



NATURE CITY SEMINAR

Book of Abstracts

Perth, 26-28 June 2019

Showcasing the latest research and best practice case studies to improve WA's capacity to manage, enhance, design, and connect with nature in urban areas.

Editor: Dr Lucy Commander

NATURE CITY SEMINAR: Wednesday 26th June

9.00 am – 10.30 am Session 1 Chair: Lucy Commander

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| Kerry-Ann Winmar | Welcome to Country |
| Paul Bodlovich Perth NRM | Welcome to Nature City |
| Lucy Commander Nature City | Introduction |
| Richard Hobbs* University of Western Australia | The city versus nature, or the city with nature: Choices, barriers and opportunities |
| Julia Cullity Parks and Wildlife Service | Looking to the past, present and future: community contributions in caring for bush in the city |
| Alison Ritchie University of Western Australia | Banksia woodlands: 30 years in review |

10.30 am Morning tea

11.00 am – 12.30 pm Session 2 Chair: Ben Miller

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| Luisa Ducki* Rehabilitating Roe 8 / Murdoch | Roe 8 recovery |
| Bruce Webber* WABSI | Prioritising solutions for improving urban biodiversity resilience |
| Ingrid Sieler Perth NRM | Perth NRM's Community Capacity Survey |
| Mark Brundrett University of Western Australia | Several complimentary plant establishment methods are required to restore banksia woodland |
| Tom Atkinson Emerge Associates | Can vegetation condition assessment provide a good benchmark for restoration? |

12.30 pm Lunch

1.30 pm – 3.00 pm Session 3 Chair: Ingrid Sieler

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| Jane Chambers* NatureLink Perth / Murdoch | NatureLink Perth |
| Jason Pitman* Perth NRM | ReWild Perth |
| Christine Allen Greening Australia | Using a whole of metropolitan approach to urban greening |
| Christine Richardson Urban Bushland Council WA Inc. | Saving Urban Bushland, piece by piece, year after year, again and again |
| Peter Mawson Perth Zoo, Department of Biodiversity, Conservation and Attractions | Bush Stone-Curlew Reintroduction to Metropolitan Perth |

3.00 pm Afternoon tea

3.30 pm – 5.00 pm - Session 4 Chair: Bruce Webber

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| Tegan Douglas BirdLife Australia | Flocking together: Connecting urban communities with nature |
| Trish Fleming Murdoch University | Foxes in urban bushland – movements, refuge, and diet |
| Juliana Pille Arnold University of Western Australia | Rediscovery of the presumed extinct Douglas's Broad-headed bee in Perth's northern suburbs, and why it matters |
| Ian Toleman City of Kalamunda | To catch a fox: the pest control program at Kalamunda. |
| Christine Groom University of Western Australia | Urban living for black cockatoos: hazards and solutions |
| Joseph Caspersz-Loney Murdoch University | Quenda or rat? |

NATURE CITY SEMINAR: Thursday 27th June

9.00 am – 10.30 am Session 1 Chair: Lucy Commander

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| Susan Prescott* Telethon Kids | Nature and Microbes: The importance of biodiversity for personal and planetary health |
| Catrina Luz Aniere Millennium Kids Inc | Green Lab - a youth led project focusing on increasing canopy to cool the planet |
| Johanna Riddell Bold Park School | Putting more nature into Natureplay |
| Yuqi Yang University of Western Australia and CRC for Honey Bee Products | Botanic gardens as unique urban bee habitats and places for interaction with nature |
| John McBain Australian City Farms and Community Gardens Network | Natural settlements: past, present and Future |

10.30 am Morning tea

11.00 am – 12.30 pm Session 2 Chair: Alison Ritchie

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| Jana Soderlund* Biophilic Solutions, Biophilic Cities, Curtin University | Integrating Nature and the Built Environment through Biophilic Design |
| Maria Ignatieva* University of Western Australia | Urban biodiversity and nature based solutions. Experiences from Europe, New Zealand and Australia |
| Danica-Lea Larcombe Edith Cowan University | Living on a higher floor level is a deterrent to leading a 'naturalistic' lifestyle – rethinking design of apartment buildings |
| Emma Ligtermoet University of Western Australia | Leaf my neighbourhood alone! Will densification destroy Perth's urban forest? |

