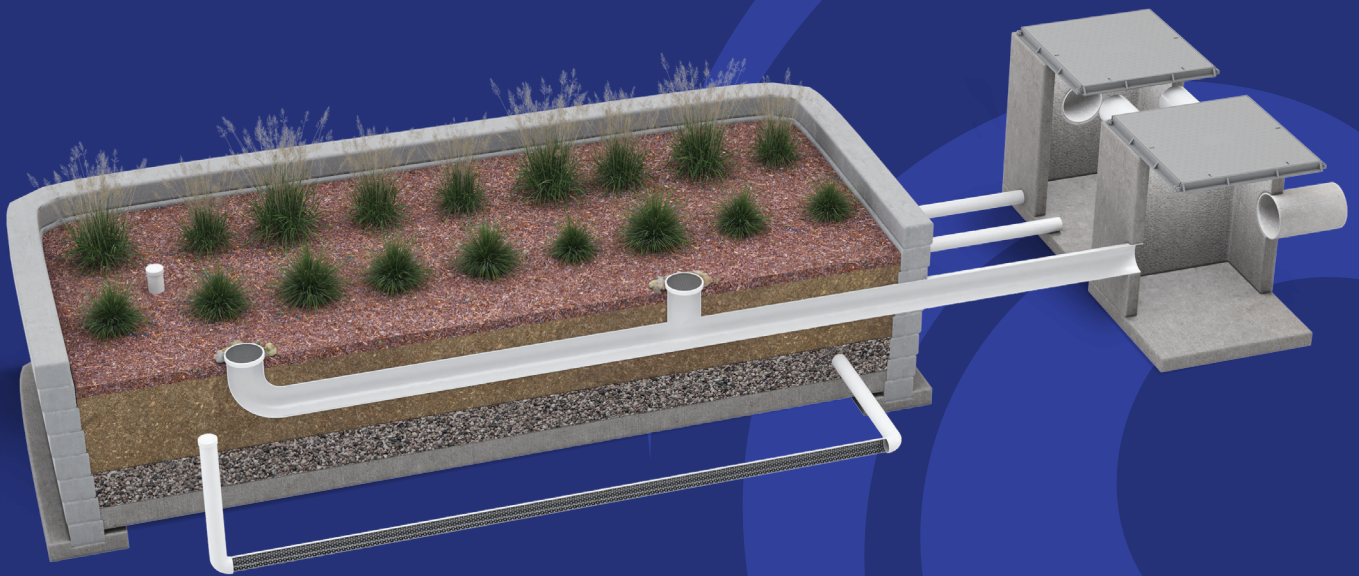


# Filterterra®

## Technical Design Guide



Stopping Pollution Entering Waterways



**[www.oceanprotect.com.au](http://www.oceanprotect.com.au)**

Introduction	3
Operational Overview	4
Features	5
Configurations	6
Performance and Select Approvals	8
Maintenance and Activation	8
Design Basics	9



## Introduction

Filtterra® is Ocean Protect's engineered high flow, high-performance biofiltration system. While it operates similarly to traditional biofiltration systems, its high-flow media allows for a reduction in footprint (as low as 0.3% of catchment area). Filtterra® provides all the benefits of typical biofiltration systems whilst being ideal for tight, highly developed sites, urban development projects, commercial parking lots, residential streets, and streetscapes.

Its small footprint reduces installation costs whilst still maintaining comparable life cycle costs compared with traditional bioretention. It can be configured in a variety of ways to integrate with other Water Sensitive Urban Design (WSUD) practices, whilst also enhancing site aesthetics. Additionally, it can increase runoff reduction through infiltration below or downstream of the system.



# Operational Overview

During a storm, stormwater enters the Filterra® biofiltration system through a pipe, kerb inlet, or sheet flow and ponds over the pre-treatment mulch layer, capturing heavy sediment and debris. Organics and microorganisms within the mulch layer trap and degrade metals and hydrocarbons. The mulch also provides a water retention function for the system's vegetation.

Stormwater then flows through the engineered high flow media, filtering fine pollutants and nutrients. Organic material in the media remove dissolved metals and act as a food source for root-zone microorganisms. Treated water exits through an underdrain pipe or infiltrates (if designed accordingly).

