Stormwater Australia

Bryan Ward

Executive Officer

Via email: executive@storwmater.com.au

15th August 2024

AWC Reference: 241900_Filter SQIDEP

Dear Bryan,

RE: StormFilter NPSorb SQIDEP Review

Water | Ecology | Management

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Australian Wetlands Consulting (AWC) and Afflux Consulting were commissioned to audit the performance monitoring of the StormFilter NPSorb system carried out at Western Sydney University (WSU) Australia and confirm compliance with Stormwater Australia's *Evaluation Protocol (SQIDEP) for Stormwater Quality Treatment Devices" (Stormwater Australia, Version 1.3, December 2014).* Ocean Protect supplied the following materials relating to the performance monitoring:

- A Detailed performance report for SQIDEP review- StormFilter NPSorb (*Ocean Protect,* April 2024)
- A Microsoft excel file *StormFilter NPSorb WSU 230901* containing data and statistical analysis from the monitoring undertaken at WSU
- A Microsoft excel file *StormFilter NPSorb WSU* antecedent rainfall analyses which provides calculation summary of the total rainfall in the 6 and 24 hrs prior to monitoring at WSU
- 2x Ocean Protect WSU NPsorb Sampler Maintenance and Calibration documents dated 11th March 2022 and 18th August 2022.
- Individual Storm Reports (ISR) for each of the monitoring events. ISR contain the time, date, duration of the storm event; rainfall and flow data; number of aliquots; and a hydrograph from the monitoring undertaken at WSU
- Laboratory Chain of Custody (COC), Sample Receipt Notifications (SRN) and Certificates of Analysis (COA) from samples collected during the monitoring undertaken at WSU
- Commonwealth Statutory Declaration forms confirming the roles of personnel involved in the project, installation dates and maintenance procedures throughout the monitoring period.

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The following key information needs to be highlighted with regards to any Treatment Claims that can be made for the Stormfilter NPSorb system evaluated under the SQIDEP framework:

- Pollutant concentration reduction claims that can be made as a result of the field trials are shown in Table 1 below
- A treatable flow rate of 2.2 litres/ second (1.1 litres/second for each of the 460mm StormFilter® NPSorb cartridges)

Table 1 Summary of pollution reduction of Stormfilter NPSorb System at the Western Sydney University site.

Analyte	Median CRE (%)	Efficiency Ratio (%)	Average CRE(%)
TSS	89	87	84
TP	69	72	67
TN	67	65	58

The following key information needs to be highlighted with regards to any Treatment Claims that can be made for the StormFilter NPSorb system:

- The tested device had a design Treatable Flow Rate (TFR) of 2.2 litres/ second (1.1 litres/second for each of the 460mm StormFilter NPSorb cartridges). Hydraulic monitoring confirmed eleven of the sixteen events exceeded the device TFR with 4 events reaching the peak measurement limit of the flow meter (5.44 L/s) used during monitoring;
- The high flow bypass volume equals the maximum treatment flow capacity of the StormFilter NPSorb system. Bypass or overflow occurs when water levels within the chamber exceed the overflow weir wall level.
- The tested device had a total area of 1.44 m^2, equating to 0.21% of the catchment area;
- It is recommended that the performance of the StormFilter NPSorb system be modelled in MUSIC using the detention node and generic treatment node with properties as recommended in Tables 3-2 and 3-3 of the "Performance Report". Note the High flow bypass will need to be modified for each application dependent on the number and configuration of the cartridges. This modelling element is critical.

Conclusion

AWC and Afflux Consulting have reviewed the performance trial of the StormFilter NPSorb system proprietary device and supporting data from the trial in Western Sydney University, NSW. Based on a review of the information provided by Ocean Protect , AWC confirm that the field testing of the StormFilter NPSorb System conducted at the Western Sydney University site between November 2021 and March 2023 complies with the requirements of SQIDEP (v1.3) Field Evaluation pathway as shown in Table 3 in Attachment 1. We confirm the following performance shown in Table 2.

Table 2 Performance of the StormFilter NPSorb

Parameter	Value
Treatable Flow Rate (L/s) *	1.6, 1.1 and 0.7 L/s per cartridge for 690, 460 and 310 StormFilter NPSorb cartridges
Pollutant Reduction % (TSS;TP;TN;GPs)	87, 72, 65 & 100
*Note: refer to Table 3-1 of Detailed Performance Report.	

