THE PROPRIETARY DEVICE EVALUATION PROTOCOL FOR STORMWATER TREATMENT IN THE AUCKLAND REGION

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ABSTRACT

Today, an ever growing selection of proprietary stormwater treatment devices are available to meet these and other challenges associated with stormwater management. However, the performance of many of these devices is not well documented. To aid in the evaluation of the performance of proprietary stormwater treatment devices, the Auckland Council has developed a stand alone assessment protocol. The Proprietary Device Evaluation Protocol (PDEP) was developed to streamline and make transparent the Auckland Council evaluation. Under PDEP, the manufacturer or vendor can make a claim based on the device's treatment performance, with relevant effectiveness assessment data and documentation. The Auckland Council then reviews application to determine if it substantiates the claim the manufacturer has made and certifies the performance claim. This paper provides an overview of PDEP, the evaluation process, and the information required to undertake the evaluation.

KEYWORDS

Proprietary device, stormwater treatment

INTRODUCTION

Historically, stormwater management in the Auckland region has been dominated by conventionally engineered inline and end-of-pipe devices. More recently, innovative technologies and pre-fabricated devices that can meet regulatory standards are included in the suite of best management practices for stormwater management in the region. As the demand increases, the variety of proprietary devices available to the stormwater management industry also increases.

The Auckland Council (AC) currently provides guidance to design stormwater management devices through *Stormwater management devices: design guideline manual* (Technical Publication No 10 - TP10) (ARC 2003). Chapter 15 broadly discusses the approach to field test a proprietary device and the information required with respect to device performance. Proprietors can submit information to the AC for approval. Currently, regulations within the Auckland region target 75% total suspended solids (TSS) removal. Consequently, to date

emphasis from industry has been to develop proprietary devices that meet 75% TSS and to obtain approval from AC that the device complies with that criteria.

Some uncertainty exists with respect to aspects in Chapter 15 due to the general nature of the guidance provisions and has led to variable information being submitted to the AC to approve proprietary devices. Consequently, a programme exists at the AC to develop a stand-alone Proprietary Device Evaluation Protocol. The protocol will make requirements more explicit, articulate timeframes clearly and provide added transparency to the evaluation process.

This paper presents the draft Proprietary Device Evaluation Protocol (PDEP). It outlines the application and evaluation process. A key change to this evaluation protocol is that devices can be evaluated for treatment of a range of contaminants, and for a range of efficiency of treatment. The vendor of the device is invited to submit a performance claim, which forms the basis of the evaluation. Two evaluation routes, Body of Evidence (BoE) or Local Pilot Trial (LPT), are explained. The sampling, laboratory, data management and report requirements are outlined. The criteria used in the detailed evaluation of device performance are provided.

1 EVALUATION FRAMEWORK

The PDEP addresses proprietary stormwater quality treatment devices that are installed on a permanent basis and provide stormwater quality treatment. It does not address stormwater quantity, or sediment and erosion control devices for construction sites.

The draft PDEP is divided into four main phases, starting with (1) the Application Phase, followed by (2) the Initial Evaluation Phase and then (3) a Detailed Evaluation Phase. If the device is approved, it can be installed in (4) the Auckland Region Performance Certification Phase. The process is shown graphically in Figure 1.

Evaluation of a device is initiated by the vendor or manufacturer of the device (vendor). The vendor prepares a Performance Claim against which the device is evaluated. A successful final outcome of the evaluation is Council certifying that the performance of the device likely meets this claim.

