FAWB
Facility for Advancing
Water Biofiltration

FACILITY FOR ADVANCING WATER BIOFILTRATION, FAWB

FINAL REPORT 2005-2008

CONTENTS

ACKNOWLEDGEMENTS

The Facility for Advancing Water Biofiltration, FAWB, acknowledges with thanks the support, assistance and enthusiastic commitments from:

Victorian State Government
Department of Innovation, Industry and Regional Development

Joint Venture Participants
EDAW (successor to Ecological Engineering)
Monash University

Industry Collaborators
Adelaide and Mount Lofty Ranges Natural Resources Management Board, SA
Auckland Regional Council, New Zealand (to 30 June 2006)
Brisbane City Council, Qld
Landcom, NSW
Manningham City Council, Vic
Melbourne Water Corporation, Vic
VicRoads, Vic

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Collaborator Representatives
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(Alternate, Mr Graham Rooney, Melbourne Water)
Ms Marianne Robertson, VicRoads (succeeding Ms Armineh Mardirossian, Landcom – NSW)
EDAW Representatives
Dr Peter Breen
Mr Malcolm Eadie
Monash University Representatives
Dr Tim Fletcher
Prof Bill Young
Prof Xiao-Ling Zhao

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Mr Claude Cullino, Manningham City Council (Alternate Mr Andrew Allan)
Mr Keith Downard, Adelaide and Mount Lofty Ranges Natural Resources Management Board
Mr Matthew Napper, Landcom - NSW (succeeding Mr Stuart McCowan and Ms Armineh Mardirossian)
Ms Marianne Robertson, VicRoads
Mr Graham Rooney, Melbourne Water (Alternates Mr Jake Moore and Mr Toby Prosser)
Mr Earl Shaver, Auckland Regional Council

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Prof Jenny Dixon,The University of Auckland
Mr Earl Shaver, Auckland Regional Council
Panel for 2007-2008
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Dr Frans van de Ven, Delft University of Technology, and
Emeritus Prof Barry T Hart, Water Science Pty Ltd

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Ms Noi Souvandi, Civil Engineering
Mr Alan Taylor, Civil Engineering
Mr Frank Winston, Civil Engineering

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Mr Sébastien Le Coustumer, INSA de Lyon and Monash University

Ms Susan Van de Meene, Monash University

Ms Anke Wendelborn, Monash University

Mr Yaron Zinger, Monash University

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INTRODUCTION - WHAT IS WATER BIOFILTRATION?

Water biofiltration is the process of improving water (stormwater and wastewater) quality by filtering the water through biologically influenced media.

Stormwater biofiltration systems include:

- Bioretention systems
- Constructed surface-flow wetlands
- Constructed sub-surface-flow wetlands

A typical biofiltration system consists of a vegetated swale or basin, overlaying a filter medium (usually soil-based) with a drainage pipe at the bottom (Figure 1). Small bioretention pods are often referred to as rain gardens, while linear systems are commonly referred to as bioretention swales. The design configuration of biofilters is flexible, and possible variations include removal of the underdrain (to promote exfiltration into the surrounding soil) and the inclusion of a permanently wet, anoxic zone at the bottom (to further enhance nitrogen removal).

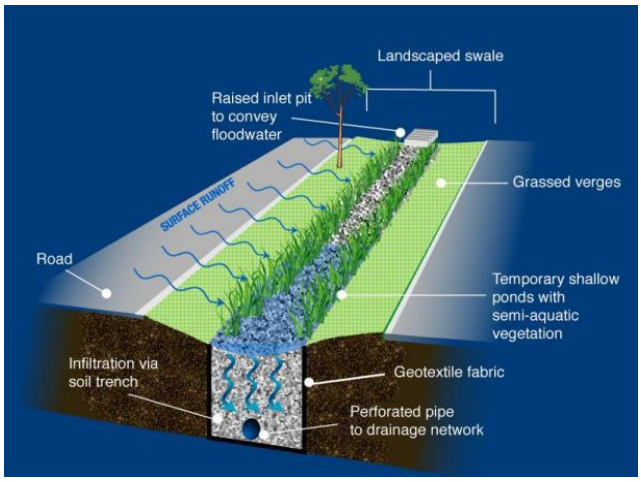


Figure 1. Schematic of a Typical Biofilter (Bioretention System)

Figure 2. Existing biofilter, Victoria Park, Sydney (Landcom)

There have been a number of successful applications of biofiltration, but also many poor outcomes owing to inappropriate utilisation of the technology, poor construction, operation and maintenance practices. There has also been insufficient understanding and dissemination of guidance on biofiltration borne out of successful applications, and research and development.

When used appropriately, biofiltration systems have been found to be viable and sustainable as a water treatment measure. Biofiltration systems also add to the quality of the landscape through the integration of these vegetated systems.

Launch of FAWB and Opening of Monash Carpark Biofilter 17 October 2006 by Mr Matt Viney, MP, Parliamentary Secretary for Industry and Innovation, pictured with FAWB CEO Dr Tony Wong

BACKGROUND, MISSION AND MAIN AIMS

Background

The Facility for Advancing Water Biofiltration, FAWB, is an unincorporated joint venture between EDAW (formerly with Ecological Engineering, which became a Practice Area of EDAW from July 2007) and Monash University. The joint venture was formed in mid-2005 following a successful application in the Victorian State Government's Strategic Innovation Initiative.

The following industry collaborators are also involved:

- Brisbane City Council (Qld)
- Adelaide and Mount Lofty Ranges Natural Resources Management Board (SA)
- Landcom (NSW)
- Manningham City Council (Vic)
- Melbourne Water (Vic)
- VicRoads (Vic)

(The Auckland Regional Council, New Zealand, participated as a collaborator to 30 June 2006.)

FAWB also has active collaboration arrangements (on-going joint research projects) with INSALyon, a leading Engineering School in France, and with Luleå University of Technology in Sweden.

FAWB is primarily funded through the Victorian State Government's Science, Technology and Innovation (STI) grant ($1.46 million), industry cash contributions ($0.5 million) and a direct cash contribution from Monash University ($0.35 million). The total value of the activities within FAWB, including both cash and in-kind contributions, is $4.3 million over three years.

As part of the STI Grant Application, FAWB developed a comprehensive Business Plan. This plan incorporates detailed research and marketing plans, with the opportunity to update the Plan on an annual basis.

Mission

FAWB's mission is to provide proof of concept by developing and field-testing a range of biofilter systems that can be applied to specific market-based needs. This includes the needs of catchment managers, environmental regulators, public utilities, local governments, land developers, and design engineers.

Main Aims

The main aims of FAWB are to:

- Provide scientific "proof of concept" for the application of stormwater biofilter technologies
- Facilitate industry-wide adoption and implementation of the technology

The specific outcomes of FAWB's work will be innovative stormwater biofilter technologies underpinned by:

- New scientific knowledge about the key physical, chemical, and biological performances which underpin the effectiveness of stormwater biofilters
- Design specifications for biofilters that form the basis for written technical design, construction and maintenance guidelines to accompany legislation/regulation
- Algorithms that assist the design of biofilters for a wide range of applications
- Prototypes of modular units for specific applications (e.g. devices for stormwater treatment and re-use at the level of an individual household or a single commercial site)

Session at FAWB Annual Workshop, November 2007

CONTRIBUTION OF FAWB TO STI OUTCOME MEASURES

Project Overview

6. Project Overview
Describe how the Project has supported the Innovation Economy attributes and contributes to your organisation's objectives. Include the project's key success measures and results. Outline your organisation's ongoing strategy in relation to the project (e.g. ongoing research, demonstration phase, product development).

Support to Innovation Economy attributes and contribution to FAWB's organisation's objectives.

Innovation Economy Attributes

The key Innovation Economy Attributes that the STI Initiative aimed to address were:

- Educated and highly skilled workforce
- Leaders in knowledge creation and innovation
- Integrated and networked local economy
- High levels of enterprise formation and business growth
- Internationally integrated economy
- Business environment and infrastructure base that facilitates business success

Organisation's objectives - Main Aims (FAWB Business Plan)

The main aims of FAWB are to:

- Provide scientific "proof of concept" for the application of stormwater biofilter technologies
- Facilitate industry-wide adoption and implementation of the technology

Innovation Economy attribute	***How FAWB has supported the Innovation Economy attributes and contributed to FAWB's objectives***
Educated and highly skilled workforce	Training of postgraduates, Workshop training of industry and industry participants Collaborative activity with industry participants (each of the above contributing industry-wide adoption and implementation of the technology)
Leaders in knowledge creation and innovation	FAWB established at forefront of biofiltration research and innovation. Indicated by: • International collaboration • Publications • Visits by specialists to FAWB • Support by collaborators for further work • Advisory work by FAWB • Research Review findings (providing an independent view how FAWB has provided scientific "proof of concept" for the application of stormwater biofilter technologies)
Integrated and networked local economy	Strong involvement with local industry, especially stakeholder organisations Involvement of consultants and other organisations in training workshops etc Public good stance has assisted development of local expert groups eg industry teams [eg Melbourne Water] , research groups and consulting firms
High levels of enterprise formation and business growth	FAWB contributes actively to the formation and growth of water industry enterprises by providing public dissemination of research findings and technology for water biofiltration. Vehicles for contributions to business growth have included the Australian Water Association, Australia's largest water industry association with more than 3500 individual members and 600 corporate or utility members, the Stormwater Industry Association, and Clearwater, Vic.
Internationally integrated economy	Collaborative links with: • INSA Lyon, France • Delft University of Technology, The Netherlands • University of Sheffield, others in UK incl Prof Malcolm Cresser, York Univ • UNESCO • Singapore Public Utilities Board Further integration into international economy with transition to EDAW(a global enterprise) as a participant in the Joint Venture via Ecological Engineering, a founding participant.
Business environment and infrastructure base that facilitates business success	Assisting business adoption and access to latest findings via Public good stance on dissemination of findings and adoption in demonstration projects with collaborators. Improving infrastructure for land development and water management via research program for more effective water management. Public awareness activities pursued to raise awareness of biofiltration systems and the benefits to environmental and water management from its adoption. Extending support for biofiltration with land development and water industry.

Project's key success measures and results.

Extract from FAWB Business Plan

3. BUSINESS MODEL

The project's success will be judged by partners, and by other stakeholders, if it can:

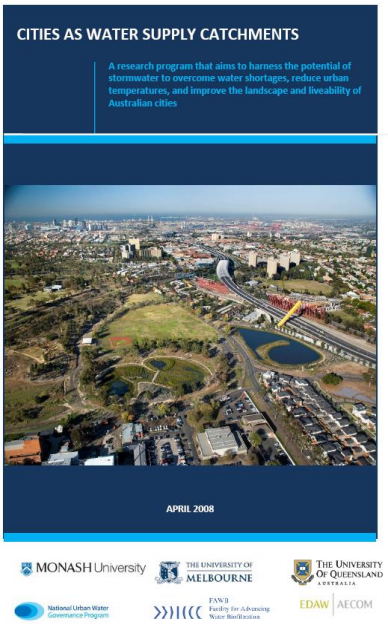
- establish the efficacy of biofilter technologies;
- provide guidelines for their deployment;
- develop software tools for modeling/developing site specific applications;
- communicate the benefits of biofiltration to all relevant stakeholder groups; and
- obtain a broader community "sign on" to the associated costs and benefits of these technologies.

FAWB's key success measures	***Results***
Establish the efficacy of biofilter technologies	FAWB research, demonstration and testing has been directed at developing effective biofiltration systems. The 2007 Research Review by eminent international specialists, commented on the 'proof of concept' being achieved by FAWB.
Provide guidelines for their deployment	Guidelines for biofilter technologies include FAWB web-based materials on soil filter media, hydraulic conductivity, and key messages. Workshops on 'designing rain gardens' have been held in 2007 and 2008 in Melbourne, Sydney, Adelaide and Perth/Albany. Comprehensive summary findings and notes were distributed.
Develop software tools for modelling/developing site specific applications	Software tools are continuing to be developed in Project 3: Adoption Tools
Communicate the benefits of biofiltration to all relevant stakeholder groups	In addition to the series of workshops noted above, extensive briefings to stakeholder groups have been pursued [as noted under the table on page ???] Collaborator stakeholders have actively participated in stakeholder meetings and FAWB annual workshops in which biofiltration findings have been communicated.
Obtain a broader community "sign on" to the associated costs and benefits of these technologies	Support by major industry collaborators including Brisbane City Council, Landcom- NSW, Melbourne Water, and VicRoads to provide extensive biofilter technologies in their infrastructure projects has confirmed 'sign on' by a broad group.

FAWB's ongoing strategy in relation to its project (e.g. ongoing research, demonstration phase, product development).

Collaboration with proposal for future research – 'Cities as Water Supply Catchments'

FAWB staff have led the development of a proposal for future research. The proposal, entitled 'Cities as Water Supply Catchments', combines expertise from EDAW and several faculties at Monash University, and also involves the active collaboration of specialists from The University of Melbourne and The University of Queensland.



An extensive schedule of presentations to potential water industry partners or stakeholders has been undertaken by the FAWB leadership group, particularly during April to June 2008. (The table of 'Presentations or Briefings to Government, Industry, Research and other Organisations 2005-2008' lists presentations on the proposals for 'Cities as Water Supply Catchments'.)

Negotiations with potential participants are proceeding.

CONTRIBUTION OF FAWB TO STI OUTCOME MEASURES (CON'T)

Science, technology and innovation skills base

1. **Science, technology and innovation skills base** Describe how the project has contributed to the advancement of Victoria's science, technology and innovation skills base. This would, for example, include information on employment and training such as expansion in the number of qualified professionals with specific skills; training courses conducted and numbers of attendees, attraction and retention of leaders in the field, ongoing impact expected from the project.

FAWB's contribution to the advancement of Victoria's science, technology and innovation skills base

FAWB has contributed to Victoria's science, technology and innovation skills base through its:

- Highly regarded research, as shown by the 2007 Research Review, and support by Collaborators
- Demonstration projects
- Adoption activities including guidelines and website
- Collaboration and other active linkages between industry and research, and research group to research group
- Innovations via research eg findings on technology - vegetation/plants, treatment performance, soil media, anoxic zone
- Strategic planning as a basis for further research eg 'Cities as water supply catchments'

Employment and training - expansion of qualified professionals with specific skills

Postgraduates and Visiting Scholars – FAWB 2005-2008

Training of postgraduates has been an integral part of FAWB's education and training program. As indicated in the following tables, six postgraduates have worked on FAWB-related projects. In addition, there have been four visiting overseas scholars.

Postgraduates, 2005-2008

Name	University	Type of postgraduate enrolment (PhD, MEngSc etc)	Supervisor(s)	Funding source(s) ARC /Uni/etc	Topic
Godecke Blecken	Luleå University of Technology, Sweden	PhD	Assoc Prof A. Deletic (Monash) Prof M. Viklander (Lulea)	Exchange Student at Monash, for part of 2006-2007	Biofilter treatment of stormwater
Dale Browne	Monash	PhD	Assoc Prof A. Deletic (Monash) Dr T. Fletcher (Monash) Dr G. Mudd (Monash)	MDS*	Predicting and modelling the clogging of stormwater infiltration systems
Belinda Hatt	Monash	PhD	Assoc Prof A. Deletic (Monash) Dr T. Fletcher (Monash) Dr P. Webley (Monash)	MDS*/James McNeill scholarship	Filtration technologies for stormwater harvesting
Sébastien Le Coustumer	Institut National des Sciences Appliquees (INSA) de Lyon.	PhD (enrolled at both INSA and Monash University)	Dr S Barraud (Lyon) Assoc Prof A. Deletic (Monash) Dr T. Fletcher (Monash)	Cotutelle Program, France/ MDS*	Measurement and modelling of hydraulic and environmental performance of urban stormwater infiltration systems
Anke Wendelborn	Monash	PhD	Dr G. Mudd (Monash) Assoc Prof A. Deletic (Monash) Assoc Prof P. Dillon (Flinders, SA/CSIRO)	MDS*	Stormwater injection aquifer storage and recovery in Melbourne and associated water quality issues.
Yaron Zinger	Monash	PhD	Assoc Prof A. Deletic (Monash) Dr T. Fletcher (Monash)	MDS*/MGS§	Advancing stormwater biofilter technologies

* Monash Departmental Scholarship § Monash Graduate Scholarship

FAWB Postgraduates (June 2007)
(L to R): Dale Browne, Godecke Blecken, Belinda Hatt and Yaron Zinger

Higher Degrees Completed and Destinations of Postgraduates, 2005-2008

Name	Degree, University	Supervisor(s)	Topic	Date Thesis Submitted/ Passed	Destination
Belinda Hatt	PhD, Monash	Assoc Prof A. Deletic (Monash) Dr T. Fletcher (Monash) Dr P. Webley (Monash)	Filtration technologies for stormwater harvesting	December 2007/ May 2008	Lecturer - Dept of Civil Engineering, Monash University
Anke Wendelborn	PhD, Monash	Dr G. Mudd (Monash) Assoc Prof A. Deletic (Monash) Assoc Prof P. Dillon (Flinders, SA/CSIRO)	Zinc and copper behaviour during stormwater aquifer storage and recovery in sandy aquifers.	May 2008/	

Visiting Scholars, 2005-2008

Name	University	Type of enrolment	Supervisor(s)	Funding source(s) ARC /Uni/etc	Topic
Lucie Alcazar	Institut National des Sciences Appliquées (INSA) de Lyon.	Undergraduate	Assoc Prof A. Deletic and Dr T. Fletcher, (Monash)	Exchange student (to October 2007)	Treatment of pathogens by biofiltration.
Katia Bratières	Institut National des Sciences Appliquées (INSA) de Lyon.	Undergraduate	Dr T. Fletcher (Monash)	Exchange student (2007)	Impact of design parameters and operating conditions on nutrient removal by biofilters.
Elen Devauchelle	Institut National des Sciences Appliquées (INSA) de Lyon.	Undergraduate	Assoc Prof A. Deletic and Dr T. Fletcher, (Monash)	Exchange student (from April 2008)	Porous pavements and biofilters
Christelle Schang	Institut National des Sciences Appliquées (INSA) de Lyon.	Undergraduate	Assoc Prof A. Deletic and Dr T. Fletcher, (Monash)	Exchange student (from April 2008)	Porous pavements and biofilters

INSA de Lyon, France, researchers
(L-R) Sébastien Le Coustumer, Elen Devauchelle, Katia Bratières, Christelle Schang

Training courses conducted and numbers of attendees,

Training seminar and workshop, September 2007

Assoc Prof Ana Deletic, Dr Tom Fletcher and Ms Belinda Hatt presented a one-day seminar, arranged in conjunction with Clearwater, on 4 September 2007 attended by over 70 people from local government, state departments and consulting. The seminar presented a comprehensive summary of the key research findings from Projects 1 and 4.