Microorganisms in the root-zone digest and transform pollutants into forms easily absorbed by plants regenerating the media's pollutant removal capacity. As roots grow, they provide a hospitable environment for the root-zone microorganisms and penetrate the media, maintaining hydraulic conductivity.

The plant trunk and foliage utilise nutrients such as Nitrogen and Phosphorus for plant health, sequester heavy metals into the biomass, and provide evapotranspiration of residual water within the system.

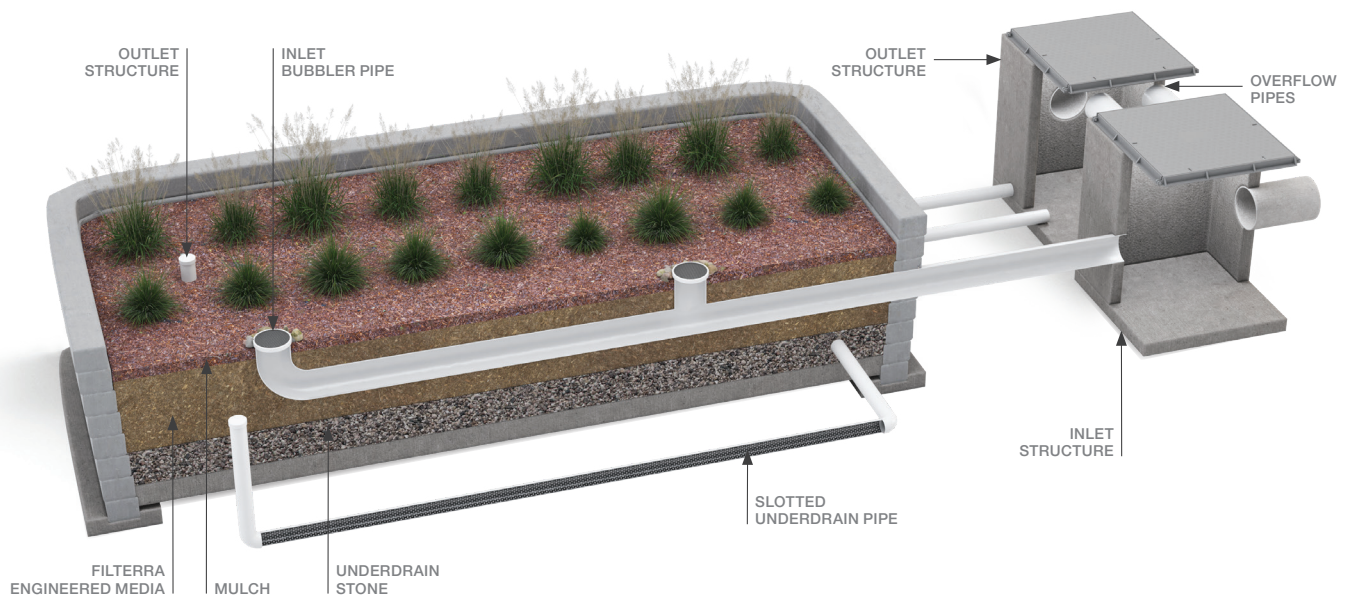


Figure 1: Filterra® components



# Features

Similar to traditional biofiltration system, a Filterra® biofiltration system consists of multiple layers. They are the mulch layer, Filterra® media layer and underdrain layer (see Figure 2).

*Please Note: A minimum 150mm of extended detention depth is required for Filterra® biofiltration systems*

