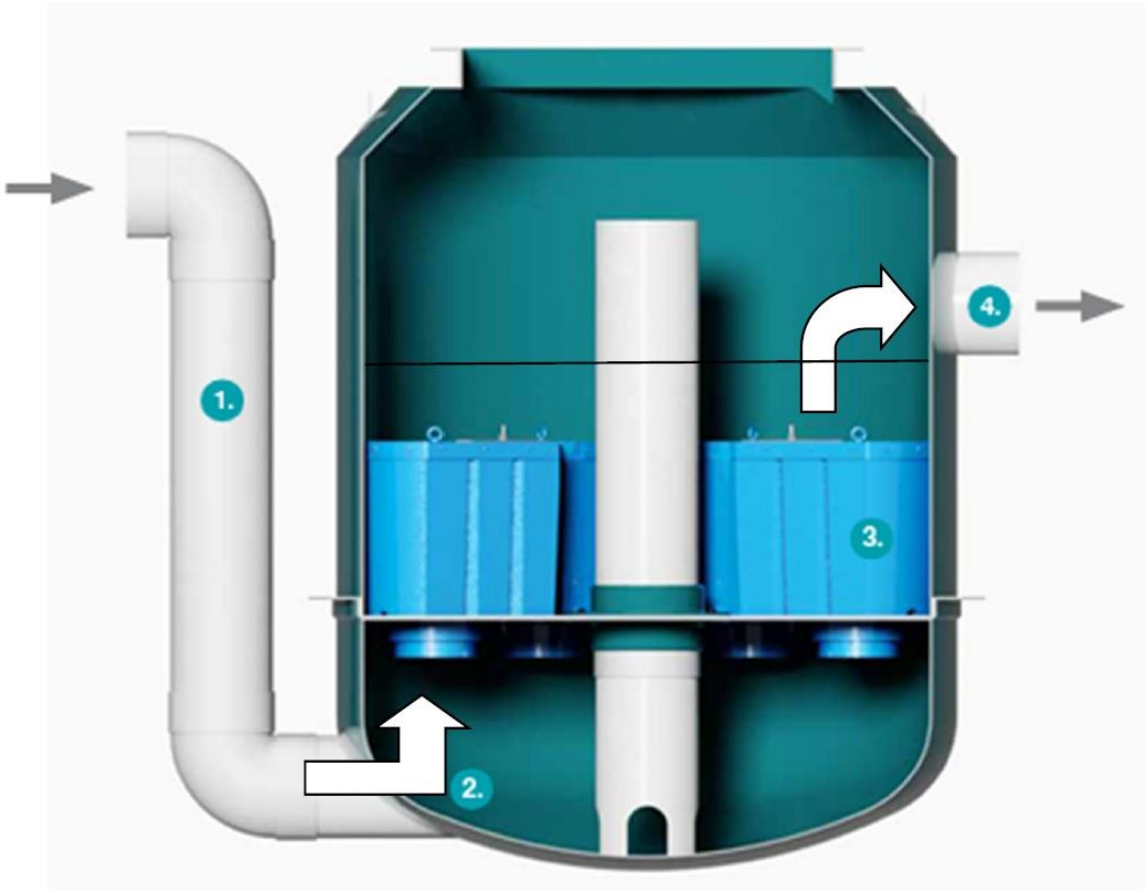

Figure 1- Atlan FlowFilter

The field testing was conducted at 8 Chifley Dr, Moorabbin Airport, Victoria 3194 (Moorabbin site). Details of the site are listed below:

- Catchment = 29,715m^2 (refer Figure 2)
  - Pavement = 21,673m^2
  - Roof = 6,502m^2
  - Landscape = 1,540m^2

- Diversion weir location in stormwater pit upstream of the Flowfilter design (diversion rate not confirmed)
- 7 filter cartridges
- Overall height of the monitored FlowFilter is 2700 mm with 1850 mm diameter and 900x900mm square lid Surface runoff
- Inflows via 225 mm diameter pipe
- Outflows via a 225 mm diameter pipe
- Internal bypass is set above the diversion weir in the upstream diversion pit upstream

The monitoring program was designed to measure the following:

1. Rainfall
2. Flow rate through the flow filter (initially via in inlet meter and then combined with an outlet meter
3. Influent quality
4. Effluent quality

Auto samplers were utilised for obtaining samples for water quality analysis of influent and effluent, while starflow ultrasonic meters were installed to measure flow. The plan view of the experimental setup is shown in Figure 3 and Figure 4.