Dr Tim Fletcher at training seminar, 4 September 2007

Dr Tony Wong, Dr Sara Lloyd, Dr Robin Allison, Georgie Wettenhall and Kerrie Burge from Ecological Engineering/EDAW ran a one-day design workshop on biofilters on 5 September 2007 attended by 30 people. The workshop, also arranged in conjunction with Clearwater, was very 'hands-on'. Attendees had been invited to bring in their projects as case studies. Working in small groups, the workshop focussed on applying the research insights presented in the previous day to their projects.

Project groups at design workshop, 5 September 2007

FAWB Training Workshops, June 2008

FAWB staff, led by CEO Dr Tony Wong, presented training workshops to stakeholder groups in South Australia, New South Wales and Western Australia. The two-day workshops provided an update on FAWB research findings and gave training in the design of biofilters.

A report entitled 'Advancing the Design of Stormwater Biofiltration, June 2008' was prepared for the workshops. The purpose of this document was to provide a summary of FAWB's findings to date on biofiltration.

The workshops were held on the following dates, with attendances per day as listed:

Location, Date	Attendance per day	Participating Organisations
Adelaide, SA, 3-4 June 2008	47, 30	Stormwater Industry Association, SA; Adelaide and Mt Lofty Ranges Natural Resources Management Board; FAWB; EDAW; Monash / National Wine Centre, Adelaide, SA
Sydney, NSW, 10-12 June 2008	115, 29, 24	Sydney Metropolitan Catchment Management Authority; FAWB; EDAW; Monash / Waterview Convention Centre: Bicentennial Park, Sydney Olympic Park, Sydney, NSW
Perth, WA, 17-18 June 2008	78, 29	Department of Water, WA; FAWB; EDAW; Monash / Bayswater City Council, Bayswater, Perth, WA
Albany, WA, 19-20 June 2008	21,16	Department of Water, WA; FAWB; EDAW; Monash / Midds Bluewater Restaurant, Middleton Beach Albany, WA

Attraction and retention of leaders in the field

FAWB has attracted a group of leaders in its formation and on-going activities.

CEO Dr Tony Wong, Research Manager Assoc Prof Ana Deletic, and project leaders and participants including Assoc Prof Rebekah Brown, Dr Belinda Hatt and Dr Peter Breen have established international reputations in the field as indicated by their extensive publications. (*please refer to 'Publications'*)

Speakers at launch and seminar of report on 'Transition to WSUD', July 2008.
L-R: Dr Tony Wong - FAWB CEO, Mr Rob Skinner – MD Melbourne Water,
Assoc Prof Rebekah Brown – FAWB Project Leader, Prof Russell Mein – FAWB Chair

Ongoing impact expected from the project

An ongoing impact and benefit to local government, land development industry and the water industry is expected with:

- Increased certainty about the design, operation and maintenance requirements of biofilters (through new designs and biofilter demonstration installations). Councils will have greater certainty in biofilter performance also (assisting their role as regulators). The flexible biofilter technology will assist them to provide retrofitting of roads to current environmental standards.
- Potential for increased harvesting of urban stormwater providing valuable additions to the available water supply in Australia cities
- Improved amenity of land developments with greater use of sustainable water management and increased attractiveness through lakes, wetlands and other water-based features using biofiltration to remove pollutants and provide suitable and visually attractive treatment processes.

The expected impact and benefits of FAWB's activities build on the:

- Commitment of a core of trained professionals in biofiltration technology, as shown by the FAWB training sessions.
- Wide awareness of biofiltration technology and its performance and application, developed through extensive briefings, seminars, workshops, conference presentations and technical publications.
- Strong interaction with participating collaborator organisations and the instalment and demonstration of biofilters as part of their ongoing infrastructure.

CONTRIBUTION OF FAWB TO STI OUTCOME MEASURES (CONT'D)

Collaboration outcomes

4. Collaboration outcomes
Describe how the project has delivered new levels of collaboration and how this has benefited Victoria. This might include new consortia, partnerships or clusters between and/or amongst government agencies, industry stakeholders, research institutes and universities. It would describe arrangements developed for other organisations to access or benefit from the project or its facilities, including benefits gained from engendering greater critical mass or economy of scale.

New levels of collaboration

FAWB has delivered new levels of collaboration involving local, interstate and international participants and stakeholders.

The collaboration involved a new participant in the FAWB joint venture with EDAW, a global organisation, succeeding the founding participant, Ecological Engineering.

The project collaborators have been a diverse group with a direct stake in the successful application of biofilters for the environmental management of urban water.

With the inclusion of the participant organisations in the FAWB joint venture, this group covers the research institutions (Monash University), environmental management consultants (EDAW/Ecological Engineering), land developers (Landcom), local governments (City of Manningham and Brisbane City Council), public utilities (VicRoads and Melbourne Water), and regional catchment managers (Adelaide & Mount Lofty Ranges Natural Resources Management Board, Melbourne Water, and to 30 June 2006, Auckland Regional Council).

All collaborators have been represented in the FAWB Stakeholders Advisory Group, established primarily to advise FAWB on research needs. Collaborators have also been consulted extensively on industry engagement matters to facilitate industry-wide adoption of the technologies.

Local and interstate cooperative links

Participants and Collaborators

FAWB linkages between its Joint Venture Participants, EDAW (succeeding Ecological Engineering) and Monash University, were strengthened over the period since the project was initiated in 2005.

The interactions and links between the FAWB Participants and Collaborators:

- Adelaide and Mount Lofty Ranges Natural Resources Management Board, SA
- Brisbane City Council, Qld
- Landcom, NSW
- Manningham City Council, Vic
- Melbourne Water, Vic
- VicRoads, Vic

were also enhanced. In particular, there was continuing active collaboration in demonstration projects, workshops, research papers, and general awareness raising and adoption activities.

Access by Collaborators and other stakeholders to FAWB findings in biofilter technology and adoption was facilitated at a number of levels including direct staff interaction on specific projects, particularly demonstration projects provided by Collaborators; stakeholder briefings and tours associated wth the Stakeholders Advisory Committee; seminars and workshops, particularly training workshops on 'rain gardens' or biofilter design.

Dr Tony Wong advising participants at Adelaide 'rain gardens' workshop, June 2008

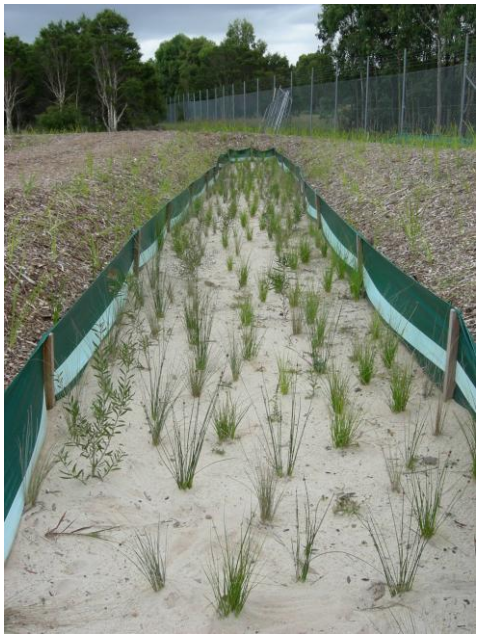
These design training workshops were set up in conjunction with local branches of the stormwater industry association and the Melbourne municipal-association based 'Clearwater' and were thus widely accessible by consultants and other organisations outside the FAWB joint venture. The FAWB website was another point of access to FAWB findings.
Specific activities with FAWB Collaborators are discussed below. As indicated, there were substantial benefits to FAWB in terms of increased access to substantial biofilter installations for demonstration and testing, and networking with more extensive networks of professionals, particularly in the water and environmental fields. Economies of scale were also achieved in providing the training and awareness raising via existing industry association networks.

Adelaide and Mount Lofty Ranges Natural Resources Management Board, SA
The Adelaide and Mount Lofty Ranges Natural Resources Management Board, SA, has contributed to raising awareness of biofilter technologies in its region through its participation in FAWB workshops and stakeholder meetings. It was a co-sponsor with the Stormwater Association of South Australia for the FAWB training workshop on 'Advancing the Design of Stormwater Biofiltration' held in Adelaide in June 2008.

Brisbane City Council
Brisbane City Council has been pursuing construction of the Wakerley Bioretention System with FAWB guidance and has maintained an extensive monitoring program for the demonstration facility. Stormwater pods were also constructed and formed a pivotal part of FAWB's demonstration and testing project. Brisbane staff joined with FAWB researchers from Monash in producing conference papers on the research and technology adoption experiences with stormwater gardens in Brisbane.


BCC and FAWB working together to test the Saturn Crescent bio-pod, Brisbane

Landcom - NSW
Landcom has strongly maintained its collaboration, including its continuing commitment to the installation and operation of a demonstration biofilter at Second Ponds Creek and associated salinity studies at Jacaranda Rise. Additional cash funding was provided to support FAWB's research and monitoring role for these installations. Landcom was also a co-sponsor with the Stormwater Association of New South Wates for the FAWB workshop on 'Advancing the Design of Stormwater Biofiltration' held in Sydney in June 2008.



Second Ponds Creek Bioretention System, Sydney NSW

Manningham City Council

Manningham City Council contributed to the governance of FAWB through the role of its representative, Mr Claude Cullino, as a Collaborator Representative on the FAWB Board. Links with FAWB were also demonstrated in Manningham's projects at a number of sites including the Ruffey Lake Park Carpark. Manningham was also instrumental in arranging in 2008 for briefings of its Council and executive staff by FAWB on FAWB research findings and proposals for future research.

Melbourne Water

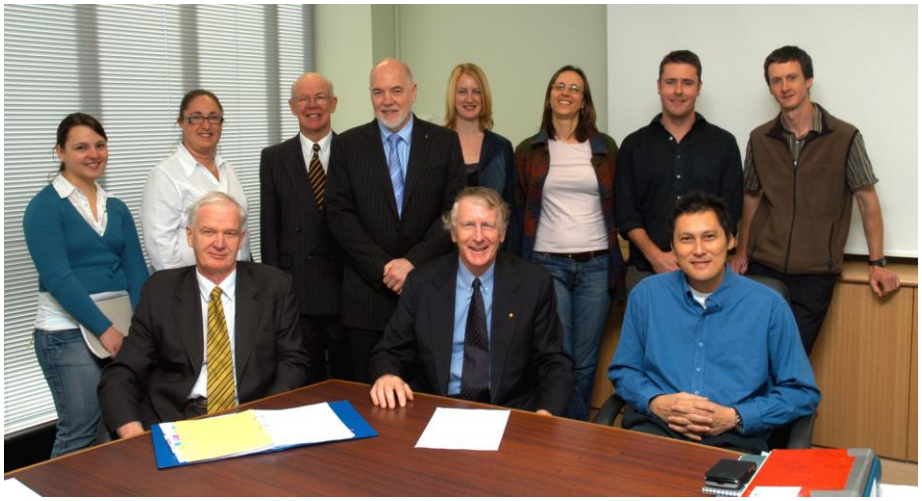
Melbourne Water provided associated cash funding for additional tests on alternative bioflIter soil media. This was in addition to funding already arranged for work by visiting scholar from France, Lucie Alcazar on 'Biofilter pathogen removal experiments', and for studies and a report to Melbourne Water on hydraulic conductivity. Through its funding of Clearwater, a not-for-profit organisation that aims to accelerate the uptake of sustainable urban water management, Melbourne Water contributed to the training workshops on 'Rain gardens design' run by FAWB in conjunction with Clearwater over two days in September 2007. Melbourne Water was also active in providing access to biofilter installations in connection with FAWB's demonstration and testing project, and as part of its in-kind commitment as a FAWB collaborator. Access to large-scale biofilter installations was also provided by Melbourne Water.

Lucie Alcazar researching pathogen removal from biofillters

VicRoads

VicRoads has continued its program of installing biofilters in its substantial roadworks projects. FAWB was provided access to biofilter facilities at Hallam, Doncaster Park & Ride, Geelong Bypass, Craigieburn and Fitzgerald Road. These sites represent a major component of the in-kind contributions from FAWB collaborators.

VicRoads also contributed to the strategic direction of FAWB through the role of its representative, Ms Marianne Robertson, as a Collaborator Representative on the FAWB Board.



FAWB Board Members and participants, September 2007,
including Collaborator representatives Marianne Robertson (VicRoads) (3rd from left)
and Claude Cullino (Manningham City Council) (5th from left)

Joint Activity - Annual Workshops

Annual workshops, with an emphasis on research planning, have been a pivotal way of enhancing the linkages and interaction with collaborators and other stakeholders.

Annual workshops were held in December 2005, September 2006, and November 2007. There was increasing participation from local and interstate collaborators over the period with over 50 attending in 2007. The 2006 and 2007 workshops were designed as a part of FAWB's Research Review being undertaken in each of those years, so the Research Review Panels took an active part in the workshops.

The November 2007 annual research workshop was also notable for the participation by industry (mainly our industry collaborators, and also people from other water industry organisations) and a number of international visitors, including members of the Research Review Panel.

FAWB team at Workshop, December 2005

FAWB team at Workshop, September 2006.

Participants at FAWB Workshop, November 2007

International collaborative links

Collaborative linkages were established by FAWB with new consortia such as the UK-based Pennine Water Group, government agencies such as the Dutch Ministry of Water Resources, industry stakeholders including the Singapore Department of Water Resources, and research institutes and universities, for example, the Institut National des Sciences Appliquées (INSA), Lyon, France.

The principal international collaborative links were with:

- Lulea University of Technology (Lulea, Sweden)
- University of Belgrade, Serbia and Monte Negro
- York University, United Kingdom
- INSA (Institut National des Sciences Appliquées), Lyon, France
- Pennine Water Group, University of Sheffield and University of Bradford
- Institute for Infrastructure, University of Innsbruck, Austria
- Technological University, Delft, The Netherlands
- Dutch Ministry of Water Resources, Delft, The Netherlands
- Singapore Department of Water Resources
- Public Utilities Board of Singapore (PUB) and the National Parks Board of Singapore (NParks)

Lulea University of Technology (Lulea, Sweden)

Dr Ana Deletic visited Lulea in January 2006 (a condition of the Monash/Lulea grant awarded for work with FAWB).

Researchers from Lulea University visited Monash for discussions prior to their participation in the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design, 2-7 April 2006, held in Melbourne. Conference participants from Lulea included: Godecke Blecken, Prof Maria Viklander and Ms K Karisson. The Lulea collaborators refined with FAWB researchers the details of the planned joint laboratory work on the influence of temperature on biofilter activites.

A PhD student from the Lulea University of Technology (Lulea, Sweden), Godecke Blecken, worked with FAWB at Monash. A joint paper with researchers from FAWB at Monash University, and the Lulea University of Technology, was presented at the Novatech 2007 Conference at Lyon, France.

University of Belgrade, Serbia and Monte Negro

Dr Ana Deletic gave a lecture on 12 January 2006 at the University of Belgrade on Biofilters and FAWB. The lecture was attended by a large number of people from Serbian industry and academia. Since Serbian towns and cities are under reconstruction, the lecture generated lots of interest.

Dr Deletic renewed links with industry colleagues and researchers at the University of Belgrade during her visit.

York University, United Kingdom

FAWB invited Prof Malcolm Cresser, from York University, UK, (who is a world renowned expert on the nitrogen N cycle in plant/soil systems) to come and work with FAWB over two weeks in April 2007.