We believe the performance observed in Western Sydney are transferrable to other locations since the key variables are treatable flow rate, appropriate media and catchment characteristics.

I hope this summary is clear but please contact me with any questions.

Your sincerely,

Damian McCann
Director AWC

Chris Beardshaw
Director Afflux Consulting

Attachment 1

Table 3 Assessment of the StormFilter NPSorb system performance monitoring undertaken at WSU against SQIDEP (v1.3) requirements (the respective page number where the requirement is discussed in SQIDEP v1.3 is shown for ease of reference).

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
Section 4.1 Data Quality (page 14)					
The events sampled must also represent rainfall, and thus runoff, patterns for the catchment across an extended period of time typically (> 12 months) and be subject to the qualifying number of characteristic storms being achieved. Representativeness shall be assessed and reported.	As shown in Table 2-3 monitoring accrued over a 17 month period from 4/10/2021 to 23/03/2023. Monitoring events were monitored for pollutants shown in table 2-4 across a range of real rainfall events (refer Table 2-3). ***Table2-3 is missing results from the final monitoring event from the 23rd March 2023. Ocean Protect to update table 2-3 to include concentration results**	Complies, 16 events monitored. All exceptions (missed events) have been justified by Ocean Protect	Complies, 16 events monitored.	*Ocean Protect provided these results on 5th July 2024	Complies, 16 events monitored.
At a minimum 15 qualifying storm events must be sampled to ensure accurate evaluation	16 qualifying events were monitored with results show in Table 2-4. ***Table2-3 is missing results from the final monitoring event from the 23rd March 2023. Ocean Protect to update table 2-3 to include concentration results**	Complies	Complies	*Ocean Protect provided these results on 5th July 2024	Complies
Section 4.3 Description of Test Site (p14).					
Catchment area described	Site description is provided in Section 2.4 Catchment Characteristics and illustrated on Figure 2-4 of the Performance Report	Y	Y		Complies

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
	The site has an area of 680m^2				
Site shall be representative of the installation and land use appropriate to the device and intended market segments.	Site description in given in Section 2.4 Catchment Characteristics and illustrated on Figure 2-4 of the Performance Report. The site is a portion of car park at WSU with 100% asphalt/ imperious surface. The chosen site is reflective of the targets market as as majority of applications for device will be for areas with impervious surfaces like carparks	Y	y		Complies
Aerial photos provided	Illustrated on Figure 2-4	Y	Y		Complies
Site Photos	Illustrated on Figure 2-1	Y	Y		Complies
Site map showing: • Catchment area • Drainage system layout • Treatment device • Sampling points	Catchment was defined by land survey and site inspections. Site description including catchment area (680m^2) is detailed in section 2-4. The location of the treatment device is shown in figure 2-4 *t* within the performance report provided. Although sampling points are not clearly defined on figure 2-4 Influent and effluent sampling locations are clearly shown on Figure 2-2 *Schematic plan of StormFilter system.*	Y	y		Complies
Treatable flow rate (TFR)	Section 2.12.1 provided detail on the treatable flow rate of the device	Y	Y		Complies

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
	2.2L/s (1.1L/s for each of the StormFilter® NPSorb cartridges)				
Expected catchment flows	**Not presented within report**	**N**	Y – checked and seem within reasonable range		Complies
Section 4.4 Measuring Rainfall (p15)					
Rainfall ≤ 5 min time interval	Section 2.6.1, rainfall was measured at 1-minute intervals	Y	Y		Complies
Rainfall ≤ 0.25mm increments	Two 0.25mm resolution ISCO 674 tipping bucket-type rain gauges were used throughout monitoring	Y	Y		Complies
Rainfall - Location shown on site map	Rain gauge location is shown on Figure 2-2 *Layout Schematic-Plan* View and at Appendix A.	Y	Y		Complies
Rainfall shall be measured by a rain gauge (pluviometer) that is capable of sampling at intervals of 5 minutes or less, and in increments no greater than 0.25mm.	Section 2.6.1 details that rainfall was measures using two 0.25mm resolution ISCO 674 tipping bucket-type rain gauges at 1minute intervals	Y	Y		Complies
Rainfall - Checked, cleared of debris and calibrated at least two times during the testing period	Section 2.6.1 states that the rain gauge was installed and maintained according with the manufacturer's instructions and checked and cleared of debris regularly. The rain gauge was factory calibrated and does not require further calibration	Y	Y		Complies
Rainfall - Protected from excessive wind velocities	Section 2.6.1 states that the rain gauge was located on the shipping container and protected from excessive wind velocities that could	**Y**	y		Complies