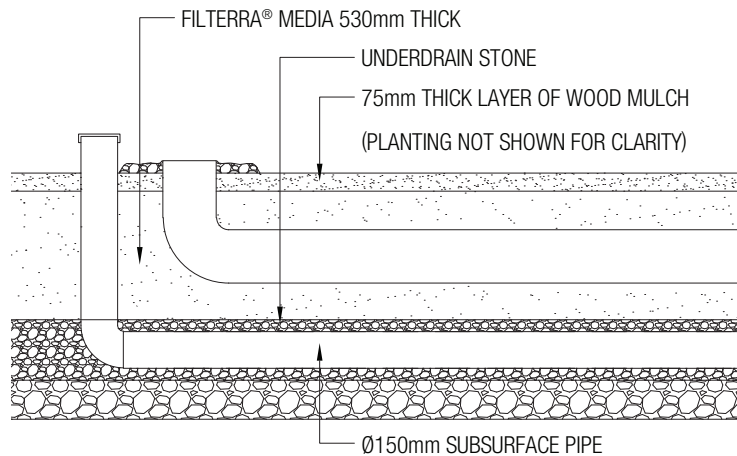


Figure 2: Filterra® sectional view

## Mulch Layer

A double shredded hardwood mulch layer is used to protect the media and assists with plant health. This mulch layer essentially acts as a Gross Pollutant Trap by capturing coarse sediment, litter and debris whilst maintaining the moisture in the media below. This layer is typically 75mm thick.

## Underdrain

The underdrain stone is tested for particle size distribution (PSD) to ensure permeability, proper bridging of media, and is further scrutinised to guarantee that no materials are present that could harm the vegetation. This layer ranges from 150 to 300mm thick, based on overall system size.

## Planting

A range of native plants are available for the Filterra® biofiltration system. Table A-1 of the report *A review of the application of Filterra® Biofiltration Systems in Australia* outlines the recommended plant species across the filter media of Filterra® biofiltration systems within Australia. Contact the Ocean Protect engineering team or your local representative for further information.

## Filterra® Media

The Filterra® media is a high flow, high quality media designed to provide optimised pollutant removal while maintaining excellent hydraulic capacity. This layer is typically 530mm thick.

The media, manufactured by Ocean Protect under strict Quality Assurance and Quality Control processes, ensures rigorous calibration and testing through every step of new media production. No other biofiltration media in Australia is produced to same exacting methods or can provide the same level of consistency across a particular batch or different manufacturing facilities. Media blends are assigned batch numbers and receive a quality control certification. The following parameters are verified and controlled:

- Particle size distribution (PSD)
- Moisture
- Organic content
- Bulk density
- Porosity
- Cation exchange capacity
- pH
- Fertility

# Configurations

The Filterra® biofiltration system can be arranged in a couple of ways such that it suits the site specific requirements for flow rate, hydraulics, accessibility and footprint restrictions. The standard configurations offered by Ocean Protect include pre-cast concrete tree-pits and bioscape in-situ construction.

## Precast Filterra® Biofiltration System

Pre-cast concrete Filterra® biofiltration systems house the media and associated components within pits or vaults. These systems are simple to install as they arrive on site after being manufactured offsite to suit site specific requirements (pipe size, inlet/outlet orientation, levels etc.).

The Filterra® tree-pit is installed along the kerb line at grade immediately upstream of a separate bypass pit. Once the storm event exceeds the design capacity of the Filterra® the excess flow proceeds along the kerb and is collected by the bypass pit shown in *Figure 3*.

In some cases, the Filterra® tree-pit may need to be located with a grated drain entry or away from the kerb as shown in *Figure 4*. In this instance, a transition box is used to convey water from the kerb to the Filterra® tree-pit.



*Figure 3: Filterra® tree pit – kerb inlet*



*Figure 4: Filterra® tree pit – grated drain inlet*

Typically, larger storms are bypassed around the Filterra® biofiltration system, however in some cases the bypass may be conveyed via a small pipe through Filterra® tree-pit system, for example small downpipe applications, see *Figure 5* below.



*Figure 5: Filterra® tree pit – with internal bypass*



## Filterra® Bioscape System

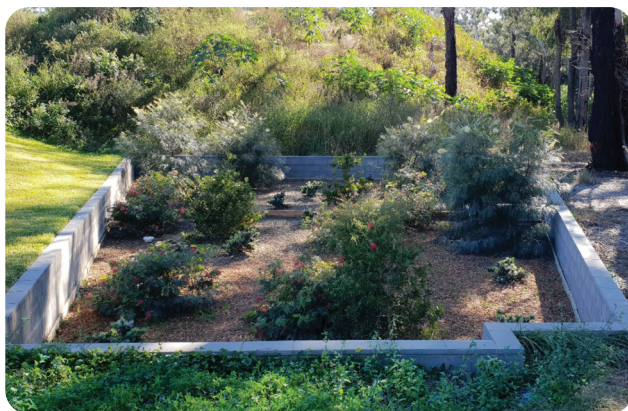
The Filterra® bioscape system utilises impermeable liners placed within an excavation to create the media holding structure. The Filterra® media, underdrain and associated distribution and collection systems are installed within this structure by Ocean Protect.