Gross pollutant monitoring was completed by seeding the catchments with floatable litter marked in a high-visibility pink colour. The number retained in the Flowfilter was evaluated.

Figure 2 - Field monitoring site aerial view (source: Atlan, 2024)

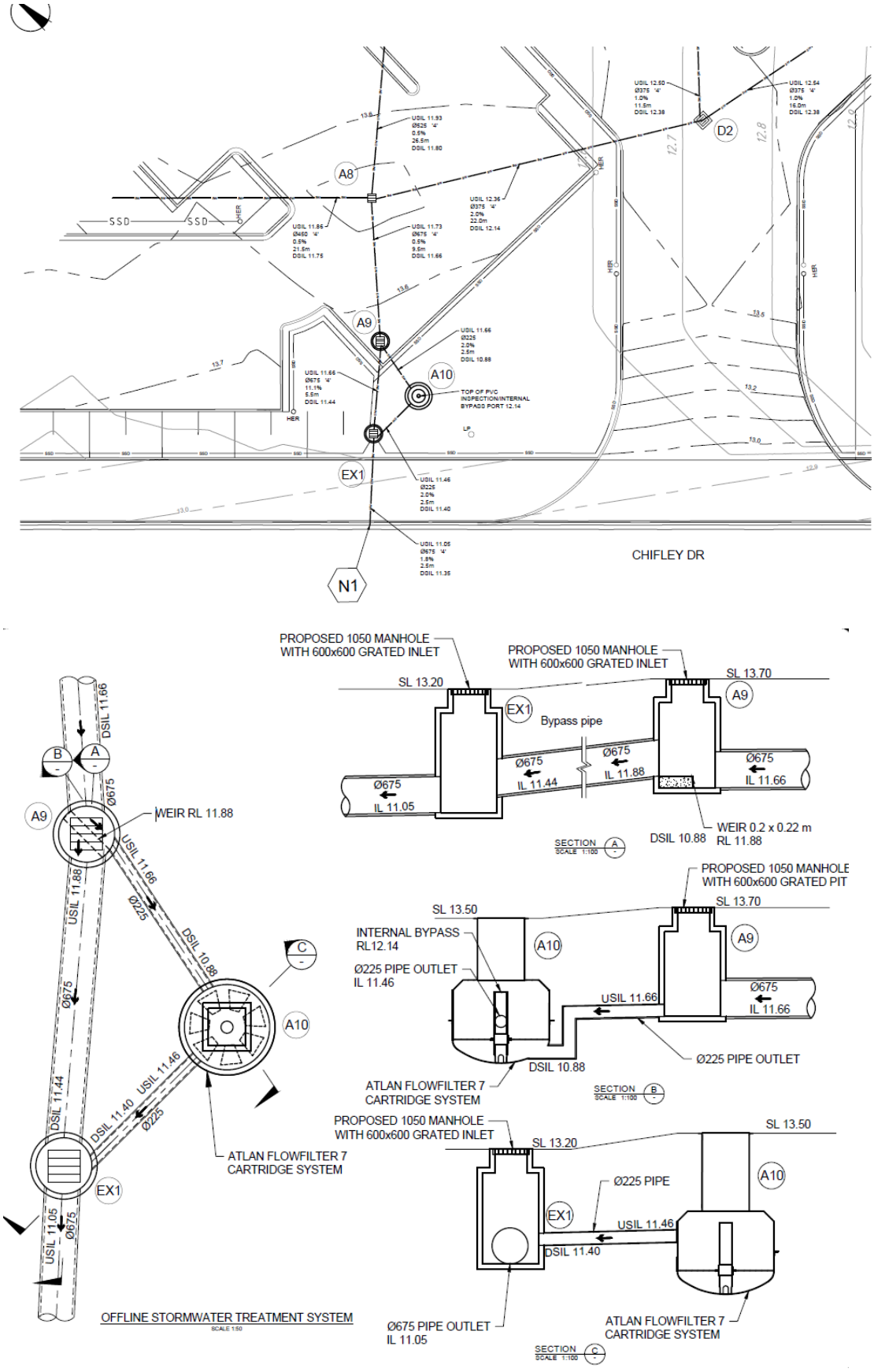

Figure 3 - Functional layout of the Atlan Flow Filter location and drainage (source: Atlan, 2024)