12.30 pm Lunch

1.30 pm – 3.00 pm Session 3 Chair: Jana Soderlund

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| Georgia Garrard* RMIT / TSR Hub | Biodiversity Sensitive Urban Design |
| Emma Yuen* CRC for Water Sensitive Cities | What is a water sensitive city? |
| Clare Mouat University of Western Australia | Native gardens on street verges: perspectives from residents and ongoing research into the social and ecological values of verge transformation |
| Fahimeh Mofrad University of Western Australia | The Importance of Green Infrastructure in Sustainable Development of National Capital of Australia, Canberra |

3.00 pm Afternoon tea

3.30 pm – 5.00 pm Session 4 Chair: Jason Pitman

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| Bonnie Beal Richardson* City of Mandurah | Designing environmental programs that support people (and people want to support) |
| Kevin Kenneally Western Australian Gould League Inc. @Herdsman Lake Wildlife Centre | Are we failing future generations? The challenges of promoting natural sciences in a climate of urban expansion, relentless change and digital dominance. |
| Mick Davis City of Kalamunda | Environmental Education and Engagement at the City of Kalamunda |
| Lucy Commander | Wrap up |

A note from the Chairperson

Nature City Seminar was held from 26th to 28th July 2019 at the South Perth Community Hall, in Perth, Western Australia. Supported by Perth NRM, the event was designed showcase the latest research and best practice case studies to improve our capacity to manage, enhance, design and connect with nature in urban areas in WA.

A key objective of the seminar was to bring together researchers, practitioners, local & state government, policy makers, urban planners, landscape architects, industry, volunteers & NGOs to facilitate new science-practice partnerships and innovative inter-disciplinary collaboration. 160 people attending across the three days, from 70 organisations.

On Wednesday 26th, presentations encompassed Banksia Woodland conservation and restoration, ideas to increase biodiversity in urban areas, and conservation and reintroduction of fauna.

Thursday 27th June focused on the importance of biodiversity for health, connecting people with nature, design that incorporates or is inspired by nature (biophilic design, biodiversity sensitive urban design, water sensitive cities), and environmental education programs.

A choice of field trips was offered on Friday 28th including a behind the scenes tour of Kings Park; an interactive workshop to showcase education activities for quenda research; a visit to Herdsman Lake Wildlife Centre; a tour of Honeywood Wetlands; and a visit to Chittering and discussion on community engagement in Threatened Species conservation.

Thanks to all the sponsors, organisations which provided in-kind support, and the steering committee. In particular, thanks to The City of South Perth for hosting the event.

Dr Lucy Commander

Chairperson, Nature City Seminar

Using a whole of metropolitan approach to urban greening

Christine Allen

Greening Australia

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Nature in Cities is Greening Australia's program which aims to enhance nature and provide benefits to people in Australia's cities and suburbs. Over the next three years we will create a Nature in Cities plan for all of Australia's capital cities. We aim to increase vegetation cover in all Australian capital cities to at least 30% by 2050. Nationally, Greening Australia is taking an approach that plans strategic on-ground action at a whole of metro level, city-by-city, without jurisdictional constraint and guided by the sciences of urban ecology and urban heat island.

We use a range of data sets to prioritise where large-scale, on-ground projects can be focused, how much they will cost and who the key collaborators are to be most cost effective and deliver impact for climate, people, water and biodiversity.

This talk showcases our Nature in Cities plans and flagships projects already in place for Sydney, and sets up the question - what's the plan for practical action at scale in Perth?

Cooling the Schools and South West Sydney Koala restoration projects are practical examples of the planning, on-ground delivery and funding of large-scale urban greening projects that are replicable across all Australian cities.

We're keen for this talk to stimulate discussion about how we can collaborate to deliver a prioritised plan and flagship projects all aimed at increasing vegetation cover in Perth to at least 30%.

Green Lab - a youth led project focusing on increasing canopy to cool the planet

Catrina Luz Aniere

Millennium Kids Inc

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Green Lab, is a youth led sustainability initiative, focussing on the UN Sustainability Goals #lifeonland and #climateaction, through individual and collective action in the Perth metropolitan area.

Hear about how kids, 10 - 24 years, are making change through Green Lab, local projects developed by local kids to increase and care for tree canopy in the Perth metropolitan area. Using a student centred design approach, using the MK 'Skills for Life' methodology, kids address the sustainability goals, learn new skills, meet scientists, poets, artists and indigenous leaders and activate their site with the wider community. With 25 years experience connecting kids to the environment, with real outcomes for kids and nature, Millennium Kids Green Lab projects aims to bring together the best of the best. Education, behaviour change, community action, design and innovation and rules and regulations are tackled through an experiential process with kids identifying solutions to the big problems, researching and implementing projects at a local level and activating those spaces with the wider community.