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
	skew accuracy of measurement.				
4.5 Qualifying Storm Events (p15-16)					
Min 15 events qualifying events sampled	Results for all 16 qualifying storms at are provided in section 2.6.2 (refer Table 2-4)	Y	Y		Complies
Achieve at least 90% statistical significance between paired samples of influent and effluent (p15-16)	Section 2.11 and Table 2.11 show that the 'P-value' for the performance results at the site is < 0.001 for TSS, TP and TN which shows that > 90% confidence that the results are correct. Calculations for statistics if significance by Ocean Protect are provided within the StormFilter NPSorb WSU excel sheet. AWC has run own test of significance for TSS, TP and TN to confirm these results	Y	Y		Complies
Each monitoring program will need to identify the period delineating the end of one event and beginning of the next – typically 24hrs or the time taken to reset monitoring equipment	Table 2-3 and Individual Storm Reports (ISR) provide the date of each event and the sampling duration in hours.	Y	y		Complies
Hydrographs for each event to demonstrate the program has representatively captured the event	ISR that include storm hydrographs were provided to AWC on request via drop box link. AWC recommends these ISR be included in the performance report as appendices	Y	Y		Complies
Min 2 peak inflows from the sampled events should exceed 75% of the design TFR of the device + 1 ≥ than its design TFR	Section 3.13.1 identifies that the TFR for each of the StormFilter cartridges is 1.1 L/s. 2x cartridges equal 2.2L/s.	Y	y		Complies

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
	Table 2-3 shows that the TFR (2.2L/s) was exceeded on 11 of the 16 events. The peak flow rate of 5.44L/s (the maximum limit of the flow meter at the outlet) stated in section 2.13.1 was reached during 4 events (refer Table 2-3).				
Events to be sufficiently distributed throughout the monitoring period to capture seasonal influences on storm conditions & The independent evaluation panel must be satisfied that the qualifying storms includes a good range of storm event (longer and shorter duration) (p15-16)	As shown in Table 2-3 monitoring accrued from 4/10/2021 to 23/03/2023 16 events were captured over a range of seasons Number of events per season: Summer: 2 Autumn: 3 Winter: 2 Spring: 9 Storm events ranged from 0.2 to 69.2hrs with 13 storm events being longer than 8 hrs.	**Y**	Y		Complies
50% of qualifying storms should include the first 70% storm hydrograph coverage (p15-16)	Provided ISR and accompanying hydrographs along with Table 2-3 show that 11 of the storm events had <70% coverage	**Y**	Y		Complies
The majority of qualifying events (80%) at least 8 aliquots are required if discreet aliquots are being collected	As per Table 2-3, 100% of qualifying events had at least 8 aliquots. This is also shown in the storm hydrographs with each ISR	Y	Y		Complies
4.6 Flow Monitoring (p 17)					

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
Flow measurement at the inlet and outlet are recommended. Monitoring of bypass flows is optional, however, at a minimum the monitoring information should be sufficient to identify periods when device is operating in bypass (p17)	Flow monitoring undertaken at outlet only. Outflow monitoring included both treated and bypass flows. Monitoring at the inlet is only recommended not mandatory. Section 2.6.1 states that *"An ISCO 750 Bi-Directional Area Velocity Flow Module with a Low Profile Area Velocity Flow Sensor was connected to the ISCO 6712 effluent sampler for water level measurement only (not flow) inside the StormFilter chamber to determine if bypass occurs".* Bypass was deemed to of occurred when water level within the chamber was greater than the weir wall level. ISRs illustrate the relationship between water level within chamber and outflows. Overflow/ bypass occurs when water level exceeds the 'weir wall level'.	**Y**	y		Monitoring is acceptable
4.7 Sample location (p17)					
The inlet sample shall be taken as close as possible to the device, at a minimum this should be at a point where total site runoff is sampled	Figure 2-2 shows the influent sampling location after the catchment inlet pit and just prior to the treatment pit	**Y**	y		Complies
Outlet flow should be sampled either prior to or	Appendix A Schematic drawing of the	Y	y		Complies