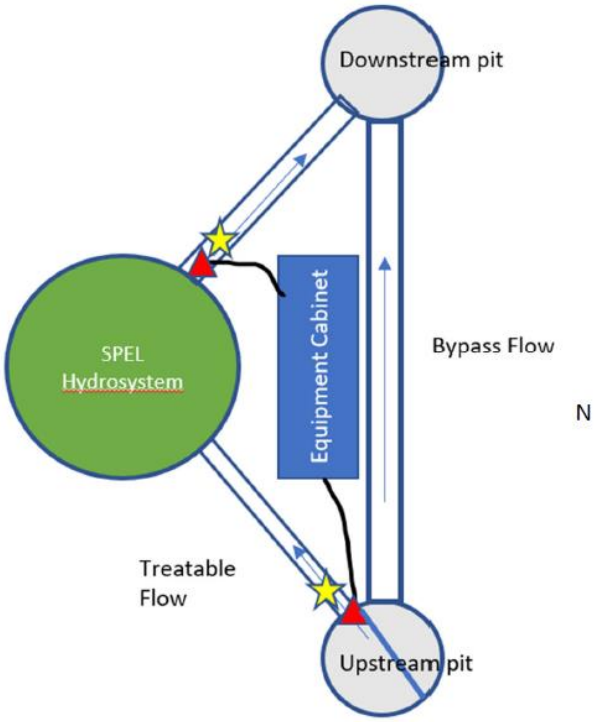

Figure 4 - Schematic view of monitoring arrangement (source: Atlan, 2024)

3 BACKGROUND

The following documents were relied upon for this evaluation report:

3.1 Review of documents and data

ALS Environmental. (2024). *Lab Reports from Sept 2022 to March 2023.*

Drapper Environmental Consultants. (12 May 2023). *Costco - Main Works - StormwaterDetailed Plan, Issue A.*

Drapper Environmental Consultants. (16 Jan 2024). *Field Monitoring of ATLAN FLOWFILTER Costco, Moorabbin - Issue 2.*

Drapper Environmental Consultants. (n.d.). *Costco hydrographs_Iss1 .pdf.* May 2022.

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Stormwater, A. (May 2023). *Sample event records from 2nd September 2022 to 31 March 2023.*

Water Research Laboratory (UNSW). (February 2020). *Performance testing of the SPEL Hydrosystem.*

Waterlabs Australia. (July 2024). *ATLAN STORMWATER Costco - FlowFilter Hydraulic Performance (Treatable Flowrate) Lab Testing report - Issue 2.*

3.2 Performance Claim

The Body of Evidence Pathway Submission provided by Atlan claims the following performance:

- Treatment flow rate = 28 L/s (4L/s per cartridge)
- Total suspended solids (TSS) removal = 95%
- Total Phosphorus (TP) removal = 93%
- Total Nitrogen (TN) removal = 45%
- Gross Pollutant removal = 100% (90% also assessed as per original application)
- Lead (Pb) removal = 90%
- Zinc (Zn) removal = 53%

3.3 MUSIC node claims

The applicant proposes the following approach to modelling FlowFilter in MUSIC:

1. Gross Pollutant Trap Node
2. High flow bypass = 4L/s per filter cartridge
3. Total suspended solids (TSS) removal = 95%
4. Total Phosphorus (TP) removal = 93%
5. Total Nitrogen (TN) removal = 45%
6. Gross Pollutant removal = 100% (90% also assessed as per original application)

4 SQIDEP COMPLIANCE

4.1 SQIDEP assessment

The minimum requirements from SQIDEP are reproduced below in Table 1 where they are evaluated against the data provided with the applicant's submission. Also included at the end of Table 1 are additional criteria requested to be included by the applicant.