Prof Cresser arrived on 12 April 2007 for his collaborative visit to FAWB at Monash. A highly successful internal workshop was arranged from which the main findings were summarised and knowledge gaps identified.

The collaboration with Prof Cresser and York University continued with further discussions between the Research Manager, Assoc Prof Ana Deletic and Prof Cresser in the UK in June 2007.

FAWB workshop with Prof Malcolm Cresser, April 2007

Collaboration with INSA de Lyon (Lyon France)

FAWB has developed a substantial collaboration with the prestigious French research institution, the Institute National des Sciences Appliquées (INSA), on biofiltration, including clogging aspects.

In particular Mr Sébastien Le Coustumer, of INSA in Lyon worked with FAWB during some two years of his PhD at Monash. He examined the performance of infiltration and biofiltration systems, and particularly looked at the potential for vegetation to reduce or prevent clogging of the filter media. His work contributed significantly to FAWB.

Researchers from INSA Lyon visited Melbourne for discussions with FAWB and participation in the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design, 2-7 April 2006. INSA Lyon participants included: Dr Sylvie Barraud, and Assoc. Prof Jean-Luc Bertrand-Krajewski (chair of the Joint Committee on Urban Drainage).

Further links were made through the visit of FAWB Project Leaders and postgraduates to Lyon before and during the Novatech 2007 Conference. Tim Fletcher has been requested by INSA Lyon to be an "External Expert" to a proposed multiple-partner biofiltration research project in France.

FAWB was visited for two weeks in November 2007 during the Review and Annual Workshop period by two experts from INSA de Lyon, Prof Jean-Luc Bertrand-Krajewski, and Dr Gislain Lipeme-Kouyi, together with graduate scholar Marjolaine Métadier. Prof Bertrand-Krajewski, and Dr Lipeme-Kouyi and Ms Métadier participated in the annual workshop together with INSA scholars Sebastien Le Coustumer and Katia Bratières already in residence at Monash University.

Marjolaine Métadier, INSA de Lyon

INSA de Lyon/Monash scholar Katia Bratières, Monash PhD scholar David McCarthy, Sébastien Le Coustumer, INSA postgraduate, and FAWB Stakeholder representative Keith Downard of Adelaide and Mt Lofty Ranges NRMB, at Annual Workshop (L to R at table on LHS)

Dr Gislain Lipeme-Kouyi, INSA de Lyon

The involvement and visits of students from INSA (Institut National des Sciences Appliquées) Lyon, France continued to strengthen the links with FAWB. INSA scholar Katia Bratières and INSA postgraduate Sébastien Le Coustumer were joined in late April 2008 by INSA scholars Elen Devauchelle and Christelle Schang. Elen Devauchelle and Christelle Schang are doing research related to FAWB projects, particularly aspects of the role of porous pavements with biofilters.

Pennine Water Group, University of Sheffield and University of Bradford

Assoc Prof Ana Deletic FAWB Research Manager, had discussions in June 2007 on cooperative future projects with Prof Richard Ashley, Managing Director of the Pennine Water Group, a centre dedicated to research into water and wastewater. It is based at the Universities of Sheffield and Bradford. Assoc Prof Deletic also presented seminars at Sheffield and Bradford Universities.

Institute for Infrastructure, University of Innsbruck, Austria

Following collaborative discussions with Prof Wolfgang Rauch of the Institute for Infrastructure, University of Innsbruck, Austria, Manfred Kleidorfer conducted collaborative research at Monash during December 2007. Mr Kleidorfer is a PhD scholar in environmental engineering and Dip-Ing from the Institute for Infrastructure at Innsbruck.

Links with the Institute for Infrastructure, University of Innsbruck, Austria, were enhanced by the visit to Monash by Prof Wolfgang Rauch during late January, early February 2008. Prof Rauch heads a major centre for urban water research and is leading figure in that field.

While at Monash, Prof Rauch held discussions with FAWB staff and other Monash colleagues, and continued his role as research project supervisor for the visiting PhD scholar from Innsbruck, Manfred Kleidorfer. Prof Rauch also gave a seminar at Monash on his research work.

Dip- Ing Manfred Kleidorfer, Institute for Infrastructure, University of Innsbruck, Austria

Prof Wolfgang Rauch, Institute for Infrastructure, University of Innsbruck, Austria

Dutch Ministry of Water Resources, Delft, The Netherlands

CEO Dr Tony Wong gave a presentation on the 'Water Sensitive City' to the Dutch Ministry of Water Resources in June 2007. Useful linkages were established and considerable interest was shown in the FAWB activities in view of the increased awareness in the Netherlands of the potential impacts of climate change on water resources management

Collaboration with Technological University, Delft, The Netherlands

Dr Rebekah Brown, Project 2 Leader, gave a seminar in Delft in June 2007 on the nature and findings of her study with Jodi Clarke on 'The Transition to Water Sensitive Urban Design, The Story of Melbourne.' The seminar strengthened the collaboration with the Delft instititution with FAWB and Dr Brown's team. Her findings were an eye-

opener for the Delft social scientists who had been pioneers in the development of 'transition' theory for the take up of new technology.

Cooperative linkages with the Technological University, Delft, The Netherlands were enhanced by the participation of Dr Ir Frans van de Ven of the Delft Technological University in the Research Review and Annual Workshop in November 2007. TU Delft PhD scholar Rutger de Graaf also visited FAWB and was involved in the Annual Workshop. Both Delft visitors held collaborative research discussions with the team for FAWB Project 2, Policy and Risk, and researchers in the National Governance Program.

Dr Megan O'Farrelly (FAWB, Monash) with TU Delft PhD scholar Rutger de Graaf and Dr Frans van de Ven, TU Delft, at Annual Workshop

Singapore Department of Water Resources

Cooperative links were furthered with the Singapore Department of Water Resources through a presentation in June 2007 by FAWB CEO Dr Tony Wong on the nature of FAWB, its joint research/industry collaboration, and its work and findings on biofiltration to date. The Singapore Government has invited Dr Wong to participate in and assist with the planning and arrangements for a collaborative research and industry group on water sensitive urban design to be established in Singapore, along the lines of the FAWB venture.

Links with Public Utilities Board of Singapore (PUB) and the National Parks Board of Singapore (NParks)
FAWB is currently assisting the Public Utilities Board of Singapore (PUB) and the National Parks Board of Singapore (NParks) in developing a research program, modelled after the activities of FAWB, to undertake studies directed at 'proof-of-concept' of biofilter technologies in tropical regions.

FAWB's link with the Singapore agencies was strengthened with the November 2007 launch of the Victoria-Singapore MOU, and acknowledgement of FAWB in the speech by Victorian Minister for Innovation Gavin Jennings. The STI-funded FAWB project was mentioned in Minister Jennings' speech as a specific example of design work being currently undertaken with Singapore.

Biofilters under construction in Singapore

UK delegation

A delegation from the House of Lords in the UK has visited Monash's Clayton campus and Ecological Engineering's office in late January 2006 as part of an Australian fact-finding trip to investigate the future management of water in the UK. In addition, members from FAWB accompanied the delegation to a number of field inspections of stormwater quality treatment facilities.

In particular, the group wanted to learn how integrated urban water management has transformed the way in which the Australian water industry develops solutions for the future which are economically, socially and environmentally acceptable. Led by Lord Selborne, the delegation was conducted on its trip by Prof Richard Ashley, Professor of Urban Water, Sheffield University.

Prof Ashley was also a participant in the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design, 2-7 April 2006, in Melbourne.

Benefits to Victoria.

Victorian State and local government policies are substantially focussed on the range of national and other State policies on sustainable management of urban water. For example, in 2006 the then Minister for Planning, Rob Hulls MP, announced the Sustainable Neighbourhoods package of new planning provisions for residential subdivisions that apply to planning permit applications lodged on or after 9 October 2006. The new residential subdivision provisions in Clause 56 of planning schemes set out requirements for the design and assessment of residential subdivisions in urban areas throughout Victoria.

Clause 57.07 refers to integrated water management and specifically stipulates the treatment of urban stormwater to meet objectives as set out in the document 'Urban Stormwater – Best Practice Environmental Management' by the Victorian Stormwater Committee (1999). FAWB's work on biofilter technology is a direct contribution to Victoria's ability to achieve these objectives.

Progressive refinement of legislation covering water conservation and stormwater management throughout Australia will expand the market for innovative stormwater treatment technologies and particularly for those that can be integrated into both established and new urban environments.

Further water supply proposals for Victoria, and Melbourne in particular, include recycling of stormwater as an important optional source. FAWB's work has contributed to a greater understanding and certainty in the application of biofilter technology in providing re-usable stormwater.

In addition to the advancement of the technology, the FAWB studies on the social and institutional aspects of the transition in Melbourne to Water Sensitive Urban Design (WSUD), and the drivers and barriers to sustainable urban water management, have directly addressed Melbourne-based issues.

Mr Tony Lupton MP, Parliamentary Secretary for Industry and Innovation, launching FAWB report 'Transition to Water Sensitive Urban Design', 23 July 2007

CONTRIBUTION OF FAWB TO STI OUTCOME MEASURES (CONT'D)

Scientific research outcomes

3. Scientific research outcomes

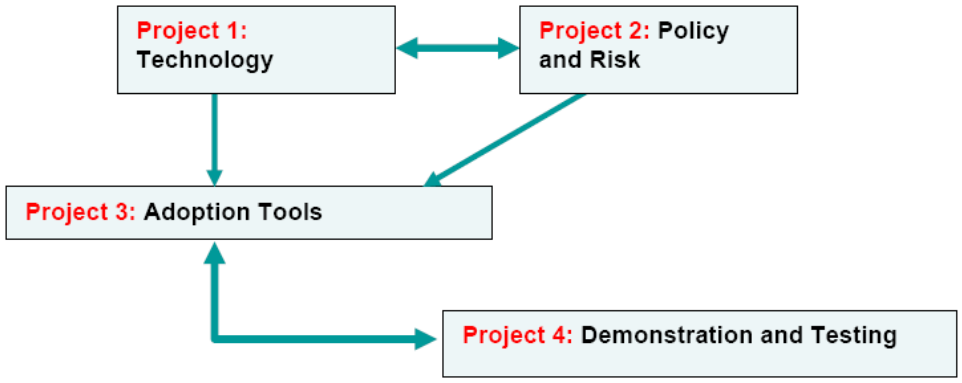
Describe how the project has contributed to world class research and positioned Victoria nationally and internationally as a leader in science, technology and innovation. This includes how the project has attracted world-wide recognition in relation to the research or innovation, such as citations, development and application of intellectual property, demonstration or production of new products and services. Research outcomes may include impact from a social, economic, regional and/or environmental perspective and may be expressed as benefits generated to specific cohorts.

Research Structure

FAWB 's research program has reflected an integrated and inter-related structure of projects as show below.

Research Program - Projects

Project 1: Technology
Project 2: Policy and Risk
Project 3: Adoption Tools
Project 4: Demonstration and Testing



Key messages from FAWB Projects

Each of the FAWB projects has resulted in key messages for research and industry, as shown below. These key findings are included in FAWB's contribution to world class research.

Key messages from Project 1: Technology

1. All biofilter configurations tested (both vegetated and unvegetated) remove more than 90% of heavy metals (both particulate and dissolved). Some plant species enhance metal uptake (and may enhance filter lifespan), but plant selection will depend more strongly on hydraulic conductivity and nutrient removal (see below)
2. Most biofilters will perform well for phosphorus removal, as long as the soil has a phosphorus index of less than 100 mg/kg. Whilst plants play a role in P removal, most species will perform well. Genera such as *Carex, Juncus, Poa, Banksia, correa, Dodonea, Goodenia, Melalecua* and *Pomaderris* all perform well for P removal.
3. Critically, however, without vegetation, most soils will naturally leach some nitrogen. Biofilters therefore rely strongly on vegetation and its symbioses with bacteria and fungi, for the removal of nitrogen from stormwater.
4. The best plants for nitrogen removal are those with (i) a dense root system which penetrates the entire soil filter meda depth, (ii) high growth rate. The following species have been found to be effective: *Carex appressa, Ficinia nodosa, Juncus flavidus, Lomandra longifolia, Melaleuca ericifolia* and *Goodenia ovata*. Where N removal is important, biofilters should be planted with at least 50% of plants from this selection, where possible, and other plants selected primarily on the morphological traits as described. Aesthetic and biodiversity considerations may also need to be taken into account.
5. For maintenance of hydraulic conductivity, plants with thick roots which penetrate the entire soil profile and create macropores, are desirable. This is primarily tree species, such as *Melaleuca*. A combination of plants (e.g. *Carex, Juncus* and *Melaleuca*) delivers the ideal combination of traits for both hydraulic conductivity and nitrogen removal.
6. The addition of vermiculite and perlite (around 5% each by volume) to the soil media may help to maintain hydraulic conductivity, making the biofilter more robust to slight deviations from the specified soil media characteristics. It is also known to enhance the (already high) heavy metal adsorption capacity of biofilters, and to help in moisture retention.
7. Biofilter soil media placed 'uncompacted' will show an initially very high hydraulic conductivity, which will settle back to the design value within a few months. It is recommended that sizing/design of biofilters be undertaken using a safety coefficient of 2 in the hydraulic conductivity. e.g. if the design Ks to be used is 180 mm/hr, size the system assuming a value of 90 mm/hr.
8. Some degree of leaching of fine sediment and nutrients from the soil media will usually occur during the establishment phase, until the soil has stabilised, and plant roots have occupied the soil volume (this will typically take 2-6 months).
9. The presence of an anaerobic zone (made of sand or gravel with around 5% carbon source, such as woodchips) will improve nitrogen removal, by promoting denitrification. It will also enhance plant survival during drought periods, and reduce the risk of an "initial flush" of elevated nitrogen concentrations from the filter media after a prolonged dry period.

Project 1 Leader Dr Tim Fletcher presenting at Rain Gardens workshop, 4 September 2007

Project 2 Leader Assoc Prof Rebekah Brown

Key Messages from Project 2: Policy and Risk

1. The WSUD approach is yet to be mainstreamed anywhere, and the mainstreaming of WSUD will require a more complex multi-sectoral governance approach that is dedicated, proactive and strategic in its pursuit of WSUD. This is because there is currently an absence of an overriding and galvanising socio-political driver or 'crisis' to drive the necessary change.
2. There is a need to provide guidance to urban water strategists and others on how to enable effective institutional change that will lead to the mainstreaming of the WSUD approach across modern cities.
3. The retrospective social research analysis of the of the key factors over the last 40 years that has enabled the successful institutionalisation of 'urban stormwater quality management' across Metropolitan Melbourne reveals: how the 'value' of environmental protection of waterways has been institutionalised towards a relatively advanced stage of increasing importance, within the broader set of well established institutional values of flood protection, public health protection, water supply security and economic efficiency within current decision and policy-making processes.
4. While the historical case study research revealed a range of interconnected activities and initiatives that on the surface seem to represent an organic development pathway, there has been a critical, and in many ways opportunistic, interplay between industry champions and important context variables that has provided the structure and catalyst for the transition so far.
5. Eight key context variables are identified as instrumental when considered as a 'package' to advancing institutional change.

No.	Key Variables	Description
1	**Socio-Political Capital**	Aligned community, media and political concern for improved waterway health, amenity and recreation.
2	**Bridging Organisation**	Dedicated organising space that facilitates collaboration across science and policy, agencies and professions, and knowledge brokers and industry.
3	**Trusted & Reliable Science**	Accessible scientific expertise, innovating reliable and effective solutions to local problems.
4	**Binding Targets**	A measurable and effective target that binds the change activity of scientists, policy makers and developers.
5	**Accountability**	A formal organisational responsibility to the improvement of waterway health, and a mandate for influencing practices that lead to such an outcome.
6	**Strategic Funding**	Additional resources dedicated to the change effort.
7	**Demonstration Projects & Training**	Accessible and reliable demonstration of new thinking and technologies in practice, accompanied by knowledge diffusion initiatives.
8	**Market Receptivity**	A well articulated business case for the change activity.

6 The insights from the Melbourne case study provide an important basis for other cities, and other sectors of activity, to learn from.

7 While the institutional dynamics of the WSUD approach may be more complex than those for the urban stormwater quality management (USQM) approach, the Melbourne case study provides a solid platform of evidence for how institutional change can successfully occur and identifies key factors that underpin such change.

Key Messages from Project 3: Adoption Tools

1. Results from the Technology, and Demonstration and Testing, projects demonstrate that the filter media type has a strong influence on pollutant removal and that the wrong filter media can result in leaching of pollutants. FAWB has thus revised its guidelines for soil filter media to provide clear guidance for specifying filter media properties to ensure hydraulic and treatment function.

2. Pollutant removal by biofiltration systems is primarily determined by the filter media type and the presence and type of vegetation. Modelling of treatment performance will therefore be relatively simple and, in many cases, lookup tables are adequate for predicting their pollutant removal performance.

3. Results from the Technology, Policy and Risk, and Demonstration and Testing, projects are currently being synthesized in the form of guidelines for the design and adoption of stormwater biofiltration systems. These guidelines will include chapters addressing planning, technical design, construction, maintenance and monitoring.