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
after mixing with bypass flow and Claims identify the inclusions/exclusion of bypass flows (p17)	Performance Report, shows sampling locations. Section 2.6.1 reiterates this.				
If a claim is being made for performance including bypass, the contribution of bypass (if/when it occurs) shall be incorporated into the calculation of device efficiency (USEPA 2002) or design tools as appropriate	The performance claims (given in Table 3-3) are for the device up to TFR. When modelling performance in MUSIC, 'transfer functions' used (to model removal of TSS/TP/TN/GPs) up to the TFR (specified by the designer/ modeller).				OK, complies, guidance on modelling setup required.
The performance claim must be made in relation to the device up to TFR, and no removal can be claimed for the bypass flows.	The performance claims (refer Table 3-3) are for the device up to TFR. These claims are thus conservative as no removal of pollutants can be made for the bypass flows.		Agree		Complies
If the outlet flow is sampled prior to mixing with bypass flow it should be noted when the bypass condition occurs (but it is not necessary to measure bypass flows).	Bypass occurs when water level exceeds the weir wall overflow level	NA			Complies
4.9 Monitoring Equipment (p20)					
The potential for power failure and subsequent loss of samples should also be considered	See section 2.6.1. Power for the Equipment within the monitoring program is supplied by a single 12V DC battery recharged with a solar panel mounted to the roof of the shipping container				Complies
Evaluation of device performance requires measurement of stormwater inflow into the	Monitoring equipment described in Section 2.6.1. See below	y	y		Complies

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
device, outflow, stormwater quality, and rainfall. Equipment is required to measure rainfall, inflow and outflow volumes, and some method of determining the bypass volumes must be incorporated (measurement or calculation).					
4.9.1 Automatic Sampler (p20)					
Automated samplers are to be used for all water sampling, except where grab samples are required (i.e. to ensure timely sample preparation, preservation or monitor unstable parameters).	Influent and effluent water quality samples were collected using individual ISCO 6712 Portable Automated Samplers configured for 9.5 litre wide-mouth carboy bottles with disposable sample liners for sample collection	Y	y		Complies
4.10 Sampling Methodology (p20)					
As a minimum, flow-weighted composite samples should be collected utilising an automated sampler, whenever possible.	Composite samples are collected for both the influent and effluent via a 3/8th inch. ISCO suction line strainer. Composite samples are split on-site with BelArt Churn sample splitter to obtain necessary representative samples for analysis	Y	y		Complies
4.10.1 Automated Sampling (p20)					
Where the constituent being measured does not require grab sampling, automated sampling should be undertaken. Samples can be taken by automatic flow-weighted compositing, or discrete samples that can be composited later.	As above	Y	y		Complies

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4.10.2 Grab Sampling (p20)					
Grab sampling is required for constituents that transform rapidly, require special preservation. adhere to bottles, or where compositing can mask the presence of some contaminants through dilution	Reported analytes (refer table 2-4) do not deteriorate readily and thus the addition of preservatives are not required and no grab samples were undertaken during monitoring				Complies
4.10.3 Flow- Proportional Sampling (p21)					
Flow proportional sampling requires at least 80% of the submitted events have at least 8 aliquots collected from both the rising and falling limbs of the hydrograph to form the composite sample	ISR with accompanying hydrograph and Table 2-3 shows that all monitoring events sampled more than 8 aliquots. Aliquots were sampled from both the rising and falling limbs of the hydrograph	Y	y		Y
4.11 Sampling Quality Assurance and Quality Control (p21)					
Operation and maintenance schedules for sampling equipment (e.g. automated), flow monitoring and rainfall equipment shall be provided.	2x Ocean Protect WSU NPsorb Sampler Maintenance and Calibration documents dated 11th March 2022 and 18th August 2022.	Y	y		Complies
Sample blanks for field and analytical testing to be supplied	**Not provided to AWC. Ocean Protect to provide**	**N**	All samples were redacted making cross checking impossible	Redacted data was for a different product trial, so not applicable.	Complies
COC documents identifying sample collection, collection agency, collection time, preservation used, laboratory receipt of sample and sample collection shall be provided	Chain of Custodies (COC) have been provided to AWC separately via drop box link. Each COC provides detail on sample code, sampler, time collected and analysis required.	N	A couple of the samples were noted as 2 days late.		Minor non compliance
Laboratory Analysis 4.12 (p21)					
NATA accreditation	Section 2.6.1 states that samples were delivered	Y	y		Complies