Table 1 SQIDEP Compliance

Criteria	Requirement	Evaluation finding	Compliance Status
Organisational Roles and Quality Assurance			
Organisational Roles and Responsibilities	The claimant, sampling organisation, analytical laboratory and reporting organisation shall be clearly identified (especially in confirming independence requirements	Organisational chart provided defining roles and responsibilities. Atlan engaged Drapper Environmental Consultants to undertake monitoring. ALS Environmental undertook laboratory sample analysis.	Compliant
Sampling QA and Quality Control	Operation and maintenance schedules for sampling equipment shall be provided. Chain of custody documents identifying sample, collection agency, collection time, preservation used and laboratory receipt of sample and sample condition shall be provided.	ALS laboratory performed blind replicates testing as part of Quality Control. Records provided in Appendices. Chain of custody and sample preservation documented.	Compliant
Reporting	By independent organisation	Reported by Darren Environmental Consultants	Compliant
Sampling Events			
Type of Event	Rainfall Events	Real storm events were sampled	Compliant
Minimum Number of Events	The greater of: a. 15 events, and b. Sufficient events to achieve 90% confidence interval, as determined by defensible statistical method (e.g. ANOVA, t-test) that examines influent and effluent pairs. This may vary between target pollutants (based on catchment variability). In this event, statistical analysis can be undertaken separately for each species of interest.	>50 complying events were included in the analysis. The spreadsheet does include statistical analysis and shows greater than 90% confidence that the influent and effluent concentrations are statistically different.	Compliant
Minimum Rainfall Depth	Sufficient to collect minimum sample volume (based on laboratory analytical requirements).	>0.6mm rainfall	Compliant
Recommended Inter-event Time	Min 6 hours	>6 hours	Compliant

Criteria	Requirement	Evaluation finding	Compliance Status
Device Size	Full Scale (where a 'family' of devices are being included as part of the claim sizing relationships must be provided for evaluation along with any basis of justification).	Device is full scale.	Compliant
Runoff Characteristics	Target pollutant profile of influent and effluent	They are representative	Compliant
Runoff Volume or Peak Flow	At least 2 events should exceed 75% of the design water quality volume/ TFR and 1 event greater than 100% of the TFR.	More than 2 events exceed 75% of the design water quality volume 10 of the events had total flow which exceeded the design treatable flowrate (TFR). The flow results are problematic and required considerably more explanation. Further, explanation of the flow monitoring was provided by Atlan but it remain unclear exactly when the FlowFilter system was in bypass (see section 4.2 Monitoring of flow rates). Laboratory testing was completed by Waterlabs on one of the Costco filters to confirm the treatable flow rate.	Compliant with the criteria , but the flow gauging at Costco is questioned. This will have little effect on the claimed removal efficiency. Subsequent laboratory testing assisted in defining the treatable flow rate.
Sampling Procedures and Techniques			
Automated Sampling	Composite samples on a flow- (preferred) or time-weighted basis	Samples were collected on a flow-weighted basis and were composited before being split into sub-samples for analysis	Compliant
Minimum Number of Aliquots	80% of field test collections should have at least 8 per event. Notwithstanding aliquots should be collected to provide hydrograph coverage of rising and falling limbs.	Most of the qualifying events (>80%) involved collection of at least 8 aliquots. There were 6 events which collected less then 8 aliquots. The results of these were include in the assessment o avoid the perception of cherry picking.	Compliant
Hydrograph coverage	At least 50% of qualifying storms should include the first 70% storm hydrograph coverage (or, for storms	10 events are reported to have poor sampling coverage, but due to the large number of events sampled inclusion or	Compliant