The finished edges of the system can have a variety of finishes, such as timber sleepers, logs, sandstone blocks, brick or blocks with capping stone or cast in situ concrete edging. Alternatively earth bunding is also possible provided there is delineation and no contamination between the surrounding soil and Filterra® media, see *Figure 6* below.

Within larger Filterra® bioscape systems the total filtration area is divided into “cells”. Each individual cell is design to have a maximum area of 90m<sup>2</sup>. Typically timber sleepers form the dividing walls between each cell (see *Figures 6 & 7* below).



*Figure 6: Filterra® bioscape – soft edging*



*Figure 7: Filterra® bioscape – hard edging*



# Performance and Select Approvals

While laboratory testing provides a means to generate hydraulic and basic performance data, all filtration devices should also be complemented with long-term field data evaluations. As a minimum, field studies should generally comply with a recognised field testing protocol, for example, the Technology Acceptance Reciprocity Partnership (TARP) or the Technology Assessment Protocol – Ecology (TAPE) in the USA.

To be considered valid, all field monitoring programs should be peer reviewed by a reputable third party and replicate local pollutant concentrations including soluble fractions of nutrients together with rainfall. Such field testing has been undertaken both locally in Australia and overseas. Further information on these studies is available in *A review of the application of Filterra® Biofiltration Systems in Australia*.

Specifically, Filterra® biofiltration systems have been accepted by some of the most stringent stormwater quality regulators around the globe including:

- Brisbane City Council
- Blacktown City Council
- Wollondilly Shire Council
- Washington State Department of Ecology (TAPE) GULD – Basic, Phosphorus
- New Jersey Department of Environmental Protection (NJ DEP)
- North Carolina Department of Environmental Quality (NC DEQ)
- Maine Department of Environmental Protection (ME DEP)

Please contact your Ocean Protect representative to obtain the approval status for Filterra® biofiltration systems in your area.

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## Maintenance and Activation

Every manufactured filtration device will eventually need routine maintenance. The question is how often and how much it will cost. Proper evaluation of long-term maintenance costs should be a consideration when selecting a manufactured treatment device.

Filterra® maintenance is low-cost, low-tech and straight forward. Simply remove the accumulated litter and sediment plus the mulch layer and replace with a fresh 75mm layer of QA/QC mulch approved by Ocean Protect. There is no confined space entry or special tools required and the mulch does not have to be purchased from Ocean Protect.

With proper and routine maintenance, the engineered media should offer a comparable life span to traditional bioretention media. Routine maintenance is included by Ocean Protect for the first year after activation. This includes a maximum of two visits to remove debris, replace mulch layer, and prune the vegetation.

For further information please refer to the *Filterra® Operations and Maintenance Manual*.

Ocean Protect provides a full install and activation service for Filterra®. This is undertaken by trained and certified personnel to ensure that the Filterra® system is installed correctly and that all of the necessary requirements are met (supervised installation options are also available for special circumstances). Included in the full installation service is the onsite activation of the Filterra® system by Ocean Protect. This will only occur once the site is fully stabilised and all drainage lines have been flushed clean. Up until the point of activation it is the responsibility of those on site to ensure adequate protection of the system.

# Design Basics

The design requirements of any Filterra® system is detailed in 3 typical steps:

- 1 Hydraulic Design
- 2 Water Quality Design
- 3 Planting Design

## 1 Hydraulic Design

All Filterra® systems must be designed to ensure that the hydraulic requirements of the system are met without adversely impacting the upstream hydraulics (limiting the likelihood of localised flooding). **All Filterra® systems must be designed in an offline configuration.**

Kerb inlet Filterra® systems **require a bypass pit directly downstream** to ensure higher flows are bypassed along the kerb line. Ensure the kerb inlet to Filterra® system is on-grade (no sag) and that the flow enters the unit parallel to the kerb line or adjacent to the inlet to eliminate any likelihood of scour.