Project 3 Leader, Dr Belinda Hatt

Project 4 Leader Justin Lewis

Key Messages from Project 4

1. In field applications, biofilters may demonstrate high variations in hydraulic performance due to different specifications of filter media characteristics, and poor construction and maintenance practices (43% of tested existing systems have field infiltration capacity below 50 mm/hour).
2. Site characteristics such as filter area (relative to catchment area), age and inflow volume were not useful predictors of long term conductivity. Rather, the initial conductivity of the filter media was found to be far more indicative of a biofilter's long-term performance.
3. To ensure reliable operation of bioretention systems, filter media specifications must be adhered to in terms of both composition and hydraulic conductivity. FAWB has produced such specifications that will be updated as required to reflect new and relevant research insights. Dispersive clay and silt from the Western Sydney area are generally unsuitable material for creating bioretention filter media owing to their unreliability in maintaining media hydraulic conductivity. Furthermore, it is important to tests soils prior their installation (see Project 1, Key Message 6).
4. Vegetation was shown to be critical in maintaining the infiltration capacity of biofiltration systems, helping them to recover from the inevitable reduction in hydraulic conductivity due to initial compaction of the filter media under hydraulic loading. The creation of macropores due to root growth and senescence is thought to contribute to this behaviour.
5. Vermiculite and perlite were also found to help maintain filter media hydraulic conductivity, making the biofilter more robust to slight deviations from the specified filter media characteristics.
6. There will be leaching of silt and some pollutants over the establishing phase. The flushing of solids should cease within 3-6 months in most cases (dependent on the amount of rainfall during this period).
7. Bioretention systems constructed in sodic soil without impermeable lining are not at risk of exporting salt from insitu soil into local streams.
8. Effective communication between designers and construction cotractors is essential, throughout all stages of the project. It is imperative that quality control issues are addressed in planning and design, construction and maintenance throughout the life of the bioretention system, and that the design intent is communicated to the contractors, at a pre-construction briefing.
9. Maintenance requirements could be high during the establishment phase; frequent weed removal is required and the juvenile vegetation should be watered during extended dry periods. However the need for this level of maintenance reduces significantly as the vegetation matures. The development of mosses on the surface should be discouraged, as these can reduce the hydraulic capacity of the system. Dense planting of the preferred plants at the time of construction will help to minimise the extent of weed invasion, and minimise any moss growth.

Other contributions to world class research

FAWB has also contributed to research at a world class level through its leading edge collaboration with prestigious groups in France, UK, the Netherlands and the USA..

Following the research project work undertaken by FAWB, its researchers have published extensively with international colleagues and Australian researchers as shown in the attached list of publications.

Edited books have included the Proceedings of the 7th Urban Drainage Modelling and 4th Water Sensitive Urban Design Conference, Melbourne, Australia, April 3-7th, 2006 and the UNESCO publication 'Data requirements for integrated urban water management.'

Nine book chapters were written in collaboration with colleagues for international publications.

Eleven technical reports were also published by FAWB researchers.

Over forty papers were prepared and published in refereed journals including prestigious international publications such as Water Science and Technology, Journal of Hydrology, Water Research, Journal of Environmental Quality, and Environmental Science and Technology.

FAWB researchers were also active participants in local and international conferences. Some sixty conferences papers were prepared and delivered during the three years 2005-2008.

Postgraduate Yaron Zinger presenting at Novatech 2007, Lyon, France
Dr Tim Fletcher, Session Chair)

Positioning Victoria as a leader in science, technology and innovation.

FAWB has contributed to Positioning Victoria nationally and internationally as a leader in science, technology and innovation through the publication in books and journals, and presentation at conferences, of its research as outlined above.

Other contributions have been achieved through FAWB's collaboration at local, interstate and international levels, and through reviews of its research in 2006 and 2007 by international specialist panels.

The features of FAWB's collaboration have been outlined above under 'Collaboration outcomes'.

Research Reviews were conducted as follows.

Research Advisory Panel – Research Review 2006

A FAWB Research Advisory Panel was formed under the arrangements in the FAWB Joint Venture Agreement, the purpose of the Panel being to provide independent peer review and to advise the FAWB Board (through the Research Manager) on the scientific merit and rigour of the research program.

Panel members for 2006-2007 included:

- Professor Simon Beecham
  (School of Natural and Built Environment, University of South Australia)
- Professor Jenny Dixon
  (School of Architecture and Planning, The University of Auckland)
- Mr Earl Shaver (at the time with Auckland Regional Council).

The Research Advisory Panel conducted a two-day review of the research activities of FAWB on 25 and 26 September 2006.

FAWB Research Advisory Committee 2006
L to R: Mr Earl Shaver,Prof Simon Beecham, and Prof Jenny Dixon

Research Review 2007

During 2007/2008, the Research Advisory Panel comprised three eminent international experts:

- Professor Bob Pitt (the Chair of the panel), Director of Environmental Engineering Programs, Department of Civil and Environmental Engineering, The University of Alabama.
- Dr Frans van de Ven, Faculty of Civil Engineering and Geosciences, Delft University of Technology, and
- Emeritus Professor Barry T Hart, Director, Water Science Pty Ltd

FAWB Review Panel 2007
L-R: Prof Bob Pitt, Dr Frans van de Ven, Prof Barry Hart

The panel conducted a FAWB Research Review over the period 12-15 November 2007.

In preparation for the Review, FAWB produced a summary of the outcomes of the entire FAWB research effort. The outcomes document consisted of a 33-page summary and copies of 22 publications (reports, conference and journal papers) that FAWB had produced in the past two years. The document was made available to the Research Review Panel several weeks before the event.

During 12 and 13 November, the Research Review Panel discussed the research program with the FAWB Project Leaders and Research Manager in a number of closed sessions. It was very intensive and highly productive work for all the FAWB team. FAWB received lots of highly valuable feedback, including comments during those two days.

The terms of reference for the review were to:

- review the quality of the science undertaken by the Facility,
- comment on any major gaps or overlaps with research elsewhere,
- suggest further research which may add value or address major questions yet to be studied.

In the executive summary of its report, the review panel included the following comments:

> 'FAWB has a very enthusiastic and productive team of young researchers undertaking targeted and relevant research. They have already produced an impressive list of publications in prestigious, peer-reviewed journals. Additionally, the Facility has a well-defined vision and clear and achievable objectives.
>
> The work of the Facility so far has significantly advanced knowledge on the operation of biofilters.
>
> This new knowledge should allow design procedures and guidelines to be improved. Moreover, the field experiments and observations in existing facilities have led to a better view on how to integrate these facilities in urban landscape design and has provided valuable information on the long-term performance and on the problems encountered in the construction and maintenance of these facilities.
>
> We are confident that the 'proof of concept' that FAWB was seeking will be achieved….'

World-wide recognition in relation to research/innovation

Recognition of FAWB's research or innovation has been demonstrated through a variety of activities.

These include:

- Collaborative links with prestigious international organisations
- Publications of research findings in international journals
- Participation at international conferences, including presentation of papers by FAWB researchers including postgraduates, and active involvement in the planning and running of the technical proceedings.
- Findings of the international panels who reviewed FAWB science in 2006 and 2007.
- Visits to FAWB by international leaders in the biofiltration field

Prof Jean-Luc Bertrand-Krajewski, INSA de Lyon, collaborator with FAWB, visiting November 2007

Development and application of intellectual property

FAWB's approach to intellectual property has been to provide its findings for public good purposes in the management and utilisation of stormwater for sustainable water use. FAWB's intellectual property has been developed with collaborators and applied in a variety of demonstration projects, particularly in Project 4: Demonstration and Testing.

It is anticipated that the majority of the outputs of the research program of FAWB will not generate substantial profits for the participants. The outputs will however result in significant cost savings and benefits to stakeholder groups that have applied or choose to apply biofilter technologies to meet their stormwater management obligations.

Demonstration or production of new products and services.

Project 4: Demonstration and Testing, was a pivotal activity in FAWB's demonstration of biofilter technology. The focus of Project 4 has been on testing the novel systems constructed in consultation with FAWB, as well as on testing a number of existing bioretention systems.

The current activities included establishing demonstration biofilters in Melbourne, Sydney and Brisbane:

Activity 4.01 Bioretention System, Second Ponds Ck, Western Sydney
Activity 4.02 Monash University Car Park Bioretention System
Activity 4.03 Wakerley Bioretention System, Brisbane
Activity 4.05 Saturn Cres stormwater garden, Brisbane

In addition, Activity 4.04 Testing Existing Bioretention Systems, involved testing existing biofilters Altogether, 37 biofilters were tested for hydraulic performance and metal accumulation in Sydney, Brisbane and Melbourne. Metal analyses were initiated to determine the levels of toxicants in soils.

The data analyses on hydraulic performance were completed and a report on this work (Hydraulic performance of biofilter systems for stormwater management: lessons from a field study) was produced for Melbourne Water.

Key findings were included and integrated with those of Projects 1 and 3 in the workshop document 'Advancing the Design of Stormwater Biofilters' prepared for training workshops on advancing the design of rain gardens and biofiltration systems in Adelaide, Sydney, Perth and Albany, June 2008.

As part of Project 3: Adoption Tools, in early May 2008, FAWB published its 'Practice Note 1: In Situ Measurement of Hydraulic Conductivity' on the FAWB website. This new product was developed to assist industry in getting reliable measurements of hydraulic conductivity, accurate measurement having been identified as an issue for the successful adoption of biofilter technologies**.**

CONDITION ASSESSMENT AND PERFORMANCE EVALUATION OF BIORETENTION SYSTEMS

PRACTICE NOTE 1: *In Situ* Measurement of Hydraulic Conductivity

Belinda Hatt, Sebastien Le Coustumer

April 2008

The Facility for Advancing Water Biofiltration (FAWB) aims to deliver its research findings in a variety of forms in order to facilitate widespread and successful implementation of biofiltration technologies. This Practice Note for *In Situ* Measurement of Hydraulic Conductivity is the first in a series of Practice Notes being developed to assist practitioners with the assessment of construction and operation of biofiltration systems.

Disclaimer: Information contained in this Practice Note is believed to be correct at the time of publication, however neither the Facility for Advancing Water Biofiltration nor its industry partners accept liability for any loss or damage resulting from its use.

1. SCOPE OF THE DOCUMENT

This Practice Note for *In Situ* Measurement of Hydraulic Conductivity is designed to complement FAWB's Guidelines for Soil Filter Media in Bioretention Systems, Version 2.01 (visit http://www.monash.edu.au/fawb/publications/index.html for a copy of these guidelines). However, the recommendations contained within this document are more widely applicable to assessing the hydraulic conductivity of filter media in existing biofiltration systems.

For new systems, this Practice Note ***does not*** remove the need to conduct laboratory testing of filter media prior to installation.

2. DETERMINATION OF HYDRAULIC CONDUCTIVITY

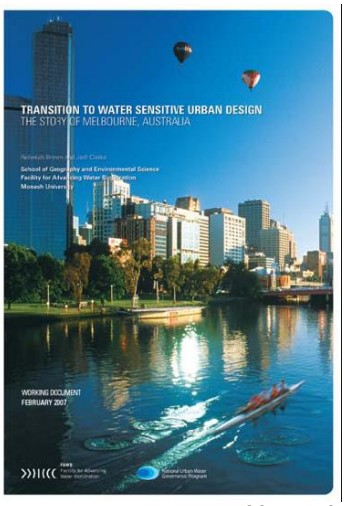
The recommended method for determining *in situ* hydraulic conductivity uses a single ring infiltrometer under constant head. The single ring infiltrometer consists of a small plastic or metal ring that is driven 50 mm into the soil filter media. It is a constant head test that is conducted for two different pressure heads (50 mm and 150 mm). The head is kept constant during all the experiments by pouring water into the ring. The frequency of readings of the volume poured depends on the filter media, but typically varies from 30 seconds to 5 minutes. The experiment is stopped when the infiltration rate is considered steady (i.e., when the volume poured per time interval remains constant for at least 30 minutes). This method has been used extensively (e.g. Reynolds and Elrick, 1990; Youngs *et al.*, 1993).

Impact from a social, economic, regional and/or environmental perspective

The FAWB report "Transition to WSUD: The Story of Melbourne, Australia", has had an impact from an institutional perspective, including social, economic and environmental aspects.

Following a successful seminar and workshop to launch the FAWB report as a working document on 15 February 2007, the Project 2 Report on mapping the institutional transition to adoption of WSUD in Melbourne was completed in June 2007. A launch and seminar on final report - which encompasses social, economic and institutional aspects - was held in Melbourne for government and industry representatives on 23 July 2007.

The report has identified key principles by which the uptake of this new technological approach can be expedited and they are relevant to many aspects of technology diffusion in society including technologies for alternative water sources such as wastewater recycling and stormwater harvesting.



Working Document on WSUD transition, February 2007

A further Project 2 report addressed social, economic and environmental aspects at various geographical scales from the household to a region. An online survey to study 'Perceptions of institutional drivers and barriers to sustainable urban water management in Australia' had been conducted and data analysed as part of the National Urban Water Governance Program (NUWGP). A draft copy of the summary report of the study was circulated at FAWB Annual Workshop, November 2007.

The final summary report of the study by Assoc Prof Rebekah Brown, Dr Megan Farrelly and Nina Keath was launched at the NUWGP Annual Forum held in Perth on 7 and 8 February 2008. FAWB, a collaborator and funding contributor of NUWGP, was represented at the workshop by senior researchers including Research Manager, Assoc

Prof Ana Deletic, and Board Member and Project Leader, Dr Tim Fletcher, in addition to the principal author and FAWB Project Leader, Assoc Prof Brown.

Covers of 'Summary Report:
Perceptions of institutional driversand barriers
to sustainable urban water management in Australia'

CONTRIBUTION OF FAWB TO STI OUTCOME MEASURES (CONT'D)

Commercial outcomes

2. Commercial outcomes
Describe how the project has contributed to wealth creation. This includes information relating to the commercial value of the project, the involvement of industry and other investors, income generated, how the project might support other commercial ventures or interests (e.g. demonstration project), and how it relates to the broader industry in which it operates. Include information on specific activities directed towards future commercial outcomes such as extension or advisory services.

Contribution to wealth creation

FAWB has contributed to wealth creation through:

- Education and training of skilled professionals
- Knowledge creation and innovation
- Being integrated in the local economy
- Assisting business formation and growth
- Linking and integrating with international research, government and industry groups
- Adding value to the business environment and infrastructure

Education and training of skilled professionals

FAWB been active in the education and training of professionals in the water and land development industry and research via:

- Training of postgraduates,
- Workshop training of industry and industry participants
- Collaborative activity with industry participants

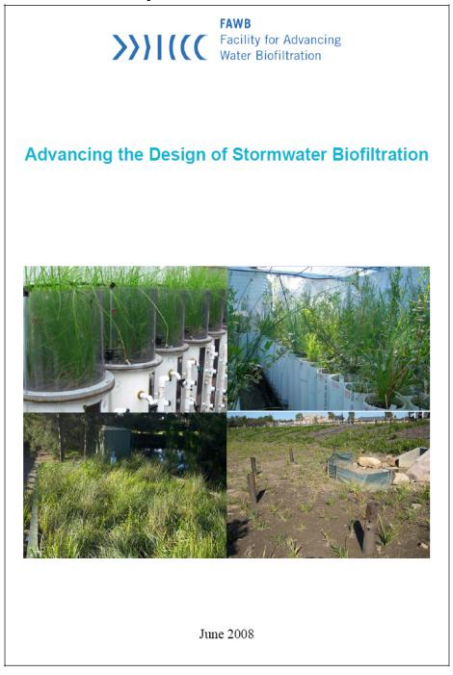
(each of the above contributing industry-wide adoption and implementation of the technology)

Knowledge creation and innovation

FAWB has established itself at the forefront of biofiltration research and innovation,indicated by:

- International collaboration
- Publications
- Visits by specialists to FAWB
- Support by collaborators for further work
- Advisory work by FAWB
- Research Review findings (providing an independent view how FAWB has provided scientific "proof of concept" for the application of stormwater biofilter technologies)

An example of FAWB's role in combining 'education and training' with 'knowledge creation and innovation', was the Inclusion of key findings and integration of Projects 1, 3 and 4 in the workshop document 'Advancing the Design of Stormwater Biofilters' prepared for training workshops on advancing the design of rain gardens and biofiltration systems held in Adelaide, Sydney, Perth and Albany, June 2008.



Being integrated in the local economy

FAWB has developed a strong involvement with local industry, especially stakeholder organisations. These include Joint Venture participants Ecological Engineering, succeeded by EDAW, and Collaborators: Adelaide and Mt Lofty Ranges NRMB, Brisbane City Council, Landcom, Manningham, Melbourne Water, and VicRoads

There has also been substantial involvement of consultants and other industry and government organisations in training workshops and seminars.

FAWB's public good stance has assisted the development of local expert groups such as industry teams in the water industry, research groups and consulting firms.

Assisting business formation and growth

FAWB contributes actively to the formation and growth of water industry enterprises by providing public dissemination of its research findings and technology on water biofiltration. Vehicles for contributions to business growth have included the Australian Water Association, Australia's largest water industry association with more than 3500 individual members and 600 corporate or utility members, the Stormwater Industry Association, and Clearwater, Vic .