Millennium Kids is currently working on a range of pathways for young people both through community and school based initiatives, building long term strategies to connect children to nature and protect and enhance canopy to cool the planet. Wesley College, Trillion Trees, City of Bayswater, Department of Biodiversity and Attractions and Leeming Lions are supporting the first pilot projects with 10 local schools developing their Green Lab initiatives.

Can vegetation condition assessment provide a good benchmark for restoration?

Tom Atkinson

Emerge Associates

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Decisions are often made as to the retention value or management requirements of remnant native vegetation on the basis of its condition. Vegetation condition assessment is therefore an important and consequential input into urban environmental management. Conceptually, vegetation condition assessment is also applicable to the evaluation of restored vegetation. Increasingly restoration objectives for urban bushland are requiring that a specified vegetation condition state is achieved.

In Western Australia vegetation condition has commonly been classified through the qualitative assessment of categorical schemes (Keighery 1994, Trudgen 1988). Applying a qualitative approaches is pragmatic as vegetation condition can be assessed relatively rapidly. However, outputs can be inconsistent across assessors, especially when the condition of vegetation appears to be at the boundary between two condition categories. Nonetheless, as quantitative approaches are often too labour intensive to be applied routinely, there remains a need for an efficient qualitative approach to assess vegetation condition.

In order for categorical schemes to provide a reliable benchmark for the evaluation of restoration, consistency in methodology is required both at conceptual level and with regard to diagnostic criteria and decision logic. In this presentation the Keighery (1994) scheme commonly applied on the Swan Coastal Plain is discussed to demonstrate that, with clarification, vegetation condition assessment can be extended to inform both the planning and evaluation of restoration projects.

Designing environmental programs that support people (and people want to support)

Bonnie Beal Richardson

City of Mandurah

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Working with volunteers and community can be as challenging as it is fulfilling. In a world with so much going on, increasing participation in environmental education programs can feel like you're trying to push the proverbial uphill. For many years, increasing volunteer hours was the main indicator of success for such programs, but is that really the best way to encourage sustainable, long-term participation or has it started reducing people to a convenient measurement?

Our community is beginning to expect higher levels of fulfilment, purpose and passion in their lives, and from the activities they participate in. It's our job to design programs to meet these changing needs, and to make caring for and connecting with the natural environment a higher priority for as many people as possible.

Using examples from the City of Mandurah, this talk will showcase community environmental projects, research collaborations and strategic volunteer development. It will also share tools for establishing effective environmental education programs that are supported by organisations, volunteers and the broader community.

Several complimentary plant establishment methods are required to restore banksia woodland

Mark Brundrett¹, Anna Wisolith², Margaret Collins², Vanda Longman² and Karen Clarke²

¹*University of Western Australia, Department of Biodiversity, Conservation & Attractions*
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Six years of comprehensive monitoring of three restoration sites with 60 ha in total suggest it may be possible to restore banksia woodland, but also identified major challenges and limitations. We analysed plant cover and abundance trends and vegetation structure relative to reference sites. The majority of native species (100 out of 160) primarily germinated from respread topsoil. However, important species including all the trees were missing from that source, so required planting or direct seeding. Thus, the restoration of banksia woodland requires several complimentary methods. We believe that restored areas with respread topsoil, planting and seeding are on a trend to recovery, but will take decades to reach some targets, while areas with only planting and seeding may become a separate vegetation type. It is very challenging to evaluate differences in flora and vegetation between restored and reference sites, since the reference sites were very different from each other due to very high beta diversity in banksia woodland. Another key finding was that the relative dominance of different plant functional groups changes over time, with disturbance opportunists initially dominant then declining back into the soil seed bank. Evidence for resilience of this restored ecosystem was provided by abundant pollination and seed set for many species and the presence of second-generation seedlings of understory plants and trees. However, longer-term monitoring is required to confirm that restoration has been fully successful.

Quenda or rat? Residents' perceptions of quenda and suggestions for future management.