Base flow or constant dry weather flows will blind and foul any biofiltration system as a result of having organic material and nutrients within the media. Be sure to consider if a low-flow bypass is required for your system. Special surface treatments such as recessed converter slabs are available for applications that are required to match a paved or landscaping scheme. Contact Ocean Protect engineering team for further details.

## 2 Water Quality Design

Ocean Protect recommends and uses the widely endorsed Model for Urban Stormwater Improvement Conceptualisation (MUSIC), which makes it easy to correctly sizing an appropriate Filterra® system for your site.

A complimentary design service which includes MUSIC modelling is provided by the Ocean Protect engineering team. Simply email your project details to [design@oceanprotect.com.au](mailto:design@oceanprotect.com.au) or alternatively you can always call one of our engineers for a discussion or to arrange a meeting in your office. The team will provide you with an efficient design containing details of the devices required to meet your water quality objectives together with budget estimates, product drawings and the MUSIC (.sqz) file.

The Filterra® biofiltration systems can be modelled in MUSIC in one of two ways. These are:

1. Firstly, using a bioretention treatment node as shown in *Table 1* below, or
2. Using the generic approved node by your local jurisdiction

Parameter	Unit	Value	Comments
<b>Inlet properties</b>			
Low-flow bypass	m <sup>3</sup> /s	0	All flows enter system
High-flow bypass	m <sup>3</sup> /s	100	Default value Overflow of high flows determined by system storage
<b>Storage properties</b>			
Extended detention depth	mm	150	
Surface area	m <sup>2</sup>	XXX	Cannot be less than 0.3% of catchment
<b>Filter and media properties</b>			
Filter area	m <sup>2</sup>	XXX	Cannot be less than 0.3% of catchment
Unlined filter media perimeter	m	N/A	Zero exfiltration assumed
Saturated hydraulic conductivity	mm/hour	3550	Design rate
Filter depth	m	0.53	Standard spec.
Total Nitrogen (TN) content	mg/kg	500	Standard spec. from laboratory tests of Filtterra® filter media
Orthophosphate content	mg/kg	1	Standard spec. from laboratory tests of Filtterra® Result is <0.1 (LOR)
<b>Infiltration properties</b>			
Exfiltration rate	mm/hr	0	Zero exfiltration assumed
<b>Vegetation properties</b>			
Plant selection	-	'vegetated with nutrient effective plants'	Standard spec
<b>Outlet properties</b>			
Overflow weir width	m	XXX	Estimated on system size
Underdrain present	-	Yes	
Submerged zone with carbon present	-	No	

Table 1: Filtterra® Biofiltration node properties in MUSIC

When designing/modelling a Filtterra® biofiltration system using a generic treatment node, two (2) treatment nodes are typically utilised in series. These are the detention/sedimentation node located immediately upstream of a generic treatment node.

For the detention node there are a number of parameters that need to be entered to ensure the node is representative of its effectiveness within the treatment train: surface area, extended detention depth, k-values, equivalent pipe diameter etc. For guidance on all of these variables, please refer to the report *A review of the application of Filtterra® Biofiltration Systems in Australia* or contact Ocean Protect.

For the generic treatment node, relevant removal efficiencies are inserted. These parameters can vary based on the jurisdiction (authority) of your project – and relevant details can be obtained from Ocean Protect. The high-flow bypass figure is adjusted within the node to represent the treatable flow rate required to obtain water quality objectives. Once finalised, this figure can be divided by the relevant square meter flow rate for Filtterra® to obtain the filtration surface area required.

All details such as drawings, specifications and maintenance manuals can also be downloaded for integration into your project's documentation. Additionally, the Ocean Protect team is available to review your model and provide additional assistance and guidance on the configuration of the Filtterra® system(s) for your project.