Criteria	Requirement	Evaluation finding	Compliance Status
	longer than 8 hours, capture of the first 8 hours). Programs should aim to capture full hydrographs for all events, but flexibility will be considered for large volume, long duration events. Dependent on catchment and rainfall patterns, multiple peaks should be accounted for (at least 1 occurrence).	exclusion of these events have little effect on the claimed removal efficiency.	
Seasonality	Events to be distributed to capture seasonal influences	All seasons are covered by the data set	Compliant
Grab Sampling	Only for constituents that transform rapidly, require special preservation or adhere to bottles, or where compositing can mask the presence of some contaminants through dilution.	NA	NA
Sampling Location	As identified and agreed in the submitted QAPP.	Sampling undertaken at influent and effluent using suction lines. Locations appear to be appropriate and representative.	Compliant
Sampling Procedures and Techniques			
Chemical and Physical analytes	As identified and agreed in the submitted QAPP.	No QAPP as this was BoE application	N/A
Minimum and maximum (influent) pollutant concentrations for qualifying events	Minimum concentrations: exclude if below limit of detection. Maximum: mean+2SD for any single event, and mean +1SD in the aggregate dataset. Refer SQIDEP Table 1.	The process for including data based on these criteria is appropriate.	Compliant
Analytical Methods	NATA accredited sample handing and analytical methods. Refrigerated autosamplers may be required to adequately preserve samples.	Laboratory is NATA accredited and COC forms provided.	Compliant
Requirements			

Criteria	Requirement	Evaluation finding	Compliance Status
Flow Measurement Location	Inlet, Outlet and Bypass, as applicable. Based on relevant accepted measurement protocols for flow type (e.g. open channel, in pipe)	Flow measurement locations are appropriate, however results require explanation (see section 4.2 Monitoring of flow rates).	Compliant with criteria
Precipitation Measurement	Automatic rain gauge (pluviometer)	A 0.2mm tipping-bucket rain gauges was used	Complies
Recording Intervals	5 minutes or less	1 minute	Complies
Rainfall Recording Increments	No greater than 0.25mm	Complies	Complies
Rain Gauge Calibration	Twice during monitoring period	Report does not define that any calibration was undertaken, however Atlan did compare to a nearby BoM gauge.	Non-Compliant, but not significant
Performance Indicators	Based on the Performance Claim stated in Detailed Performance Report. (Can include but not limited to TSS, Metals, TPH, TP & TN). The target pollutants and testing rationale must be described in the QAPP & Detailed Performance Report. Where a device is claiming total reductions of a particular pollutant, it is not necessary to include speciation. If speciation is not undertaken then reductions of sub-species cannot be claimed.	There was no QAPP submitted or endorsed prior to the monitoring program commencing. The performance claims relate to TSS, TP, TN, Gross Pollutants, Lead and Zine which were included in the suite of parameters.	Complies
Data Analysis and Reporting			
Performance Indicators Calculation	Concentration Removal Efficiency (CRE) (See Section 6.4.3) (Arithmetic average and median. If difference is 10% or greater, inspect data set closely) Mass Removal Efficiency (MRE) (See Section 6.4.4) (Arithmetic average and median. If difference is 10% or greater, inspect data set closely) Relative Achievable Efficiency (RAE) (See Section 6.4.5) (Arithmetic average and median. If difference is 10% or greater, inspect data set closely	SQIDEP requires only CRE and ER to be calculated as a minimum. Atlan have calculated these as average CREm median CRE, Average ER and Median ER. They adopted Average ER for the final performance claim which sits within the range of performance percentages. SQIDEP does not provide firm guidance on which method is preferred.	Complies

Criteria	Requirement	Evaluation finding	Compliance Status
	Summation of loads (SoL) (See Section 6.4.6) (Arithmetic Average and median. If difference is greater than 10% inspect dataset closely) Efficiency Ratio (ER) (See Section 6.4.7) (Arithmetic Average and median. If difference is greater than 10% inspect dataset closely) Flow Based Variability (FBV) (See Section 6.4.8), including a plot of one of the above performance measures against the 25, 50, 75, 100 and 125 percent of the treatable flow rate. Provide details on the selected curve and the associated R^2 value.		
Performance Variability Schematics	Box and Whisker Plots of inlet and outlet EMCs.	Provided and shows: • Consistent reduction of TSS • The TP and TN concentrations observed at the inlet from the fully compliant events, were reasonably consistent, • Concentrations indicate predictable reductions for Lead and Zinc	Complies
Statistical Significance Testing	Log-transformed inlet and outlet paired samples at 90% confidence level.	Provided in spreadsheet but not report.	Complies
Sizing Methodology	A sizing methodology must be provided that allows an evaluation of performance of other devices in a 'family' to be reviewed. This should include relationships established under defensible theoretical/ modelled conditions or testing undertaken under either field or laboratory conditions.	The submitted report includes a proposed methodology for modelling FlowFilter performance in MUSIC. The approach proposed is appropriate. Refer to Conclusions for MUSIC modelling method.	Complies The approach proposed is appropriate. Refer to Conclusions for MUSIC modelling method. .