Joseph Caspersz-Loney

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The rapid urbanisation of the Swan Coastal Plain as part the Perth Metropolitan Region has resulted in widespread displacement of native wildlife. However, quenda (*Isodon fusciventer*), are maintaining populations within this urban matrix, frequently interacting with human residents. Significant interactions occur between quenda and human residents on private property, areas often heavily modified to suit human interests, but with potential to provide critical resources for quenda. The possible relationships between residents' perceptions of quenda and their interactions with quenda is unknown, however exploring these relationships could be integral to maintaining urban quenda populations. We interviewed 61 residents in the City of Mandurah on their perceptions of quenda, and how they interact with quenda in their garden. It emerged that 57% of residents initially mistook quenda for rats and instances where quenda are shot or poisoned due to misidentification do occur. However, grassroots movements are underway to redress this misconception. Residents readily communicate with each other regarding quenda, including correcting misidentification, and actions from local councils, such as installing bandicoot-crossing signs, alert residents to quenda presence. It is suggested that programs to increase community awareness of quenda are urgently required and that existing programs should be extended. A considerable level of pre-existing community engagement was found to exist around quenda, and raises the possibility of quenda being utilised as a vehicle to increase community participation in conservation projects and for quenda to be used as a flagship species for urban conservation in Perth.

NatureLink Perth

Jane Chambers

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NatureLink Perth is a new initiative to connect and coordinate a diverse array of stakeholders to champion nature sensitive urban design and nurture a biodiverse and livable city. There is currently no holistic strategy or plan informed by ecological understanding to conserve our natural estate or integrate nature into our city. The loss of our world class biodiversity through individual planning decisions - death by a thousand cuts - is not sustainable. NatureLink Perth advocates systems thinking. Currently our natural assets are scattered in disconnected parts across Perth. As ecosystems work through linkages, we need to be thinking of interconnectedness and the how the whole of the natural estate can be sustained. Similarly, many people in Perth with knowledge, ideas and projects about how to better manage nature are working in isolation, in silos. NatureLink Perth seeks to bring all stakeholders together - to hear and understand different perspectives and find a common ground - working together to create an agreed way forward. The perspectives and information obtained from our 70+ face-to-face stakeholder meetings are being collated to find out 'What needs to be done to enable nature sensitive urban design and nurture a biodiverse and livable city?'. This is the topic of the Naturelink Perth symposium on 4th July 2019, which has been strategically and creatively planned so that everyone can interactively participate throughout the day. If you are lucky there may be a last-minute ticket left: go to naturelinkperth.org. Let's make Perth a great place to live - for all species.

ReWild Perth

Jason Pitman

Perth NRM

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Our ReWild Perth campaign started in 2017 when we envisioned a city enriched with the return of our long-lost native wildlife and a permeable urban landscape fostering biodiversity. We will empower the community by providing accessible information and experiences to drive behaviour change to enhance urban habitat and encourage the return of our wildlife. Communal effort will drive the success of ReWild Perth. We will incentivise early participation and community interest by subsidizing or providing plants, habitats, and signage.

To mobilise the community, we will work with our partners to run communication campaigns, community events, and school-based education to share information and empower the Perth community. ReWild Perth will make urban habitat an authentic educational theme by aligning resources, incursions and excursions with the curriculum. Students and teachers will be inspired and equipped to grow and provide habitat for wildlife at school and at home. Perth NRM is partnering with Birdlife Australia to develop the ReWild Perth website, due to be launched by September 2019. The website is a critical step in launching the campaign. One backyard at a time, working together, our community can bring nature back to the suburbs.

Looking to the past, present and future: community contributions in caring for bush in the city

Julia Cullity

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A look backwards and forwards to recognise and build on the legacy of community efforts in Perth's bushland management and conservation. Delving into the Bushland News/Ecoplan News archives I'll review some of the actions, values, partnerships and outcomes that community groups have achieved and maintained to protect bushland. How to support community action, what has worked, where to next?

Environmental Education and Engagement at the City of Kalamunda

Mick Davis

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The City of Kalamunda is located on Perth's urban fringe, straddling the Swan Coastal Plain and Darling Ranges and provides a gateway for people to access many spectacular local, Regional and National Parks. With over 260 Local Natural Areas to manage, the City's Parks & Environment team cultivates partnerships with the local community and other stakeholders to manage the high biodiversity values within its reserve system.

Our community education program is delivered at a local and regional level, providing ongoing opportunities for our community to learn about plant identification, weed control Phytophthora Dieback management, erosion control, local fauna, the impact of invasive animals of biodiversity and more.