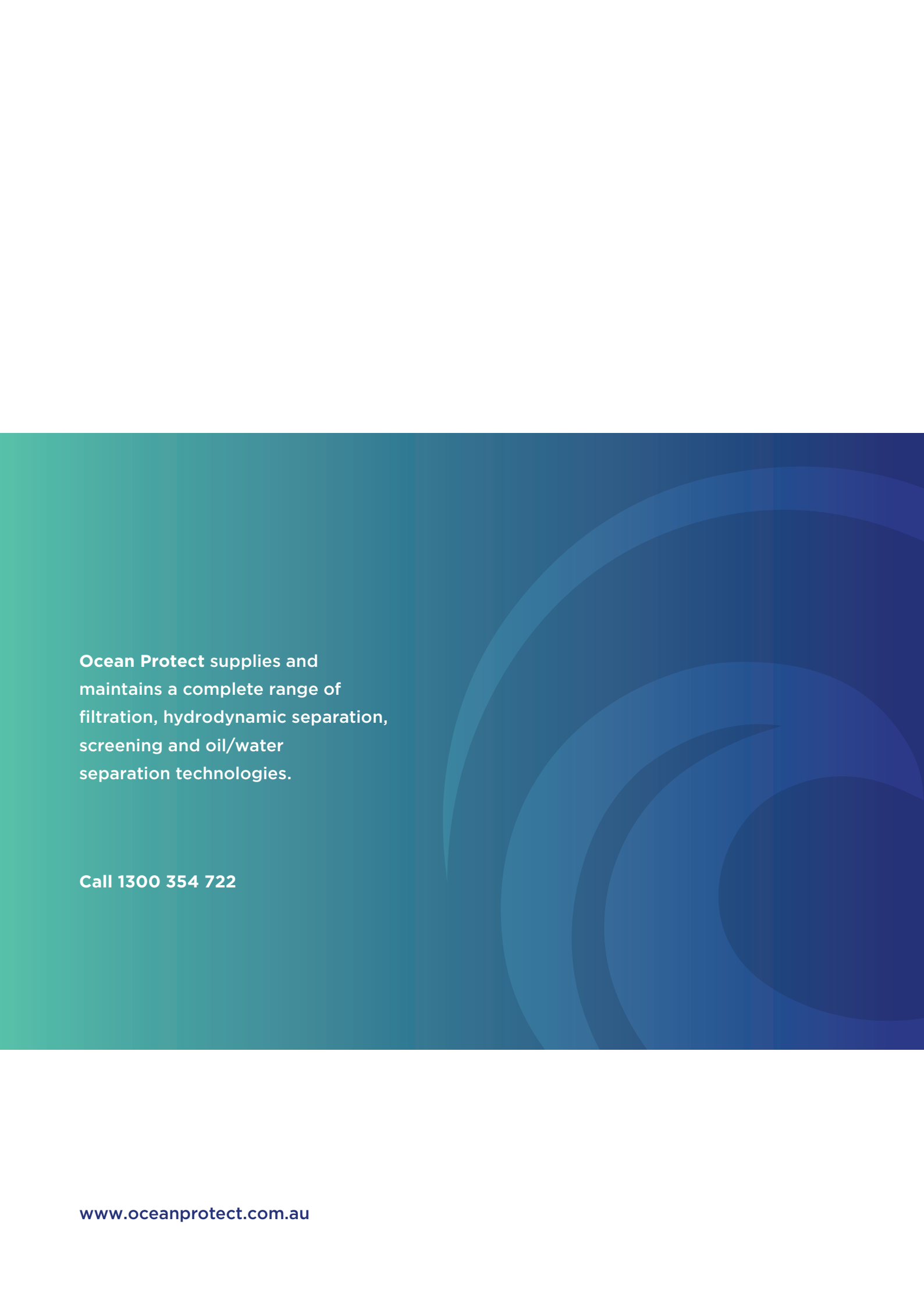
### 3 Planting Design

Filtterra® systems require both vegetation and media to function properly. When evaluating the quantity and size of plantings, it is essential that system aesthetics are weighed against the overall perform of the system.

For appropriate planting, Filtterra® biofiltration systems must have the following:

- Adequate access to undertake maintenance
- Adequate plant spacing to prevent roots from matting together
- Adequate sunlight necessary to sustain plantings and aid in evapotranspiration following storm events whilst minimising the drying out of the media

A combination of trees, shrubs and grasses is recommended and Ocean Protect has a comprehensive suite of recommended plant species. Recommended plants take into consideration attributes like hardiness, longevity and water quality benefits along with the expected adult size and growing region. For guidance on the available options please refer to Table A-1 of the report *A review of the application of Filtterra® Biofiltration Systems in Australia* or contact Ocean Protect.



**Ocean Protect** supplies and maintains a complete range of filtration, hydrodynamic separation, screening and oil/water separation technologies.

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