In parallel with its public good approach to research findings, the income generated by FAWB itself has been nominal. However the output of FAWB has provided a solid basis for future collaborative work.

Linking and integrating with international research, government and industry groups

Collaboration and integration with international groups has been an important aspect of FAWB's approach. As outlined earlier, these groups included:

- INSA Lyon, France
- Delft University of Technology, The Netherlands
- University of Sheffield, and others in UK including Prof Malcolm Cresser, York University
- UNESCO, Paris
- Singapore Public Utilities Board

In other international linkages, FAWB presented its work and activities to delegations from the Dutch Ministry of Economic Affairs, and the UK House of Lords.

Dutch Ministry of Economic Affairs delegation visting FAWB, October 2007

There was further integration into the international economy with the transition to EDAW (a global enterprise) as a participant in the Joint Venture via Ecological Engineering, a founding participant.

FAWB has been assisting the Public Utilities Board of Singapore (PUB) and the National Parks Board of Singapore (NParks) in developing a research program, modelled after the activities of FAWB, to undertake studies directed at 'proof-of-concept' of biofilter technologies in tropical regions.

FAWB's link with the Singapore agencies was strengthened with the November 2007 launch of the Victoria-Singapore MOU, and acknowledgement of FAWB in the speech by Victorian Minister for Innovation Gavin Jennings. The STI funded FAWB project was mentioned in Minister Jennings' speech as a specific example of design work being currently undertaken with Singapore.

Adding value to the business environment and infrastructure

FAWB has been assisting business adoption of technology and providing access to its latest findings via its public good stance on dissemination of findings and adoption in demonstration projects with collaborators. The new knowledge and skills provided through FAWB's research, demonstration and training activities have provided new opportunities for consultants and the water and land development industries.

Greater certainty in designing and operating biofiltration installations has also assisted in improving the infrastructure for land development, local government and water management. Public awareness activities have also been pursued to raise awareness of biofiltration systems and the benefits to environmental and water management from its adoption.

Future Outcomes - Research and Development contracts negotiated

Building on the skills and research findings achieved in FAWB projects, members of the FAWB team have negotiated the following contracts or grants with industry and government.

Alternative biofilter soil media

Funding of $85k has been negotiated with Melbourne Water for additional tests on alternative biofllter soil media. This is in addition to funding of $30k already arranged with Melbourne Water for work by visiting scholar Lucie Alcazar on "Biofilter pathogen testing experiments", and $5k for studies and a report to Melbourne Water on hydraulic conductivity.

Smart Water Fund Grant

Monash Civil Engineering PhD postgraduate David McCarthy, FAWB Research Manager Assoc Prof Ana Deletic, and FAWB Project Leader Dr Tim Fletcher were successful with Monash Epidemiology and Preventive Medicine PhD scholar, Joanne O'Toole, in winning a Victorian Government Smart Water Fund grant. The grant ($249,000 over two years) will be used to conduct a research project entitled "New Technologies for Mitigating Risks of Stormwater Reuse".

Research into Porous Pavements

FAWB Project Leader Dr Tim Fletcher and FAWB Research Manager Assoc Prof Ana Deletic were successful with other colleagues in attracting and negotiating a research contract with private investors to investigate sustainable water resources aspects of porous pavements. The contract provides funding of $1.2 million.

Other discussions and negotiations on biofilter development and potential commercialisation

FAWB has been involved in discussions and negotiations with:

- Israeli industry and government on biofilter development, including potential funding by the Jewish National Fund (JNF) for a proposed pilot project for a biofiltration system in Israel.
- The Victoria-Israel Science and Technology R&D Fund (VISTECH) regarding a project to develop novel and robust technologies for the recycling of greywater and stormwater.
- Cardno Grogan Richards for FAWB to undertake a trial of prefabricated biofilters using vegetated columns.

FAWB trial of prefabricated biofilters using vegetated columns.

A key impediment to the more widespread adoption of biofiltration systems is the "fussiness" of their construction, in terms of specification and placement of filter media, and the planting and maintenance of plants. In response to this, Cardno Grogan Richards have, in partnership with Australian Ecosystems, developed a concept which involves "pre-growing" the selected vegetation in FAWB-specified filter media (within a nursery situation).

FAWB has developed a proposal for the testing of Cardno Grogan Richards' pre-established biofilter design so determine whether pre-established biofilter soil media/plant arrangement will work effectively in treating stormwater and maintaining hydraulic conductivity over time. Funding arrangements are under discussion.

CONTRIBUTION OF FAWB TO STI OUTCOME MEASURES (CONT'D)

Science awareness outcomes

5. Science awareness outcomes
Describe how the project has contributed to improving community awareness and understanding of technological change and the importance of innovation. This might include the project's education, awareness or marketing activities and who has been targeted, whether the project attracted mainstream and industry based media reports and how supportive the community is in participating in the project's activities.

Improving community awareness of technological change and innovation

FAWB's community awareness raising embraced:

- Networking with Australian business and government
- Conference participation and sponsorship
- Presentations and briefings
- Seminars
- Workshops
- Website news
- Media outreach

Networking and integration with Australian and international government and business

In addition to the networking outlined under 'Collaboration Outcomes', FAWB was able to and participate in visits by Victorian Parliamentary delegations in 2007 and 2008, and outline its activities.

The Parliamentary Secretary for Innovation, Industry and Regional Development Mr Tony Lupton led a parliamentary delegation on a tour of the FAWB carpark biofilter and vegetation trials at Monash on 26 February 2007.

Justin Lewis outlining vegetation trials to Mr Tony Lupton and Ms Marsha Thompson

Closer links with the Victorian Government were developed with the visit of the Victorian Cabinet delegation to Monash on 12 February 2008.

The delegation included the following Cabinet members and their staff:

- The Hon Jacinta Allan MP, Minister for Regional & Rural Development, Minister for Skills & Workforce Participation (accompanied by Chris Gartner, Adviser)
- The Hon Gavin Jennings MLC, Minister for Innovation, Minister for Environment & Climate Change (accompanied by Prue Stewart, Chief of Staff, and Chris McDermott, Adviser)
- The Hon Maxine Morand MP, Minister for Children & Early Childhood Development, Minister for Women's Affairs (accompanied by David Bell, Adviser)

- The Hon Tony Robinson MP, Minister for Consumer Affairs, Minister Assisting the Premier on Veterans' Affairs, Minister for Gaming
- The Hon Rob Hudson MP, Parliamentary Secretary for Public Transport and the Arts

Assoc Prof Ana Deletic, Institute for Sustainable Water Resources, Research Manager FAWB; and Belinda Hatt, Institute for Sustainable Water Resources, Project Leader FAWB; gave a presentation to the delegation on FAWB and the Institute's work on sustainable water resources and proposals for the future, including further research on biofiltration.

Group of participants in visit to Monash by members of Victorian Cabinet, February 2008

Conference participation and sponsorship

The substantial involvement and commitment of FAWB and its key staff to the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design, Melbourne, Australia, 2-7 April 2006, has been a pivotal step in raising awareness of biofiltration technologies. This was seen as a strategic initiative in building industry networks across government and commercial enterprises as part of FAWB's initial commercialisation planning.

FAWB was the sponsor of the Poster Paper session of the 7th International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design. The FAWB Chairperson, Professor Russell Mein, welcomed delegates to the session and provided a brief overview of the Facility. There was specific mention of FAWB, as a sponsor, on the Conference Program.

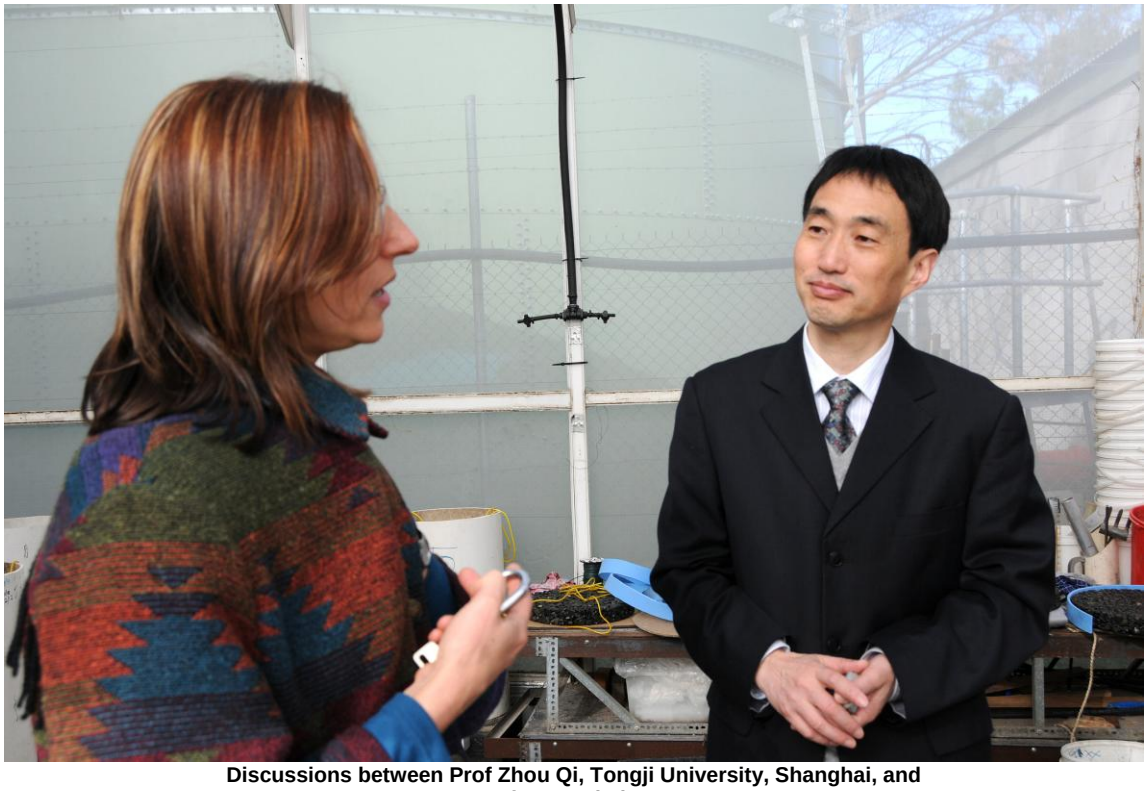
A FAWB display booth was prepared and set up at the conference. The display featured project information and an experimental set-up of a biofilter column. A brochure on FAWB was handed out at the display.

FAWB display and stand at UDM/WSUD Conference, April 2006

Presentations and Briefings

An extensive program of briefings or presentations to government, industry and research organisations was undertaken by FAWB staff, including the collaborative links discussed earlier.

For example, links were established by FAWB with Tongji University, Shanghai, China, through the visit of Prof Zhou Qi, Dean of School of Environmental Science and Engineering at Tongji University,Shanghai, China. Prof Zhou had discussions with Assoc Prof Ana Deletic and inspected FAWB laboratory installations on 22 May 2008.



Discussions between Prof Zhou Qi, Tongji University, Shanghai, and Assoc Prof Ana Deletic. May 2008

Outline details of the twenty-seven briefings or presentations made during 2005-2008 are listed in the following table.

Presentations or Briefings to Government, Industry, Research and other Organisations 2005-2008

Date	Speakers/Presenters	Topic	Organisation/Venue
15 September 2005	Dr Ana Deletic, Monash	FAWB and its activities	Sustainable Campus Group (SGC) (SGC membership includes facility and services managers for TAFEs and universities, and related environmental) /Monash University
17 October 2006	Prof Russell Mein, FAWB Chair; Dr Tony Wong, Ecological Engineering; Mr Matt Viney, MP, Parliamentary Secretary for Innovation and Industry; Mr Graham Rooney, Melbourne Water	Launch of FAWB	FAWB/ Monash University, Clayton Campus
23 November 2006	Yaron Zinger, Monash	Optimisation of the nitrogen retention capacity of stormwater biofiltration systems	FAWB Board/ Monash University, Clayton Campus
26 February 2007	Dr Tony Wong, Ecological Engineering; Assoc Prof Ana Deletic, Monash; Justin Lewis, Monash	Parliamentary delegation tour of FAWB facilities led by Parliamentary Secretary for Innovation, Industry and Regional Development Mr Tony Lupton.	FAWB / Monash University, Clayton Campus, FAWB facilities – Monash Carpark Biofilter and Vegetation Trials.
June 2007	Dr Rebekah Brown, Monash	Transition to water sensitive urban design	Technological University, Delft, The Netherlands
June 2007	Dr Tony Wong, Ecological Engineering	Water Sensitive City	Dutch Ministry of Water Resources, Delft, The Netherlands
June 2007	Assoc Prof Ana Deletic, Monash	FAWB and biofiltration research	Pennine Water Group/ University of Sheffield
June 2007	Assoc Prof Ana Deletic, Monash	FAWB and biofiltration research	Pennine Water Group/ University of Bradford
June 2007	Dr Tony Wong, Ecological Engineering	FAWB, its joint research/industry collaboration, and its work and findings on biofiltration to date	Singapore Department of Water Resources/ Singapore
6 July 2007	Dr Tim Fletcher, Monash	Monash research capabilities in water including FAWB	Environment Protection Authority, Vic /Melbourne
16 Aug 2007	Dr Tim Fletcher, Monash	Discussion on French-Australian research collaboration, focussed on cotutelle research in FAWB	French Scientific Attaché Dr. Michel Thibier/Monash, Clayton
6 September 2007	Lucie Alcazar, INSA de Lyon, Visiting scholar	Biofilter Pathogen Removal Experiments	FAWB Board/ Monash, Clayton

Date	Speakers/Presenters	Topic	Organisation/Venue
18 October 2007	Dr Tony Wong, EDAW; Assoc Prof Ana Deletic, Monash; Assoc Prof Rebekah Brown, Monash; Belinda Hatt, Monash	FAWB research and adoption activities	Dutch Ministry of Economic Affairs delegation/ Monash, Clayton
12 February 2008	Assoc Prof Ana Deletic, Monash; Belinda Hatt, Monash	FAWB, work on sustainable water resources, and proposals for the future, including further research on biofiltration.	Victorian Cabinet for Bio Tech 'Cabinet Forum' delegation/ Monash, Clayton
14 March 2008	Dr. Tim Fletcher, Monash	Performance of biofiltration systems in pathogen removal	Melbourne Water Corporation and Manningham City Council/ Monash, Clayton
7 April 2008	Dr Tony Wong, EDAW; Assoc Prof Ana Deletic, Monash	Proposal for future research: 'Cities as Water Supply Catchments'	Staff of DIIRD, DSE, Treasury and State Cabinet/ DIIRD, Melbourne
24 April 2008	Assoc Prof Rebekah Brown, Monash; Assoc Prof Ana Deletic, Monash	Proposal for future research: 'Cities as Water Supply Catchments'	Councillors and Executive of the City of Manningham/ City of Manningham, Doncaster
24 April 2008	Dr Tony Wong, EDAW; Assoc Prof Rebekah Brown, Monash; Dr Tim Fletcher, Monash; Assoc Prof Ana Deletic, Monash	Proposal for future research: 'Cities as Water Supply Catchments'	Director Sustainability, Recycling and Innovation, Office of Water, Department of Sustainability and Environment, Victoria / Monash, Clayton
6 May 2008	Assoc Prof Ana Deletic, Monash; Dr Tim Fletcher, Monash	Monash research capabilities in water and energy, including FAWB	Meeting between GE Global Research, New York; GE Infrastructure; GE Australia & NZ; and Monash/Monash, Clayton
8 May 2008	Assoc Prof Ana Deletic, Monash; Assoc Prof Rebekah Brown, Monash	FAWB research findings	Councillors and Executive of the City of Manningham/ City of Manningham, Doncaster
22 May 2008	Dr Tony Wong, EDAW; Assoc Prof Rebekah Brown, Monash; Dr Tim Fletcher, Monash	Sustainable urban water management	Mr Craig Wallace, Queensland Minister for Natural Resources and Water and Minister Assisting the Premier in North Queensland/Monash
22 May 2008	Assoc Prof Ana Deletic, Monash	FAWB research findings and facilities	Prof Zhou Qi, Dean of School of Environmental Science and Engineering, Tongji University, Shanghai, China/Monash
30 May 2008	Dr Tony Wong, EDAW; Assoc Prof Rebekah Brown, Monash; Dr Tim Fletcher, Monash; Assoc Prof Ana Deletic, Monash	Proposal for future research: 'Cities as Water Supply Catchments'	Melbourne Water senior group including Chair, MD, Gen. Mgr/ Melbourne Water
2 June 2008	Dr Tony Wong, EDAW; Assoc Prof Rebekah Brown, Monash; Dr Tim Fletcher, Monash; Assoc Prof Ana Deletic, Monash	Proposal for future research: 'Cities as Water Supply Catchments'	Dept of Sustainability and Environment/ Dept of Sustainability and Environment, Melbourne
4 June 2008	Dr Tony Wong, EDAW; Assoc Prof Ana Deletic, Monash	Proposal for future research: 'Cities as Water Supply Catchments'	Water Services Association of Australia (WSAA), Executive Director, Mr Ross Young
5 June 2008	Dr Tony Wong, EDAW; Assoc Prof Rebekah Brown, Monash; Dr Tim Fletcher, Monash; Assoc Prof Ana Deletic, Monash	Proposal for future research: 'Cities as Water Supply Catchments'	National Water Commission (NWC) and officers of the Department of Environment, Water, Heritage and the Arts/ NWC, Canberra
25 June 2008	Dr Tony Wong, EDAW; Assoc Prof Ana Deletic, Monash	Proposal for future research: 'Cities as Water Supply Catchments'	Executives of Department of Innovation, Industry and Regional Development (DIIRD)/ Melbourne

Seminars

In addition to the conferences and seminars where proceedings/papers are listed under 'Publications', FAWB arranged, or was substantially involved with, eleven seminars during 2005-2008.