4.2 Monitoring of flow rates

The Unidata Doppler flow units were used for the in-field flow monitoring of this stormwater unit. Although Atlan have stated they were calibrated, there is no evidence provided for on-site Site calibration as required in the specifications from UniData.

Both flow meters appear to have been poorly installed, with the sample tube close to the Doppler sensor head and cabling not well secured leading to ragging and blocking of the sensor heads. Small weirs were installed downstream of the sensor, but these also have the potential to create ragging. The resulting flow monitoring appears to have significant errors in many events as shown with mass balance issues between the upstream and downstream gauges for a number of events (*Figure 5*). It is not clear whether the inflow rate or outflow rate are more accurate. Therefore, the flow rate information submitted does not provide a reliable understanding on the treatment flow rate.

The Water resources Laboratory report (Water Research Laboratory (UNSW), February 2020) completed flow testing of a preloaded 3 cartridge Flowfilter system over 5 flow tests. The first test found a treatment flow rate of 10.8 L/s (3.6L/s per cartridge) which dropped to 7.9Ll/s (2.63L/s).

Subsequent laboratory testing of a filter cartridge removed from the Costco FlowFilter device (Waterlabs Australia, July 2024) against the draft Stormwater Australia's laboratory testing protocol (Stormwater Australia)has confirmed a treatable flow rate of 4 L/s.

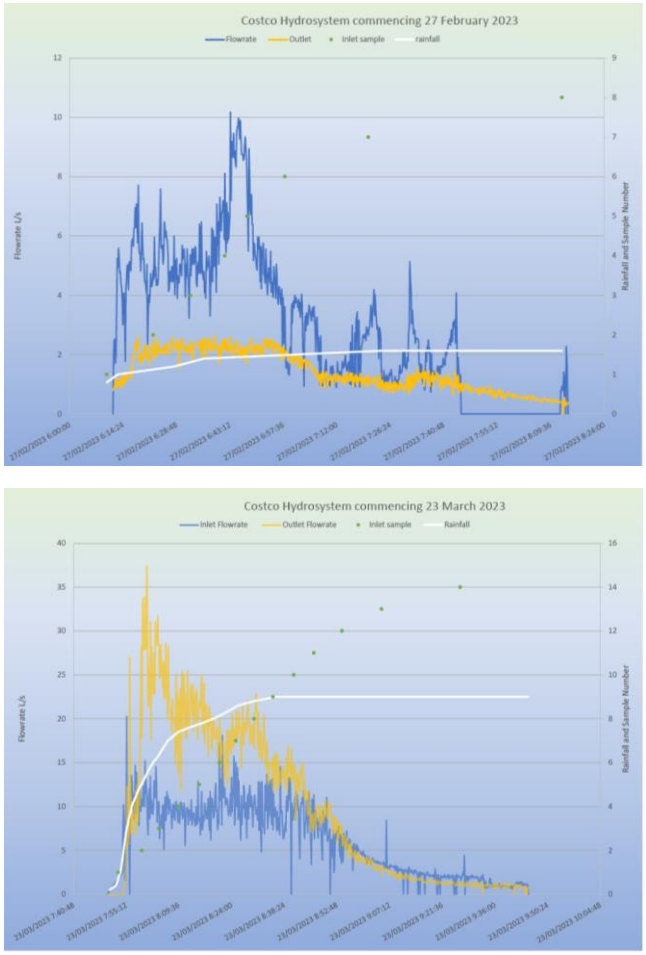

Figure 5 - Example events where inflow and outflow at the Costco site were significantly different

4.3 Pollutant removal and statistical analysis (excluding gross pollutants)

A review of the Body of Evidence suggests the analysis and approach taken for all water quality parameters other than gross pollutants was robust and the reviewers have no objection to what is presented nor to the claims of water quality improvements for flows up to the treatable flow rates.