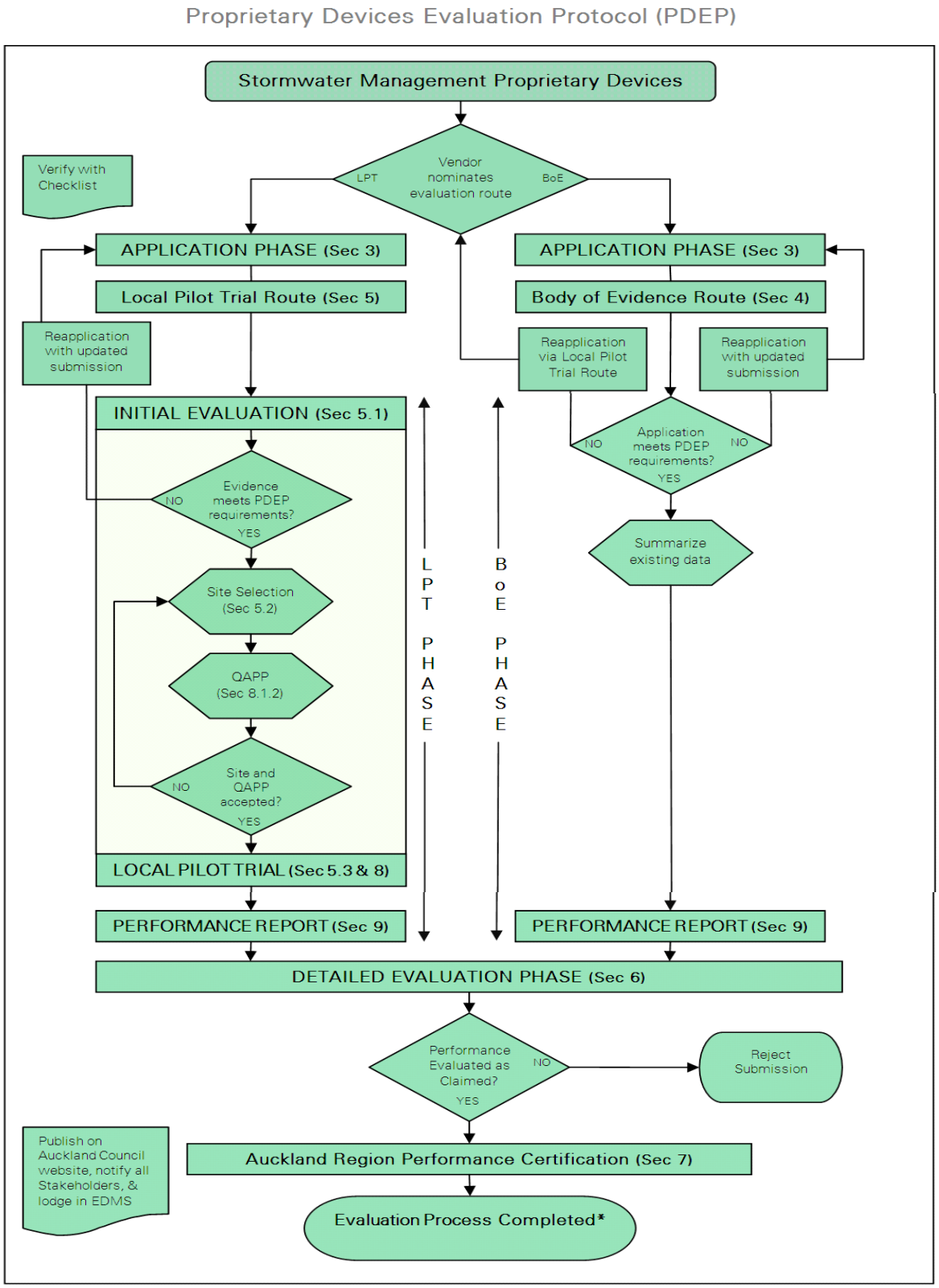
The information required to evaluate the device may be obtained by one of two routes. The first route is to supply information and data from trials undertaken outside the Auckland region, including internationally. This evaluation route is termed the Body of Evidence (BoE) route. The information for the BoE application must be in a format and relevant for conditions in the Auckland region (explained later in the paper). The second route information can be obtained by installing a device locally and undertaking field testing to obtain local data. This evaluation route is termed the Local Pilot Trial (LPT) route. The detail for each method is provided in PDEP, and an overview of the relevant sections is given.

2 APPLICATION PHASE

Both BoE and LPT routes commence with an Application Phase. The vendor must supply an Application Form and Application Report, and also complete their portion of an Application Checklist. The forms and checklists are in Appendix A of PDEP. There is a different checklist for BoE and LPT. The application report must contain detailed information on the device, its design, and its performance.

Once the application is received, the evaluator (who may be a Council officer or representative) reviews the Application Checklist to ensure all information requested has been provided. If information is missing, the Application is put on hold and missing information requested. Once the application has been checked as complete, the evaluator informs the vendor in writing that the Application Phase is complete.

Figure 1 Flow Chart



- *Proprietary Device Performance Evaluation Certification is valid for 5 years and may be renewed if the performance is still acceptable.
- Proprietary Device Performance Evaluation Certification will be required for any emerging contaminants that are discovered after issue.
- For application and evaluation fees see Table 1.