Two major recent events were the launch and seminar for the final report on the 'Transition to WSUD: the Story of Melbourne' and the forum on 'Sustainable water futures for Melbourne'. As discussed under Project 2, the 'Transition to WSUD' report was launched on 23 July 2007 by Mr Tony Lupton, Parliamentary Secretary for Industry and Innovation.

As part of Monash University's 50th Anniversary Public Lecture Series, the Faculty of Engineering presented a forum on 'Sustainable water futures for Melbourne' on 22 April 2008, at the BMW Edge Theatre at Federation Square. Over 200 guests including Monash alumni, members of the public, guests from the water and energy industry, Monash staff and students attended. FAWB was represented by Assoc Prof Ana Deletic, and Dr Gavin Mudd, two of the four Monash speakers.

L-R: Dr Gavin Mudd, Assoc Prof Ana Deletic, Prof Paul Webley (meeting chair), Dr Grace Mitchell, David Flower

Audience at the forum on 'Sustainable water futures for Melbourne' on 22 April 2008 at Federation Square

Seminars 2005-2008

Date	Speakers/Presenters	Topic	Organisation/Venue
9 November 2005	Dr Ana Deletic, Monash	FAWB and Biofiltration (Seminar on: Water - the LIQUID A$$ET)	Stormwater Industry Association of Victoria – 5th Annual SIAV Seminar/ Corporate Centre, Manningham City Council
14 November 2006	Assoc Prof Ana Deletic, Monash	Facility for Advancing Water Biofiltration (at the Annual Stormwater Industry Association Victoria, SIAV Seminar: 'The Stormwater Alternatives')	Stormwater Industry Association Victoria /Corporate Centre, Manningham City Council, Doncaster
22 November 2006	Assoc Prof Ana Deletic, Monash; Dr Tim Fletcher, Monash; Dr Rebekah Brown, Monash	FAWB and its research projects	Victorian Water Engineering Branch, Engineers Australia / Engineers Australia, North Melbourne
15 February 2007	Dr Rebekah Brown, Monash; Jodi Clarke, Monash; Dr Tony Wong, Ecological Engineering	Seminar and workshop to launch the report on "Transition to WSUD: The Story of Melbourne, Australia"	FAWB/ Fenix, Richmond
19 April 2007	Prof Malcolm Cresser, York University, UK; FAWB Project Leaders and Researchers - Ecological Engineering, Monash /Postgraduates - Monash	Biofitration Research	FAWB / Monash University, Clayton Campus
23 July 2007	Prof Russell Mein, FAWB Chair	Seminar welcome	DIIRD, FAWB/ Treasury Theatre, Treasury Place, Melbourne.
	Mr Tony Lupton, Parliamentary Secretary for Industry and Innovation	Launch of the final report: 'Transition to Water Sensitive Urban Design: the Story of Melbourne, Australia'	
	Dr Tony Wong, EDAW, FAWB CEO,	FAWB research program, aims and activities.	
	Assoc Prof Rebekah Brown, Monash	'Transition to Water Sensitive Urban Design: the Story of Melbourne, Australia'	
	Mr Rob Skinner, Managing Director, Melbourne Water	Closing remarks for the seminar proceedings.	

Date	Speakers/Presenters	Topic	Organisation/Venue
21 Aug 2007	Dr Tim Fletcher, Assoc Prof Ana Deletic, Dr. Belinda Hatt, Yaron Zinger, (all Monash)	Various conference presentations regarding FAWB	Rainwater and Urban Design 2007 Conference / Sydney
28 Aug 2007	Dr Tim Fletcher, Monash	Water recycling and filtration as an alternative water source	Research Matters public seminar series, Monash University/ Clayton
22 November 2007	Assoc Prof Ana Deletic, Monash	Researching for improved stormwater outcomes	Australian Water Association (AWA), Stormwater Industry Association of Victoria (SIAV) seminar on 'Climate change and stormwater opportunities'/ Bayview Eden, Melbourne
	Dr Peter Breen, EDAW	Cities as Catchments: As Illustrated by Royal Park Wetland and Stormwater Reuse System	
	Belinda Hatt, Monash	Advancing stormwater biofiltration	
6, 7 December 2007	Dr Tim Fletcher, Monash; Yaron Zinger, Monash; Assoc Prof Ana Deletic, Monash; Katia Bratières, INSA de Lyon, Visiting scholar, Monash	Biofiltration Technologies for Treating Polluted Waters: Results of a Large Scale Laboratory Study	Tri-University Advanced Research Workshop 2007 (convened by Monash University, Central South University, China, and Wuhan University of Technology, China)/ Monash, Clayton
	Assoc Prof Ana Deletic, Monash; Dr Tim Fletcher, Monash	Urban Water Sustainability; Focusing on Stormwater	
22 April 2008	Assoc Prof Ana Deletic, Monash; Dr Gavin Mudd, Monash; (with David Flower, Monash; Dr Grace Mitchell, Monash; and meeting chair, Prof Paul Webley, Monash)	Sustainable water futures for Melbourne	Monash University's 50th Anniversary Public Lecture Series/ BMW Edge Theatre at Federation Square

Workshops

Three series of workshops were run by FAWB during 2005-2008 with a total of .ten workshops for the period.

In August and September 2006, four workshops on 'Implementing Water Sensitive Urban Design' were held in the Melbourne region conjunction with Clearwater and Melbourne Water.

During September 2007, two back-to-back workshops on Design of Rain Gardens were presented at Monash in partnership with Clearwater.

In conjunction with stakeholder organisations, four workshops on Advancing Rain Garden Design were held in in Adelaide, Sydney, Perth and Albany during June 2008. Details are outlined in the following table.

Project groups at design workshop, 5 September 2007

Dr Sara Lloyd assisting Adelaide workshop participants, June 2008

Workshops 2005-2008

Date	Speakers/Presenters	Topic	Organisation/Venue
30 August 2006	Dr Tony Wong, Ecological Engineering; Dr Ana Deletic, Monash; Dr Tim Fletcher, Monash	Implementing Water Sensitive Urban Design	FAWB, Clearwater, Melbourne Water /Civic Centre, City of Casey, Narre Warren
7 September 2006	Dr Tony Wong, Ecological Engineering; Dr Ana Deletic, Monash; Dr Tim Fletcher, Monash	Implementing Water Sensitive Urban Design	FAWB, Clearwater, Melbourne Water /The Mansion, Werribee
8 September 2006	Dr Tony Wong, Ecological Engineering; Dr Ana Deletic, Monash; Dr Tim Fletcher, Monash	Implementing Water Sensitive Urban Design	FAWB, Clearwater, Melbourne Water /Emu Bottom Homestead, Sunbury
15 September 2006	Dr Tony Wong, Ecological Engineering;	Implementing Water Sensitive Urban Design	FAWB, Clearwater, Melbourne Water /Melbourne Business

	Dr Ana Deletic, Monash; Dr Tim Fletcher, Monash		School, Mt Eliza
Date	**Speakers/Presenters**	**Topic**	**Organisation/Venue**
4 September 2007	Assoc Prof Ana Deletic, Monash; Dr Tim Fletcher, Monash; Belinda Hatt, Monash	'Design of Rain Gardens' : Summary of key research findings from FAWB Projects 1 and 4	FAWB, Clearwater/ Monash, Clayton
5 September 2007	Dr Tony Wong, EDAW; Dr Sara Lloyd, EDAW; Dr Robin Allison, EDAW; Georgie Wettenhall, EDAW; Kerrie Burge, EDAW	'Design of Rain Gardens' : Workshop on design of biofilters	FAWB, Clearwater/ Monash, Clayton
3,4 June 2008	Assoc Prof Ana Deletic, Monash; Dr Tim Fletcher, Monash; Dr Tony Wong, EDAW: Dr Belinda Hatt, Monash	Advancing Rain Garden Design	Stormwater Industry Association, SA; Adelaide and Mt Lofty Ranges Natural Resources Management Board; FAWB; EDAW; Monash / National Wine Centre, Adelaide, SA
10,11,12 June 2008	Assoc Prof Ana Deletic, Monash; Dr Tim Fletcher, Monash; Dr Tony Wong, EDAW: Dr Belinda Hatt, Monash	Advancing the Design of Rain Gardens	Sydney Metropolitan Catchment Management Authority; FAWB; EDAW; Monash / Waterview Convention Centre: Bicentennial Park, Sydney Olympic Park, Sydney, NSW
17,18 June 2008	Assoc Prof Ana Deletic, Monash; Dr Tim Fletcher, Monash; Dr Tony Wong, EDAW: Dr Belinda Hatt, Monash	Advancing rain gardens and biofiltration systems in Western Australia	Department of Water, WA; FAWB; EDAW; Monash / Bayswater City Council, Bayswater, Perth, WA
19, 20 June 2008	Assoc Prof Ana Deletic, Monash; Dr Tim Fletcher, Monash; Dr Tony Wong, EDAW: Dr Belinda Hatt, Monash	Advancing rain gardens and biofiltration systems in Western Australia	Department of Water, WA; FAWB; EDAW; Monash / Midds Bluewater Restaurant, Middleton Beach Albany, WA

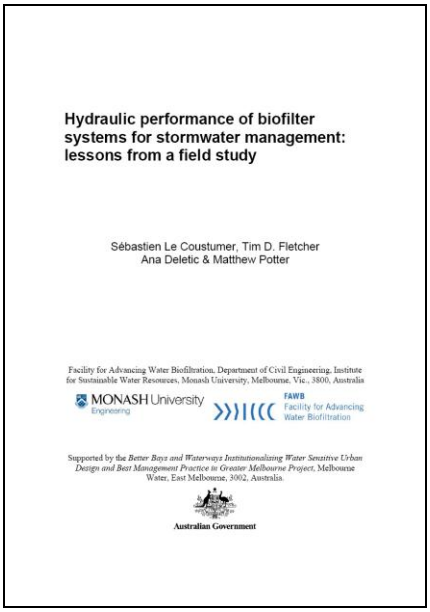
Website news

The FAWB website provided a focus for FAWB links with stakeholders and acted as a very accessible source of information on FAWB activities.

There were 43,541 successful website hits to 30 June 2008 for 2007/2008 compared to a total of 23,632 hits recorded for 2006/2007 and 2731 for 2005/2006.

Active use has been made of the publications generated by FAWB. At July 2008, a total of four reports, eleven journal paper abstracts, and eleven conference paper abstracts were posted for the guidance of users under the technical categories:

- Policy and Risk
- Filter Media
- Vegetation
- Submerged Zone
- Hydraulic Performance
- Field Studies
- Other


Hydraulic performance of biofilter systems for stormwater management: lessons from a field study

Sébastien Le Coustumer, Tim D. Fletcher
Ana Deletic & Matthew Potter

Facility for Advancing Water Biofiltration, Department of Civil Engineering, Institute for Sustainable Water Resources, Monash University, Melbourne, Vic., 3800, Australia

MONASH University Engineering

FAWB Facility for Advancing Water Biofiltration

Supported by the *Better Boys and Waterways Institutionalizing Water Sensitive Urban Design and Best Management Practice in Greater Melbourne Project*, Melbourne Water, East Melbourne, 3002, Australia.

Australian Government

FAWB report available on website

Media Outreach

FAWB activities, staff or postgraduates, were featured in some fourteen media references during 2005-2008.

For example, an article on postgraduate Yaron Zinger and his research appeared in the Melbourne suburban newspaper 'Port Phillip Leader' in August 2007. (Details of the media references are listed in the table below.)

Young water scientist Yaron Zinger. Picture: STEVEN CRABTREE N06CK501

Device to help improve health of rivers

CAULFIELD North PhD candidate Yaron Zinger won't let the rivers run dry.

Mr Zinger, 34, is one of three finalists in the 2007 "Riversymposium" Young Water Scientist Award.

The Monash student has invented a system to reduce nitrogen in fresh water to improve river health.

The "biofilter" is a tank that houses plants to reduce nitrogen levels and bring life back to unhealthy rivers.

Mr Zinger moved from Israel in March 2005 to study at Monash.

The engineering student said he had done work in genetics and cancer research, but because Australia had experienced its driest decade in 100 years, working with the environment became his priority.

Have you seen a smart way to save water or energy in your neighbourhood?

Leader Community Newspapers has begun its Greener Communities competition to reveal, celebrate and reward households, schools and businesses that are being smart about the environment.

Three winners, chosen by the Department of Sustainability and Ecovantage, will each receive an enviro-pack.

Readers can nominate themselves, their neighbours, their local school or business.

» **Go to www.leadernews.com.au and look for the Greener Communities banner**

Media References 2005-2008

Date	Medium	Title / Subject	FAWB Representative /Aspect
3 April 2006	Monash Newsline	Rain gardens to reduce pollution in Melbourne's waterways	Dr Tim Fletcher
April-May 2006	Ecos Issue 130) (Feature, page 15, in the CSIRO magazine 'Ecos – Towards a Sustainable Future')	Rain gardens buffer Melbourne's waterways	Dr Tim Fletcher
25 October 2006	Monash Memo *(Monash University website weekly newsletter)*	Biofilter garden unveiled at Clayton. A biofilter garden that collects and filters stormwater has been unveiled at the Clayton campus by the Victorian Parliamentary Secretary for Innovation and Industry, Mr Matt Viney.'	Dr Tony Wong, CEO, at Launch of FAWB, 17 October 2006
09 November 2006	Stormwater Industry Association Victoria 'SIAV E-News'	FAWB opening and launch by the Minister for Innovation and Industry, Matt Viney, on 17 October.	In the article it was noted that: 'Several SIAV Committee members were at the launch and we will work with FAWB to disseminate key outcomes of this important research.'
November 2006	Monash Magazine (Issue 18, Spring/ Summer 2006)	Trickle Down Technology	Dr Tim Fletcher and Assoc Prof Ana Deletic / Permapave porous paving slab.
14 March 2007	Monash Memo *(Monash University website weekly newsletter)*	Parliamentary delegation visits key projects	Dr Tony Wong, FAWB Project Leaders/The delegation visited the "Rain Garden" at the Facility for Advancing Water Biofiltration (FAWB) on February 26 2007.
April 2007	National Urban Water Governance Program Newsletter, Number 5, www.urbanwatergovernance.com	Transition to a Water Sensitive City	Dr Rebekah Brown/ release of working paper on 'Transition to Water Sensitive Urban Design:The Story Of Melbourne, Australia.'

Date	Medium	Title / Subject	FAWB Representative /Aspect
25 July 2007	Monash Memo *(Monash University website weekly newsletter)*	Melbourne as a model for sustainable stormwater management	Launch of report by Dr Rebekah Brown and Ms Jodi Clarke, from the University's School of Geography and Environmental Science and Facility for Advancing Water Biofiltration, authors of Transition to Water Sensitive Urban Design: The Story of Melbourne, Australia.
14 August 2007	Port Phillip Leader *(Melbourne suburban newspaper)*	Device to help improve health of rivers	Project by FAWB PhD scholar Yaron Zinger
August – September 2007	Hydroplus *(French technical journal)*	L'Australie, un pays sec gros consommateur d'eau	Interview in France with FAWB Project Leader, Dr Tim Fletcher.
12 December 2007	Monash Memo *(Monash University website weekly newsletter)*	Joint winners of Vice-Chancellor's Early Career Researcher Awards	FAWB Project Leader, Dr Rebekah Brown, from the Faculty of Arts, and Dr Travis Beddoe, from the Faculty of Medicine, Nursing and Health Sciences - joint winners of the Vice-Chancellor's Awards for Excellence in Research by Early Career Researchers.
January 2008	Urban: Sustainable Solutions for a Developing Australia *(Magazine distributed to members of the National Urban Development Industry Association (UDIA))*	A Storm of Innovation	Four-page article as follow up to the July 2007 launch of the FAWB report 'Transition to Water Sensitive Urban Design: The Story of Melbourne, Australia', by Assoc Prof Rebekah Brown and Jodi Clarke, at Treasury Place , Melbourne
6 May 2008	Faculty of Engineering website, Monash University	Sustainable water futures for Melbourne	Article on Faculty of Engineering forum as part of Monash's 50th Anniversary Public Lecture Series, held at the BMW Edge Theatre, Federation Square, 22 April 2008 (FAWB was represented by Assoc Prof Ana Deletic, and Dr Gavin Mudd, two of the four Monash speakers.)
May-June 2008	Stormwater Industry Association website (State links to national association website)	Advancing Rain Garden Design	Event notices for FAWB training workshops in Adelaide, SA; Sydney, NSW; Perth and Albany, WA, held in June 2008.