4.4 Gross pollutants

Gross pollutants are all material greater than 5mm. Previous monitoring of gross pollutants has found the majority of gross pollutants is sediment and organic material. Review of the photos provided by Atlan (refer Figure 6) found the same gross pollutant occurring at Moorabin.

The approach used by Atlan to seed the catchment with floatable litter is not representative of gross pollutants in the catchment and therefore is not a reliable measure of gross pollutant capture. However, the approach does provide an indication of capture rates for floatable litter and it is clear that the system is also collecting organics and sediment. This is expected given the filter size of the cartridges is well below the size of gross pollutants 5mm and greater).

Figure 6 - Photos of captured gross pollutants confirming most material is sediment and organic material

5 CONCLUSION

The assessors were generally comfortable with the approach to the monitoring water quality performance for the Atlan Flow filter for all parameters other than gross pollutants. Gross pollutant monitoring requirements is not yet defined in SQIDEP and the seeding method used by Atlan does not appropriately define removal of all gross pollutants. This was discussed with SQIDEP panel and based on previous assessments of similar products a removal of 100% gross pollutants up to the treatable flow rate has been adopted provided the assessors are comfortable that the filter system will effectively capture and hold gross pollutants (greater than 5mm). The assessors were comfortable the filter system will effectively capture and hold gross pollutants up the treatment flows rate so a removal of 100% was adopted.

The assessors have concerns with the flow monitoring data collected in the field at Costco and believe the data cannot be used to define a treatment flow rate for the Atlan Flowfilter. Therefore, the laboratory data collected by Waterlabs Australia has been used by the assessors to define treatment flow rates for this assessment only.

5.1 Treatment flow rate

The treatment flow rate has been taken from the the laboratory testing of a used Flowfilter cartridge and defined as 4 L/s per cartridge.

For this treatable flow rate to be achieved, the internal high flow bypass (crest of the internal riser) must be at least 630mm above the top of the cartridges.

5.2 Treatment performance

It has been determined from this review that the performance of the FlowFilter system is:

- Total suspended solids (TSS) removal = 95%
- Total Phosphorus (TP) removal = 93%
- Total Nitrogen (TN) removal = 45%
- Lead (Pb) removal = 90%
- Zinc (Zn) removal= 53%
- Gross pollutants removal = 100%

5.3 MUSIC modelling

Modelling of the FlowFilter system in MUSIC should be undertaken as follows:

1. Generic Treatment Node or Gross pollutant Trap
    a. Low Flow Bypass = 0
    b. High Flow Bypass = 0.004 m^3/s x number of cartridges (4L/s x number of cartridges
2. Transfer functions set to achieve the following removal rates:
    a. Flow 0% reduction
    b. TSS 95% reduction
    c. TP 93% reduction
    d. TN 45% reduction
    e. Gross pollutants 100% reduction

6 REFERENCES

ALS Environmental. (2024). *Lab Reports from Sept 2022 to March 2023.*

Drapper Environmental Consultants. (12 May 2023). *Costco - Main Works - StormwaterDetailed Plan, Issue A.*

Drapper Environmental Consultants. (16 Jan 2024). *Field Monitoring of ATLAN FLOWFILTER Costco, Moorabbin - Issue 2.*

Drapper Environmental Consultants. (n.d.). *Costco hydrographs_Iss1 .pdf.* May 2022.

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Drapper Environmental Consultants. (n.d.). *Image - StarflowInlet.jpg.*

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Drapper Environmental Consultants. (Jan 2024). *Costco_Event Record_Jan2024.pdf.*

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Waterlabs Australia. (July 2024). *ATLAN STORMWATER Costco - FlowFilter Hydraulic Performance (Treatable Flowrate) Lab Testing report - Issue 2.*