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
	to ALS (a NATA-accredited laboratory) for analysis Sample Receipt Notifications (SRN) from ALS have also being provided.				
Method of analysis detailed should be detailed	Water quality analytical parameters and methods are detailed in Table 2-2	Y	y		Complies
4.12.1 Laboratory Quality Assurance and Control (p21)					
The laboratory should also be able to provide a suitable chain of custody documentation to identify sample receipt and condition, the samples should be properly labelled and stored pending testing, and holding times for samples should be observed.	COC and Analytical results by ALS have been provided to AWC separately via drop box link.	Y	y		Complies
4.12.2 Laboratory Data Management					
All documentation pertinent to undertaking field testing, sample collection and analysis, and reporting of results should be retained in full and presented in a logical and easy to follow format for evaluation.	COC have been provided to AWC separately via drop box link.	Y	Y		Complies
4.13 Reporting					
A Statutory Declaration disclosing the nature of any commercial relationship between the claimant and the report author (or its affiliates) and must be supplied.	Statutory declarations are provided to AWC separately via drop box link.	Y	Y		
5 1 Non-Detects (p23)					
Effluent sample results below the limit of detection (LOD) shall be set at 0.5 x LOD and must be accompanied by a sensitivity analysis showing impact on performance	Table 3 of the StormFilter NPSorb WSU excel sheet provided recorded flow and water quality data (and associated calculations) associated	Y	Y		Complies.

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
metrics of adopting both LOD and 0).	for WSU StormFilter monitoring and sensitivity analysis when recoded values were below LOD. Sensitivity analysis showing impact on performance metrics of adopting both LOD and 0) is also included for comparison.				
5.2 Framework for Reporting (p23)					
A Detailed Performance report (DPR) is required after the local pilot trial (LPT) is completed.	AWC is satisfied that requirements of reporting have been addressed within the provided Detail performance report for SQUIDEP review- StormFilter NPSorb (Ocean Protect, February 2024).	Y	y		Complies
5.3 Data Quality (p25)					
Representativeness, completeness and applicability of rainfall/ runoff	Section 2.12 of the performance report highlight how the monitoring program meet data quality requirements stated in SQUIDEP V1.3	Y	y		Complies
Values relative to the detection limits of the analytical methods applied					Complies
5.4.2 Performance metrics (p25)					
The pollutant removal capacity of a device needs to be consistent, and provided that suitable information is collected at the time of field trials, multiple metrics can be determined and should point to a consistent interpretation for the highest levels of confidence in evaluating results	Section 2-13 discusses performance metrics and highlights results of the monitoring program.	Y	y		Complies
5.4.3 Average and Median Concentration Removal efficiency (25)					

SQIDEP Requirement	Initial AWC comments	Compliance	Afflux Review	Ocean Protect Response	Final AWC comments / compliance
Pollutant Concentration Removal Efficiency (CRE) is computed to determine the reduction in pollutant concentration through a device.	The results for the 16 events are provided within Table 2-5. Calculations are provided in Table 3 of the spreadsheet provided by Ocean Protect.	Y	y		Complies
5.4.7 Efficiency Ratio (p28)					
The efficiency ratio (ER) is defined in terms of the difference between the average Event Mean Concentration of influent and effluent pollutants calculated over all of the analysed events.	The results for the 16 events are provided within Table 2-10. Calculations are provided in Table 3 of the spreadsheet provided by Ocean Protect.	Y	y		Complies
5.4.9 Event Mean Concentration (p30)					
Event Mean Concentration and Mass Discharge Variability (p30) The event mean concentration and Mass Discharge variability are required to verify the ability of the device to manage large variability in EMCs and mass discharges. Box and whisker plots should be prepared for influent and effluent EMCs as well as mass loads (where presented). The number of EMCs and mass loads contributing to each distribution should be clearly indicated.	Box and whisker plots for influent and effluent have been provided in Section 2.10 (refer figure 2-6). EMCs and mass loads contributing to each distribution have been indicated. Event Mean Concentrations (EMCs) are provided in Table 2-7 of the performance report.	Y	y		Complies
5.5 Statistical Significance testing (p 31)					
The statistical significance testing on influent and effluent data sets should be tested	Refer to Section 2.11 and spreadsheet sheet ' tab Statistical significance testing'	y	y		Complies