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SUMMARY OF PERFORMANCE AGAINST PROGRAM MILESTONES, PROGRAM OBJECTIVES AND APPROVED BUSINESS PLAN

Monash Carpark Biofilter

B. PERFORMANCE REPORT			
Facility for Advancing Water Biofiltration	**Progress Achieved v Planned Program Milestones**		**OUTLOOK**
	Program Milestones/ Performance Indicators/ Activities Planned (September 2006 Quarter)	**For specified activities planned Result Achieved/Not achieved**	**List any issues impacting the progress of planned activities or changes in milestones and dates.**
Task 1 – Management			
M1.1 Establishment of UJV 1-Aug-05	A1.1 Establishment of the Board	Board established under Unincorporated Joint Venture Agreement.	
	A1.2 Appointments of CEO, BM, RM, MTCM,	Appointments of CEO, BM, RM, confirmed at Board meeting of 16 Sept 2005. MTCM appointment deferred.	
	A1.3 Appointment of RAC	Research Advisory Committee established under joint venture agreement. Met as Review Panel, Sept 2006.	
	A1.4 Signing the UJV contract and collaboration agreements	UJV Agreement signed 2 August 2005. Collaboration agreements signed over period December 2005 to May 2006. Joint Venture Agreement between Monash and Ecological Engineering (EE) amended on 31 March 2008 by which the parties agreed that EE may assign its interest to EDAW. (EE and EDAW are parties to the Acquisition Deed for the transfer of EE's business to EDAW.) Novation Deed signed on 31 March 2008 between EDAW (Aust) Pty Ltd, EE and Monash by which the parties agreed to novate the Joint Venture Agreement. Under the Novation Deed, EDAW will be bound by the Joint Venture Agreement as it relates to EE and will enjoy all the rights and benefits conferred on EE under the Joint Venture Agreement. The consent of the Minister for Innovation to the novation of the Joint Venture Agreement was noted in the Novation Deed.	
M1.2 Decisions on the main business matters (Quarterly)	A1.5 Regular Management Board meetings (Quarterly)	Board meetings held 16 Sept 05, 24 Nov 05, 21 Feb 06, 25 May 06, 7 Sept 06, 23 Nov 06, 16 Feb 07, 24 May 07, 6 Sept 07, 27 Nov 07, 14 February 2008 and 22 May 2008.	

Facility for Advancing Water Biofiltration	Progress Achieved v Planned Program Milestones		OUTLOOK List any issues impacting the progress of planned activities or changes in milestones and dates.
	Program Milestones/ Performance Indicators/ Activities Planned (September 2006 Quarter)	**For specified activities planned Result Achieved/Not achieved**	
Task 1 – Management *(Cont'd)*			
M1.3 Reports of SAC (Stakeholder Advisory Committee) (4 times in first year)	A1.6a Regular meetings of SAC	SAC meetings held 4 Aug 05, 10 Mar 06, 18 Aug 06. 4th meeting held 20 April 07. 5th Meeting held on 13 Nov 07 as dinner meeting prior to Annual Workshop next day, 14 Nov 07. 6th Meeting held 11 April 2008.	
Reports of RAP (Research Advisory Panel)(Once each year)	A1.6b Annual meetings of RAP	Formal panel met on 25 and 26 September 2006. Research Review sessions held during 12-13 and 14 November 2007 with Panel meeting over 12-15 November 2007.	
M1.4 Appointment of the staff (Oct 05)	A1.7 Appointment of other staff: RF in plant sci., PhD in soil sci., MSc in crashworthiness, RF in arts, RA for field tests, Lab technician, Programmer	Staff appointed as required in Revised Business Plan. MSc in crashworthiness no longer applicable. Programmer not required. Project Leader, Project 3, appointed.	
M1.5 Submission of Progress Report	A1.8 Annual audit A1.9 Reporting to DIIRD (Quarterly)	Annual Audit completed and submitted with October 2006 and October 2007 reports. Reports submitted for four quarters to 30 June 2006; four quarters to 30 June 2007; 30 September 2007, 31 December 2007, 31 March 2008 and this quarter.	
Task 2 – Technology Development			
M2.1 Detailed technology development plan (Oct 05)	A2.1 Refining the research plan	Project research plans submitted October 2005 to Management Board and approved November 2005. Supplementary plans to research plan were completed in May 2007, based on a review of outcomes to date.	
M2.2 Design for long term sustainability (30 June 07)	A2.1 Refining the vegetation	On-track: Vegetation trials have are now published in Water Research. The results show that for nutrients particularly, there are key differences in uptake capacity, between species. Delay in writing up of 2nd paper (due to analysis delays), but task is progressing.	
	A2.2 Refining filter types	All sampling has ceased. Key findings to date: - TSS removal consistently above 90%, P above 75% and heavy metals above 95%. Nitrogen removal varies substantially with vegetation type (best for Carex and Melaleuca). Further statistical analysis is being undertaken In particular, we are using data from the last two columns to determine: 1. The influence of drier conditions on performance 2. Effectiveness of retrofitting anaerobic zone; so far this has shown that N removal is increased, but because the anaerobic zone includes soil, it results in a leaching of P. In reality, this would not occur (because the anaerobic zone would not include the soil component) Project 1 team is also working with Melbourne Water to test alternative filter media (using washed sand as a base, ameliorated to suit plant requirements). Melbourne Water is providing $85k for this research.	

Facility for Advancing Water Biofiltration	**Progress Achieved v Planned Program Milestones**		**OUTLOOK** **List any issues impacting the progress of planned activities or changes in milestones and dates.**
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M2.2 Design for long term sustainability (30 June 07) *(Continued)*	A2.3 Refining design for long term sustainability	Batch tests on the column filter media are currently completed. (undertaken by Anke Wendelborn), and analysis has begun; Gavin Mudd is undertaking this.	
M2.3 Design for multi-functionality (30 Sept 07)	A2.5 Biofilters for urban developments	Progress against A2.5 is reported in Project 3 (under Milestone Activity 4.3).	
	A2.6 Biofilters for stormwater re-use	Results to date (3 runs) show that most design configurations give very good removal (around 95-99.99%), with the exception being those with carbon + saturated anaerobic zone (which result in removals of only 40-60% often). Drought conditions results in a flush of E.coli upon rewetting, whereas the opposition occurs for the coliphages and protozoa. Journal publication of these results is being written.	
	A2.7 Biofilters for road safety	Component on crashworthiness and road safety biofilters no longer applicable.	
Task 3 – Adoption Facilitation (Policy and Risks)			
M3.1 Detailed adoption facilitation work plan (30 Oct 05)	A3.1 Refining the adoption facilitation work plan	Outline included in updated Business Plan submitted October 2005. Policy and Risk Project Plan approved by Management Board, Nov 2005.	
M3.2 Regulatory, policy and strategic guidance (30 April 06)	A3.2 Regulatory and policy	Project 2 Report on mapping the institutional transition to adoption of WSUD in Melbourne completed. Final report published June 2007. Industry launch of working document and workshop on 'Transition to WSUD' held 15 Feb 2007. Launch and Seminar on Final Report held in Melbourne for government and industry representatives, 23 July 2007. Paper presented at 2007 Novatech Conference, France. Final Report available on FAWB website.	
M3.4 Assessed risk perception, liability and opportunities (30 Jan 07)	A3.3 Risk perception, liability and opportunities	Online survey conducted and data analysed. Draft copy circulated at FAWB Annual Workshop, November 2007. Final copy launched at National Urban Water Governance Program (NUWGP) Annual Forum in Perth, 7&8 February 2008. Summary report: *'Perceptions of institutional drivers and barriers to sustainable urban water management in Australia. Survey results of urban water professionals across Brisbane, Melbourne and Perth'* available on NUWGP website.	

Facility for Advancing Water Biofiltration	Progress Achieved v Planned Program Milestones		OUTLOOK List any issues impacting the progress of planned activities or changes in milestones and dates.
	Program Milestones/ Performance Indicators/ Activities Planned (September 2006 Quarter)	**For specified activities planned Result Achieved/Not achieved**	
Task 4 – Design Tool Development (now - Adoption Tools)			
M4.1 Detailed adoption facilitation work plan (15 Nov 06)	A4.1 Refining the design tools work plan	Project 3 Research Plan discussed at 18 August 06 Stakeholders Meeting and approved at 7 September 06 Board. Project 3 title is now 'Adoption Tools' Project 3 was discussed at the Stakeholders Meeting of 20 April 2007, and at Annual Workshop, 14 November 2007 The framework of the adoption guidelines has been developed and endorsed by the team. Project Leader Belinda Hatt presented the framework at the annual workshop in 2007. The presentation was followed by a vigorous discussion (involving FAWB's main industry stakeholders). Further details on proposed industry and research activities and issues for Project 3: 'Adoption Tools' were outlined and discussed at Stakeholders Meeting No 6 on 11 April 2008.	
M4.2 Software for design of biofilters for a wide range of applications (30 Dec 07)	A4.2 Development of software (Design algorithms)	The conceptualisation of the algorithm has started. The model will draw on results from Project 1, and will be tested using results from Project 4. A database to store all the data from Project 1 and 4 activities has been developed. Quantification of the relationships between design elements and pollutant removal has begun and a "first cut" set of algorithms for nitrogen removal, based on filter media type, vegetation and presence or absence of a submerged anoxic zone, has been developed. The next step is to incorporate the influence of other design elements and hydrology into the design algorithms as well as to develop algorithms for suspended solids, phosphorus and heavy metals.	
M4.3 Design recommendations (30 April 08)	A4.3 Development of design recommendations	Details of the framework were outlined to the Review Panel and discussed at the Annual Workshop, November 2007. Several meetings have been held and the framework of the guidelines has been drafted. A focus group and workshop to further develop the guidelines was held on 25 February 2008. 11 selected participants from consulting, local and stage government attended. The revision of the filter media guideline specifications has been finalised. The revised guidelines were made available on the FAWB website on 14 March 2008. Practice Note 1: 'In Situ Measurement of Hydraulic Conductivity' was developed and added to the FAWB website in May 2008. Training workshops were held at: Adelaide, SA, 3-4 June 2008, Sydney, NSW, 10-12 June 2008, Perth, WA, 17-18 June 2008 and Albany, WA, 19-20 June 2008.	

Facility for Advancing Water Biofiltration	Progress Achieved v Planned Program Milestones		OUTLOOK List any issues impacting the progress of planned activities or changes in milestones and dates.
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Task 5 – Demonstration and Testing			
M5.1 Detailed demonstration/testing plan (24 Dec 05)	A5.1 Refining the demonstration and testing plan	Demonstration and Testing Project Plan approved by Management Board, Nov 2005.	
M5.2 Novel systems installed (Jan 08)	A5.2 Building of novel systems	FAWB is actively helping VicRoads and Melbourne Water to include novel designs into their tenders for biofilters With the Monash University carpark biofilter, in order to test the revised FAWB filter media specifications, the middle cell of the biofilter has been excavated. The excavated media has been analysed for heavy metal concentrations at surface and at depth. Replacement filter media which complies with the latest specifications is currently being sourced and tested. The cell will be planted out with 100% *Carex appressa* . Further infiltration testing of the Monash University carpark biofilter. has recently been completed to determine the role of vegetation in assisting the recovery of hydraulic conductivity. Results from this study are being compiled for a paper submitted to the 11th ICUD conference in Edinburgh August 2008. Two trial trenches in the Second Ponds Creek (Western Sydney) biofilter have been revegetated to ascertain whether vegetation, coupled with filter media developed from the FAWB specifications, will improve performance at this site. Final planting of *sporobolus virginicus* has been completed with hydraulic testing to commence once vegetation is established.	
M5.3 Field data on filter performance (May 08)	A5.3 Field testing of existing and innovative biofilter designs	Field and lab tests have been completed on existing designs. 41 biofilters were tested for hydraulic performance and metal accumulation in Sydney. Brisbane and Melbourne. Metal analyses are still underway to determine levels of toxicants in soils. The data analyses on hydraulic performance are finished. A report on this work ('*Hydraulic performance of biofilter systems for stormwater management: lessons from a field study*') has been produced for Melbourne Water. Copy included in FAWB website, 1 April 2008. FAWB has been active in the monitoring of an innovative Brisbane biofilter pod. In October 2007 FAWB conducted a third and fourth storm simulation. Flow and water quality data were collected. With the maturation of the system, and the replacement of the *Dianella* with *Carex*, improved nutrient reduction was achieved. The system already efficiently removed sediment, heavy metal and phosphorous with moderate reductions in nitrogen. However with the implementation of *Carex* the system has now been shown to remove 80% of Nitrogen. Plans are being developed to reconfigure the system with an anaerobic zone	

Facility for Advancing Water Biofiltration	Progress Achieved v Planned Program Milestones		OUTLOOK List any issues impacting the progress of planned activities or changes in milestones and dates.
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Task 6 – Marketing			
M6.1 Strategic Marketing plan established (1Nov 05)	A6.1 Industry/focus group market research - establish market needs and environment (with collaborators)	Agreements with seven FAWB Collaborators, completed: Landcom NSW, Manningham City Council, Melbourne Water, VicRoads. Brisbane CC, Auckland Regional Council (to 30 June 2006), and Adelaide & Mount Lofty Ranges Natural Resources Management Board (see also A7.2)	
	A6.2 Establish strategic marketing plans and operational objectives	Strategic Marketing Plan submitted with DIIRD report (Jan 2006) Revised Strategic Marketing Plan: 'Strategic Marketing and Stakeholders Management Plan' submitted with Jan 2007 report.	
M6.2 Strategic Marketing plan implementation commenced (1 Jan 06)	A.6.3 Internal marketing - establish consistent and robust messages and cultures within the Facility team and collaborators/partners	Board meetings, Stakeholder Advisory Committee meetings, and Annual/ Research Workshops (Dec 2005, Sept 2006, Nov 2007) have been used to enhance internal marketing.	
	A6.4 Utilise email newsletter and promotional material (including static website) to establish Facility branding, profile and positioning	FAWB logo established with letterhead and business cards produced. FAWB website came online on 31 March 2006. Brochure 'About FAWB' added 1 June 2006. Total of 2,731 successful website hits were recorded for 2005/2006. Total of 23,632 hits to 30 June 2007 for 2006/2007. Total of 43,541 hits for the 12 months to 30 June 2008. FAWB was a sponsor of the International Conference on Urban Drainage Modelling (UDM) and Water Sensitive Urban Design (WSUD), 3-7 April 2006. A FAWB display booth was prepared and set up at the UDM/WSUD Conference. The display featured project information and an experimental set-up of a biofilter column. Launch of FAWB held 17 October 2006 with over 350 invitations issued including invites to all Victorian Local Gov Councils. Parliamentary Delegation Tour held by FAWB at Monash 26 February 2007. Closer links with the Victorian Government were developed with the visit by members of the Victorian Cabinet for Bio Tech Cabinet Forum to Monash, on 12 February 2008. Assoc Prof Ana Deletic, Research Manager FAWB; and Belinda Hatt, Project Leader FAWB; gave a presentation to the delegation on FAWB, work on sustainable water resources, and proposals for the future, including further research on biofiltration.	

Facility for Advancing Water Biofiltration	Progress Achieved v Planned Program Milestones		OUTLOOK List any issues impacting the progress of planned activities or changes in milestones and dates
	Program Milestones/ Performance Indicators/ Activities Planned (September 2006 Quarter)	**For specified activities planned** **Result Achieved/Not achieved**	
M6.3 Marketing and promotion activities targeting broader stakeholders including industry practitioners and professional associations (1 Sep 06)	A6.5 Preparation of technical and industry targeted reports to establish understanding and confidence in technology as appropriate	A brochure on FAWB and its activities was prepared with copies being handed out at the International Conference on Urban Drainage Modelling (UDM) and Water Sensitive Urban Design (WSUD), 3-7 April 2006.. Project 2 Report on mapping the institutional transition to adoption of WSUD in Melbourne published as working document, February 2007. FAWB workshop held on 15 February 2007 in conjunction with the release of Project 2 WSUD working document. Final Report published in June 2007. (Launched on 23 July 2007) Guideline Specification for soil media prepared to assist planning, design, construction and operation of biofiltration systems. Available on FAWB website July 2006. (See also A7.6). 175 downloads for 2006/07; 754 downloads for 12 months to 30 June 2008. Revised guidelines were published on the website on 14 March 2008 and subscribers notified. FAWB prepared a practice note for the In Situ Measurement of Hydraulic Conductivity to assist practitioners with the assessment of the hydraulic performance of bioretention systems. Placed on website 2 May 2008. This test method is designed to complement FAWB's Guidelines for Soil Filter Media in Bioretention Systems and is accompanied by a set of example calculations (also available via the above link). Conference papers written for International Public Works Conference (Cairns, Australia, August 2007), NovaTech'07 (Lyon, France, June 2007) (12 papers presented by FAWB-related staff at Lyon). Substantial number of papers submitted to 11th International Conference on Urban Drainage, 11ICUD to be held in Edinburgh, Scotland, in September 2008. Journal papers also prepared and accepted or in review stages.	
	A6.6 Establish regular series of presentations and/or technical workshops to create awareness and understanding/implications of research results	In association with Clearwater and Melbourne Water, FAWB prepared and presented four one-day training courses on "Implementing Water Sensitive Urban Design" on:- - 30 August 2006 (Civic Centre, City of Casey, Narre Warren) - 7 September 2006 (The Mansion, Werribee) - 8 September 2006 (Emu Bottom Homestead, Sunbury) - 15 September 2006 (Melbourne Business School, Mt Eliza Industry launch of report and workshop on 'Transition to WSUD' held 15 Feb 2007. Final report launched 23 July 2007 with seminar on findings. Workshops on WSUD – 'Design of Rain Gardens' held in conjunction with Clearwater on 4, 5 September 2007(Monash, Clayton Campus) Training workshops on FAWB findings and biofilter design were held at: Adelaide, SA, 3-4 June 2008, Sydney, NSW, 10-12 June 2008, Perth, WA, 17-18 June 2008 and Albany, WA, 19-20 June 2008.	