Information required for BoE route

Substantial information is required for the BoE route. This information is detailed in Table 1. BoE evidence may include laboratory tests using full scale devices, controlled field tests (these are evaluated as full scale lab tests), and field tests. In brief, validated data from a minimum of 15 test runs (laboratory trials) or 15 qualifying storms (field tests) must be provided. Field test data may be provided from a single site or several sites – again depending upon the relevance of the site characteristics and data captured for the Auckland region. Where more than one site contributes to the data, data must be obtained from a minimum of eight qualifying storms per site. Criteria for qualifying storms are given in Section 8.1.6 of PDEP. An important aspect is that the particle size distribution (PSD) of the stormwater runoff influent and effluent must be provided to allow comparison with local conditions. Without this information, this type of data cannot be considered in the evaluation.

Supporting information on site characteristics, methods of sampling (autosampler, with some exceptions), flow, and precipitation measurement, laboratory analysis, equipment calibration, and data QA and QC must also be provided. Reporting requirements, including performance and methods for calculating removal efficiency, are detailed in PDEP. Information supplied for a BoE evaluation must meet all of these requirements to enable the application to be evaluated under the BoE route.

Table 1 BoE information requirements (PDEP Table 2)

Requirements	Field Evidence Criteria	Full Scale Laboratory Evidence Criteria
Sampling Events		
Type of Event	Rainfall Events[1]	Test Runs[2]
Minimum Number of Events	Total of 15[3]	15
Minimum Rainfall Depth	Total event rainfall depth ≥5mm	3 tests each at a constant flow rate of 25, 50, 75, 100, and 125 percent of the treatment flow rate; loaded with an initial sediment loading of 50% of the unit's capture capacity
Minimum Storm Duration	1 hour	
Minimum Interevent Time	6 hours	
Device Size	Full Scale	Full Scale
Runoff Characteristics	Particle size distribution of influent and effluent	Particle size distribution of influent and effluent
Sampling Procedures and Techniques		
Automated Sampling	Composite samples on a flow weighted basis OR Discrete samples which are composited later	
Minimum Number of Aliquots	8 per event (refer Section 8.1.8))	
Manual Sampling	Only for constituents that transforms rapidly, require special preservation or adhere to bottles, or where compositing can mask the presence of some contaminants through dilution. See Section 8.1.8.1 for details.	
Sampling Location	Maximum mixing of flow or in a zone of well-mixed flow,[4]	
Analytical Methods	Various (refer to Table 4 in Section 8.1.1 for details)	
SSC	ASTM Method D 3977-97 (If SSC provided instead of TSS, provide converted TSS with method and calculations of conversion)	
TSS Concentration	APHA (2005) 2540 D modified* (See Table 4 in Section 8.1.1 for details)	
Requirements	**Field Evidence Criteria**	**Full Scale Laboratory Evidence Criteria**
Flow Measurement Location	Inlet, Outlet and Bypass, as applicable	
Precipitation Measurement	Automatic rain gauge, OR historic monthly mean rainfall from nearest site	N/A
Recording Intervals	5 minutes or less	
Recording Increments	No greater than 0.01 inches (0.25mm)	
Rain Gauge Calibration	Twice during verification period	

1 Must not Include Controlled Field Tests. See Section 4.2 for the definition of controlled field tests.
2 Includes Controlled Field Tests. See Section 4.2 for the definition of controlled field tests.
3 15 from 1 site or minimum of 8 per site if >1 site is used
[4] As close as possible to the device inlet and/or outlet, mid- depth, except hydrocarbons, or other light nonaqueous phase liquids

Data Analysis and Reporting		
Performance Indicators	Based on the Performance Claim stated in AP Report. (Can include but not limited to TSS, Metals, TPH, TP & TKN)	
Performance Indicators Calculation	1. Percent Removal *(Arithmetic average and median. If difference is 10% or greater, inspect data set closely) (See Section 8)* 2. Relative Achievable Efficiency *(Arithmetic average and median. If difference is 10% or greater, inspect data set closely) (See Section 8)*	Individual removal efficiency of each test run; average runs for each operating rate; average for all runs
Performance Variability Schematics	Box and Whisker Plot	
Statistical Significance Testing	Log-transformed inlet and outlet paired samples at 90% confidence level	
Sizing Methodology	See Section 8.2 of the PDEP	

*****For detailed description of the sampling and analysis minimum requirements, refer Section 8.

3 INITIAL EVALUATION PHASE - LPT

Obtaining information for a LPT consists of several steps. First, information supplied with the application is subject to an initial desktop evaluation. This is performed to determine if there is enough confidence the device will function to allow it to be installed for a LPT. Next, a suitable trial site is identified by the vendor and approved by the evaluator. A Quality Assurance Project Plan (QAPP) is developed by the vendor and approved by the evaluator. Then, the device is installed and subjected to field testing and data collection.

Information required for the initial evaluation is described in Section 5.1 of the PDEP. This information may be theoretical, full-scale laboratory or controlled field trials, field trials, or a combination of all of the above. This information may be similar to that required for a BoE evaluation, but insufficient to meet BoE requirements.

A site is selected with characteristics that match that described in the Performance Claim. Sites may be characterised as Residential and Commercial; Roads, Highways & Trafficked; and Industrial. Stormwater on the site must have minimum concentrations of contaminants before treatment; these concentrations are provided in PDEP. Once a site is selected, a QAPP must be developed in accordance with the requirements of PDEP Section 8.1.2. A resource consent to install and operate the device should be sought at this stage, if applicable.

For field testing, the vendor must comply with all the requirements of Section 8 of PDEP. The QAPP must be followed, to ensure the methods and procedures for sampling and analysis are documented, and test data is valid. A minimum of 15 qualifying storms must be sampled within two years, or a time extension must be sought. Once data collection is complete, it must be analysed and reported in accordance with requirements detailed in PDEP.

QAPP and Reporting Requirements

The vendor's performance claim forms the basis of performance monitoring, by specifying the contaminants the device is targeting eg TSS, dissolved contaminants, gross pollutants, oil and grease, nutrients. The intended use of the device eg pre-treatment, basic TSS, operation and maintenance requirements, and method for sizing the device all need to be included in the performance claim. The contaminants provided in the performance claim are used to determine the appropriate sampling and analytical methods.

A QAPP is prepared by the vendor before any field monitoring project is commenced, and is revised and amended through the life of the project. The QAPP's objective is to ensure methods and procedures are followed and documented to ensure data obtained is valid for verification of device performance. The QAPP includes data quality objectives, roles and responsibilities, description of test sites, qualifying storm events sampled, sampling equipment, methods and location, sampling quality assurance (QA) and quality control (QC), laboratory analysis, QA and QC, data management methods and reporting requirements. Each of these components is detailed in PDEP.

The reporting requirements of PDEP are very explicit. The report submitted must address sampling details (date, time, location, rainfall), comparison of sampling and storm results to criteria in PDEP, influent and effluent contaminant concentration, statistical data evaluation, and a discussion of results, including whether QAPP objectives were met and any deviation from the QAPP. PDEP details how results are to be analysed and reported. Non-detects are to be reported at laboratory detection limits. Percent removal of contaminants can be calculated by concentration removal efficiency (CRE), mass reduction efficiency (MRE) and relative achievable efficiency (RAE). The procedure for each of these is provided in PDEP.

The report provided with the BoE application, or produced following a LPT project, proceeds to the Detailed Evaluation Phase of the evaluation. The information supplied for BoE must meet the same reporting requirements as LPT where relevant.

4 DETAILED EVALUATION PHASE

Both BoE and LPT applications are now subjected to a Detailed Evaluation. The evaluation is undertaken by an evaluator, who provides recommendations to an evaluation panel. The evaluation panel may be made up of Council technical staff and/or independent third party experts.

The Detailed Evaluation Phase utilises an evaluation matrix to score devices. The evaluation matrix contains several main criteria, within each of which there are multiple facets. The PDEP focuses on criteria and facets that affect device performance (performance criteria), but allows for potential purchasers to score each device on other criteria (operational criteria). In some instances, the same criteria will be used, but different facets emphasised or different weighting applied to the scoring. These are summarized in Table 2.

Table 2 Detailed Evaluation Criteria (PDEP Table 3 pg 19)

Criteria	Performance	Operational
Removal efficiency	✓	
Performance Reliability	✓	
Land Uses and Limits of Application	✓	
Pre-treatment	✓	
Sizing Methodology	✓	
Constructability	✓	✓
Cost		✓
Operation and Maintenance	✓	✓
Reliability of treatment mechanism	✓	
Other factors		✓

Scoring guidance for each matrix is provided within the matrix. Some criteria are evaluated in both matrices but the facets used to evaluate devices are different for each purpose.

The performance matrix is used to evaluate whether a device passes its evaluation. Where a facet of a criteria is critical to device performance, the score ranges from zero to ten, and if the facet is not met the device scores a zero and fails the evaluation. For non-critical facets, the score ranges from one to ten, with one being poor and ten excellent of fully met. An example of a scoring sheet is provided in Table 3.