Facility for Advancing Water Biofiltration	Progress Achieved v Planned Program Milestones		OUTLOOK List any issues impacting the progress of planned activities or changes in milestones and dates.
	Program Milestones/ Performance Indicators/ Activities Planned (September 2006 Quarter)	**For specified activities planned** **Result Achieved/Not achieved**	
M6.3 Marketing and promotion activities targeting broader stakeholders including industry practitioners and professional associations (1 Sep 06) *(Continued)*	A6.7 Annual planning/reporting w/shop	Planning workshop held December 2005. Second Annual Workshop held 26 September 2006. Third Annual Workshop held on 14 November 2007.	
	A6.8 Contribute articles/presenters to high profile events and publications within the target market	*Articles* 1. Article published in CSIRO Ecos magazine, April-May 2006. 2. MONASH MEMO: News and information for Monash University staff, 25 October 2006. Article on: 'Biofilter garden unveiled at Clayton - A biofilter garden that collects and filters stormwater has been unveiled at the Clayton campus by the Victorian Parliamentary Secretary for Innovation and Industry, Mr Matt Viney.' 3. Stormwater Industry Association Victoria 'SIAV E-News' Thu, 09 Nov 2006. Article on FAWB opening and launch by the Minister for Innovation and Industry, Matt Viney, on 17 October. In the article it was noted that: 'Several SIAV Committee members were at the launch and we will work with FAWB to disseminate key outcomes of this important research.' 4.Article , Monash Magazine, Issue 18, November 2006, , Spring/Summer 2006 'Trickle Down Technology' *FAWB Seminars, Public presentations November 2006* a) Assoc Prof Ana Deletic presented a workshop on the 'Facility for Advancing Water Biofiltration' at the Annual Stormwater Industry Association Victoria, SIAV Seminar: 'The Stormwater Alternatives' held Tuesday 14 November 2006 at the Corporate Centre, Manningham City Council, Doncaster b) Assoc Prof Ana Deletic, Dr Tim Fletcher and Dr Rebekah Brown gave presentations on FAWB and its research projects at a seminar held by the Victorian Water Engineering Branch, Engineers Australia, on Wednesday 22 November 2006 at Engineers Australia, North Melbourne. Industry launch of report and workshop on 'Transition to WSUD' held 15 Feb 2007 with presentations by Dr Rebekah Brown, Dr Tony Wong, and Jodi Clarke. Article in the 'Monash Memo' 14 March 2007 'Parliamentary delegation visits key projects Piece in: National Urban Water Governance Program www.urbanwatergovernance.com Newsletter, April 2007 Number 5, 'Transition to a Water Sensitive City' In June 2007, presentations/seminars were given by FAWB CEO, Research Manager and/or Project Leaders to University Research Groups and Gov Industry Agencies in UK, Netherlands and Singapore. Article in Monash Memo 25 July 2007 'Melbourne as a model for sustainable stormwater management'. (Launch of report by Dr Rebekah Brown and Ms Jodi Clarke, from the University's School of Geography and Environmental Science and Facility for Advancing Water Biofiltration, authors of Transition to Water Sensitive Urban Design: The Story of Melbourne, Australia.)	

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M6.3 Marketing and promotion activities targeting broader stakeholders including industry practitioners and professional associations (1 Sep 06) *(Continued)*	A6.8 Contribute articles/presenters to high profile events and publications within the target market *(Continued)*	Article: 'Device to help improve health of rivers' in 'Port Phillip Leader' 14 August 2007, on project of FAWB PhD scholar Yaron Zinger. Article: 'L'Australie, un pays sec gros consommateur d'eau' in the French technical journal 'Hydroplus' (for August – September 2007) following an interview in France with FAWB Project Leader, Dr Tim Fletcher. Presentations to Australian Water Association (AWA), Stormwater Industry Association of Victoria (SIAV) seminar on 'Climate change and stormwater opportunities', 22 November 2007: • Ana Deletic, Monash University: Researching for improved Stormwater outcomes • Peter Breen, Ecological Engineering: Cities as Catchments: As Illustrated by Royal Park Wetland and Stormwater Reuse System • Belinda Hatt Monash University: Advancing Stormwater Biofiltration Presentation to Tri-University Advanced Research Workshop 2007 6, 7 December 2007, Monash University: [The Tri-University workshop is convened by Monash University, Central South University, China, and Wuhan University of Technology, China] • Tim Fletcher, Y. Zinger, A. Deletic , Katia Bratières: Biofiltration Technologies for Treating Polluted Waters: Results of a Large Scale Laboratory Study Ti m Fletcher, Y. Zinger, A. Deletic , Katia Bratières • Ana Deletic and Tim Fletcher : Urban Water Sustainability; Focusing on Stormwater A na Deletic and Tim Fletcher, Institute for Sustainable Water Resources Article: 'Joint winners of Vice-Chancellor's Early Career Researcher Awards' in the Monash Memo, 12 December 2007. As noted under A6.4, members of the Victorian Cabinet for Bio Tech 'Cabinet Forum' visited Monash on 12 Feb 08, Assoc Prof Ana Deletic and Belinda Hatt, gave a presentation to the delegation on FAWB, work on sustainable water resources, and proposals for the future, including further research on biofiltration. The magazine 'Urban: Sustainable Solution for a Developing Australia', featured a four-page article entitled 'A Storm of Innovation' in its January 2008 edition. The article covered the FAWB report 'Transition to Water Sensitive Urban Design: The Story of Melbourne, Australia' by Assoc Prof Rebekah Brown and Jodi Clarke launched in July 2007.	

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M6.3 Marketing and promotion activities targeting broader stakeholders including industry practitioners and professional associations (1 Sep 06) *(Continued)*	A6.8 Contribute articles/presenters to high profile events and publications within the target market *(Continued)*	As part of Monash University's 50th Anniversary Public Lecture Series, the Faculty of Engineering presented a forum on 'Sustainable water futures for Melbourne' on 22 April 2008, at the BMW Edge Theatre at Federation Square. Over 200 guests including Monash alumni, members of the public, guests from the water and energy industry, Monash staff and students attended. FAWB was represented by Assoc Prof Ana Deletic, and Dr Gavin Mudd, two of the four Monash speakers. *(Article in Monash University, Faculty of Engineering website, 6 May 2008)* Assoc Prof Ana Deletic and Dr Tim Fletcher gave presentations on Monash research capabilities in water and energy, including FAWB, at a high level meeting on 6 May 2008 between GE and Monash. GE Global Research, New York; GE Infrastructure; and GE Australia & NZ were represented.	
	A6.9 External marketing - build industry conviction/confidence in the research outcomes through practical demonstration and monitoring	Launch of Monash Carpark Biofilter held on 17 October 2006 with substantial invitation list to industry. Over 350 invitations to launch sent out, including invitations to Mayor, CEO and Director Environment/ Infrastructure for all Vic Local Councils Site inspection offered with launch of FAWB at Monash Carpark Biofilter. Considerable interest in Carpark biofilter by audience including local gov reps. Soil spec on website and conference participation also used to build confidence in research outcomes. Good Industry representation at FAWB workshop held in conjunction with the release of Project 2 WSUD working document 15 February 2007. The Parliamentary Secretary for Industry and Innovation, Mr Tony Lupton, led a parliamentary delegation on a tour of FAWB facilities at Monash on Monday 26 February 2007. Government Representatives briefing and tour of FAWB facilities held 2 July 2007. Over 500 invitations sent out for to local government, consultants and Vic government agencies staff for Launch and Seminar for report on 'Transition to WSUD' held in Melbourne on 23 July 2007. The Parliamentary Secretary for Industry and Innovation, Mr Tony Lupton, launched the report. Visit by delegation from Dutch Ministry of Economic Affairs, and Canberra Embassy, 18 October 2007.	
M6.4 Industry field days, training courses and site visits delivered and well attended (1Oct 07)	A6.10 Develop industry capacity and confidence to utilise software and other tools developed from research outputs	As in A6.9, Launch of FAWB held 17 October 2006 with over 350 invitations issued including invites to all Vic Local Gov Council. Launch of FAWB and opening of Monash Biofilter combined with tour of biofilter and offered tours of lab-based research facility. Attendance of over 50 at Launch. Parliamentary Delegation Tour held by FAWB at Monash 26 February 2007. Workshops on WSUD – 'Design of Rain Gardens' held in conjunction with Clearwater on 4, 5 September 2007(Monash, Clayton Campus) Training workshops on FAWB findings and biofilter design were held at: Adelaide, SA, 3-4 June 2008, Sydney, NSW, 10-12 June 2008, Perth, WA, 17-18 June 2008 and Albany, WA, 19-20 June 2008.	

Facility for Advancing Water Biofiltration	Progress Achieved v Planned Program Milestone		OUTLOOK
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Task 7-Commercialisation			
M7.1 Revised Strategic Marketing Plan (1 Jul 07)	7.1 Refine the Strategic Marketing Plan and alignment with Business Plan to support potential commercialisation	Updated and Revised Business Plan forwarded to DIIRD on 31 May 2007.	
M7.2 Commercialisation plan completed (1 Sept 07)	A7.2 Establish and recruit key industry stakeholders with interest in development and commercialisation	Agreements with seven FAWB Collaborators, completed: Landcom NSW, Manningham City Council, Melbourne Water, VicRoads. Brisbane CC, Auckland Regional Council (to 30 June 2006), and Adelaide & Mount Lofty Ranges Natural Resources Management Board (see also A6.1) Government Representatives briefing and tour of FAWB facilities held 2 July 2007. 14 design and management staff from Depts of Innovation, Industry & Regional Development, Human Services, Sustainability and Environment, and Environment Protection Authority attended. 70 industry and R&D participants from consulting engineering, landscape architecture, plumbing industry, and local government were briefed on FAWB projects, activities and technologies at the Rain gardens design training held in conjunction with Clearwater, 4, 5 September 2007. FAWB Stakeholders and other industry collaborators participated in Annual Workshop, 14 November 2007. An extensive schedule of presentations to potential water industry partners or stakeholders was undertaken by the FAWB leadership group during April to June 2008 regarding the proposal for future research entitled 'Cities as Water Supply Catchments'. An outline of the program is shown below with the main presenters listed: - 7 April 2008, Over 20 staff of DIIRD, DSE, Treasury and State Cabinet. (Dr Tony Wong, Assoc Prof Ana Deletic) - 24 April 2008, Councillors and Executive of the City of Manningham including the Mayor and the CEO of Manningham City Council(Assoc Prof Rebekah Brown, Assoc Prof Ana Deletic) - 24 April 2008, Dr Phillip Johnstone, Director Sustainability, Recycling and Innovation, Office of Water, Department of Sustainability and Environment, Victoria (Dr Tony Wong, Assoc Prof Rebekah Brown, Dr Tim Fletcher, Assoc Prof Ana Deletic) - 30 May 2008, Melbourne Water senior group including Chair Cheryl Batagol, Managing Director Rob Skinner, and Gen. Mgr Chris Chesterfield . (Dr Tony Wong, Assoc Prof Rebekah Brown, Dr Tim Fletcher, Assoc Prof Ana Deletic) - 2 June 2008, Department of Sustainability and Environment (Dr Tony Wong,Assoc Prof Rebekah Brown, Dr Tim Fletcher, Assoc Prof Ana Deletic) - 4 June 2008, Water Services Association of Australia (WSAA), Executive Director, (Dr Tony Wong, Assoc Prof Ana Deletic) - 5 June 2008, National Water Commission and officers of the Department of Environment, Water, Heritage and the Arts (Follows earlier submission of a full research proposal to the National Water Commission) (Dr Tony Wong, Assoc Prof Rebekah Brown, Dr Tim Fletcher, Assoc Prof Ana Deletic) - 25 June 2008, Department of Innovation, Industry and Regional Development (DIIRD) Executives, (Dr Tony Wong, Assoc Prof Ana Deletic)	

Facility for Advancing Water Biofiltration	Progress Achieved v Planned Program Milestones		OUTLOOK List any issues impacting the progress of planned activities or changes in milestones and dates.
	Program Milestones/ Performance Indicators/ Activities Planned (September 2006 Quarter)	**For specified activities planned** **Result Achieved/Not achieved**	
Task 7-Commercialisation *(Cont'd)*			
M7.2 Commercialisation plan completed (1 Sept 07) *(Cont'd)*	A7.3 Review in detail identified market needs and context for application.	Identifying market needs and application of biofilter technology continue as pivotal components of Project 4 'Demonstration and testing'. FAWB has tested novel biofiltration systems constructed by Stakeholders in consultation with FAWB, tested a number of existing systems, and engaged industry on the design, construction, operation and maintenance of biofilters. The infiltration capacities of 41 biofilters were tested in situ at 18 sites in Melbourne, Sydney and Brisbane. FAWB Stakeholders, Melbourne Water and Brisbane City Council, have noted that: (a) demonstration projects were a key part of the FAWB Business Plan from the Stakeholders' perspective; (b) without demonstration sites and projects, Stakeholders, local councils, and the urban development industry, would not be able to assess facilities and proceed with the adoption of innovative biofiltration technologies.	
	A7.4 For each potential commercialisation product, establish detailed plans for management of legal, financial, marketing and production aspects	Possible external collaborations involving the potential protection and exploitation of intellectual property associated with the second generation of biofilter technology, such as the role of the anoxic zone, were considered. FAWB's aim of providing its information to the public domain had been emphasised in discussions. This approach to intellectual property was seen as consistent with the spirit of the STI Grant. Accordingly, it had been decided not to participate in collaborations where intellectual property would be withheld from industry and other end-users. FAWB has continued to provide wide exposure of its findings through its website 'Key messages' and training sessions such as: * 4, 5 September 2007 'Rain gardens design' courses held in conjunction with Clearwater. * Workshops on FAWB findings and biofilter design held at Adelaide, SA, 3-4 June 2008; Sydney, NSW, 10-12 June 2008; Perth, WA, 17-18 June 2008; and Albany, WA, 19-20 June 2008.	

Facility for Advancing Water Biofiltration	Progress Achieved v Planned Program Milestones		OUTLOOK List any issues impacting the progress of planned activities or changes in milestones and dates.
	Program Milestones/ Performance Indicators/ Activities Planned (September 2006 Quarter)	**For specified activities planned** **Result Achieved/Not achieved**	
M7.3 Commercialised products introduced to market (1 Jun 08)	A7.5 Develop prototypes for demonstration & industry testing - work with industry collaborators to refine products to meet target market needs	To be identified, scoped and developed.	
	A7.6 Develop market ready products/knowledge in partnership with SMEs and other partners/co-investors	Guideline Specification for soil media prepared to assist planning, design, construction and operation of biofiltration systems. Available on FAWB website July 2006. (See also A6.5). Updated guidelines published 14 March 2008.	
	A7.7 Establish clear channels for launch, promotion and delivery of products to market	Links to industry via Collaborators/Stakeholders being pursued. Launch of Monash Biofilter combined with tour of facility Oct 2006.. Soil spec on website and conference participation also used to build confidence in research outcomes from July 2006 onwards. Industry launch of report and workshop on 'Transition to WSUD' held February 2007. Launch and seminar on 'Transition to WSUD' Final report held 23 July 2007. Workshops on Design of Rain Gardens held in conjunction with Clearwater on 4, 5 September 2007 at Monash, Clayton Campus. Workshops on FAWB findings and biofilter design held at Adelaide, SA, 3-4 June 2008; Sydney, NSW, 10-12 June 2008; Perth, WA, 17-18 June 2008; and Albany, WA, 19-20 June 2008.	
M7.4 Income stream established for Facility (1 Jun 08)	A7.8 Implement industry targeted integrated marketing communications strategy to establish and support product offer in market place.	As noted under A7.3, an extensive schedule of presentations to potential water industry partners or stakeholders was undertaken by the FAWB leadership group during April to June 2008 regarding the proposal for future research entitled 'Cities as Water Supply Catchments'.	
	A7.9 Ongoing product support & development. (new product launches or extensions)	Ongoing product support & development falls within the future options for the FAWB joint venture. As discussed by the FAWB Board, a continuing FAWB joint venture could be a partner or participant in a successful 'Cities as Water Supply Catchments' consortium.	