Table 3 Matrix sheet

Contact
Product
Date

1 → 10

Poor sizing methodology & poor representativeness in flow regime

Good sizing methodolog good representativeness flow regime

NOTE if any scores are 0, the application has failed. More information has to be provided for the application to proceed.

Item	Sizing Methodology	Selection	Score Guidance	Device Score
1	Is a sizing methodology provided for the device?	• No	0	
		• Yes	10	
2	Is the sizing methodology adequately justified?	• No	0	
		• Yes	10	
3	Is the sizing methodology appropriate for the treatment mechanism?	• No	0	
		• Yes	10	
4	What is the level of pollutant removal at design flow?	• The removal efficiency does not equate to the performance claim.	0	
		• The removal efficiency is the same as the performance claim.	10	
5	What proportion of the TP10 Water Quality requirement does the device sizing methodology treat?	• The proportion over TP10 Water Quality Volume/ Flow Rate requirements represented in percentage and divide it by 10	100	
6	What is the Rainfall runoff model used?	• Proprietor selected (Rational, Modified Rational, etc)	3	
		• Continuous simluation of at least 20 years of rainfall record at one representative station	5	
		• ARC endorsed and reviewed Hec-HMS	8	
		• ARC endorsed TP108	8	
		• Continuous simluation using ARC endorsed representative rainfall data	10	
7	What is the design residence time in the entire system?(Can the minimum residence time/ contact time be defined for each treatment mechanism?)	• Less than the minimum demonstrated in the supporting evidence to achieve the performance claim.	0	
		• The minimum demonstrated in the supporting evidence to achieve the performance claim.	10	
8	Has the scaling effects of the device been accounted for in the sizing methodology?	• No	0	
		• Yes	10	
		• N/A	10	
9	Is there a catelogue of all device models? Information contained in the catelogue shall include dimensions and specifications of the device models and their model name.	• No	1	
		• Yes	10	
10	Is scour or by-pass accounted for in the device design?	• No	0	
		• Partially	1	
		• Yes	10	
11	Does the scour or by-pass flow consideration adequately demonstrates minimal resuspension of captured contaminants?	• No	1	
		• Partially	5	
		• Yes	10	
12	Has the design flow regime predicted by the sizing methodology been validated with a monitored storm event?	• No	1	
		• Yes	10	
13	What is the level of confidence in sizing methodology?	• Express the percentage of confidence interval in the sizing methodology and divide it by 10.	1-100%	

The operational criteria are not used to score device performance, The operational scoring matrix is provided so that owners and operators of the device, who could be private entities or local authorities, can evaluate factors other than contaminant removal efficiency eg constructability, maintenance requirements and cost. The evaluator can weight criteria according to the requirements of the organization.

The advantages of using the scoring matrices are that they provide clear guidance for evaluators, they provide consistent and repeatable scoring of devices, and allow different devices to be compared at a glance.

5 AUCKLAND REGION PERFORMANCE CERTIFICATION

If the recommendation of the evaluator and the decision of the evaluation panel agree that the device is likely to perform to the standard stated in the Performance Claim, an Auckland Region Performance Certificate will be issued. The Auckland Region Performance Certificate is valid for five (5) years, and will contain provisions regarding the device e.g. the device may have been assessed for pre-treatment. The Auckland Region Performance Certificate acts like a warrant of fitness. If, during the five years the certificate is valid, devices that are installed meet the Performance Claim, the vendor can apply for re-certification, which will likely be granted. If a device is not meeting the Performance Claim, or other unforeseen issues arise, the Auckland Region Performance Certificate will not be renewed. In this case, the vendor may modify the device or the Performance Claim and re-apply.

During the five years the certificate is valid, device performance will be assessed through compliance with consent conditions. Furthermore, the Council may choose to monitor, at random, devices that have been installed, to confirm performance is as claimed by the vendor.

Acknowledgements:

PDEP co-authors: Grace Wong, Consultant; Elizabeth Fassman, University of Auckland; Tommy Wells, URS.

References

Auckland Regional Council (ARC) (2003). *Stormwater management devices: design guideline manual*. Auckland Regional Council Technical Publication 10.

Wong, G., Ansen, J., Fassman, E., Wells, T. (in prep) *Proprietary Device Evaluation Protocol*. Auckland Council Guideline Document GD2011/003.