The new Adopt-a-Patch program works with local schools to increase our youth's knowledge and skills on topics including Aboriginal Culture, Waste & Recycling, Flora and Fauna identification and protecting local habitats. Adopt-a-Patch is currently engaging almost 500 students and we expect this program to grow in the future.

An ongoing partnership with Edith Cowan University is helping us to seek answers to more complex questions like how Wavy-leaved Smokebush (*Conospermum undulatum*) responds to prescribed burning and the potential reduction in recent pollinator availability.

This highly visual presentation will showcase a selection of environmental programs delivered by the City of Kalamunda and demonstrate how monitoring these programs has provided confidence to our community, internal and external funders to continue supporting our ongoing environmental education and reserve management program.

Flocking together: Connecting urban communities with nature

Tegan Douglas

BirdLife Australia

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As part of a three-year collaboration with multiple stakeholders (including Perth NRM, Cities of Cockburn and Joondalup) and supported by Lotterywest, BirdLife Australia is leading a multi-faceted program that uses birds as a centrepiece to connect urban communities with nature. The scope is broad, but in all elements the project encourages urban residents to look beyond their back fence, to see the potential for habitat creation across the landscape and the benefit of birds as part of a healthy urban ecosystem. As part of the project, we are quantifying the current state of our urban birds and identifying the characteristics of urban bushland that are critical for urban-declining birds, by conducting bird monitoring in urban bushland remnants. We are working with local councils to identify corridors in established suburban spaces for targeted work to connect existing remnants - across varied landscapes. This necessitates sharing knowledge and successes on working at a variety of scales - from private residence to bushland reserve. To further this, we are partnering with Perth NRM to bring ReWild Perth to life - a web platform to demonstrate the benefit that a multitude of small individual actions can have on our urban spaces, through collective knowledge and sharing. The project will run until at least 2021, and anyone interested in being involved in any of these components is encouraged to get in touch.

Roe 8 recovery

Rachel Standish, Luisa Ducki

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Roe 8 Recovery. The Roe 8 corridor was cleared of native vegetation in February 2017. Motivation to restore the Roe 8 corridor emerged soon after and ultimately resulted in the development of a ten-year rehabilitation plan for the corridor. My colleagues, students and I have tracked the recovery of native vegetation at the Roe 8 corridor 7 months and 18 months after the clearing disturbance. Density, species richness and percentage cover of native perennial species was monitored in permanent plots across seven ecosystem types. Data on vegetation recovery were benchmarked to reference woodlands to assess progress against restoration goals listed in the ten-year Rehabilitation Management Plan. These data suggest recovery is on-track for most ecosystem types, and particularly banksia-woodypear and banksia-jarraah ecosystem types. We found no evidence of mulch, soil compaction and soil pH influencing recovery. Intervention may be necessary to return trees to banksia-blackbutt and holly-leaved banksia woodlands. Ongoing weed control is likely to be required especially in the banksia woodland ecosystem type. Overall, vegetation recovery at Roe 8 is on track. I conclude the talk with some reflections on the novel blend of science, education, community involvement and restoration practice.

Foxes in urban bushland – movements, refuge, and diet

Trish Fleming, Edward Swinhoe, Heather Crawford, Bill Bateman, Peter Adams, Halina Kobryn

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Animals such as the red fox (*Vulpes vulpes*) have had marked impacts on the biology of the Australian continent. Together, the red fox and feral cat are recognised as the major contributors to extinction and decline of Australian native species, and these species represent a major conservation threat, including in the urban landscape. The red fox has established populations in over 100 cities across the world. Their success as an invasive species reflects their highly adaptable and generalist ecology: they have very few specific habitat requirements and opportunistically use a diverse range of foods. And they are smart - adapting their behaviour to avoid conflict with people. Here in Perth, foxes are present across many urban bushland reserves, with numbers controlled on an ad hoc basis by pest management services contracted by Shire or City Councils. Here we describe data on movements, refuge, and diet of Perth foxes. Increasing understanding of urban fox biology will help improve our ability to manage them.

Everyday nature and biodiversity sensitive urban design

Georgia Garrard, Sarah Bekessy

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Cities around the world are facing unprecedented challenges to maintaining liveability, and an emerging body of evidence is revealing the potential of nature in cities to address them. As a result, many cities are preparing greening strategies and investing in green infrastructure. Yet while green is good, biodiverse may be better. Our most rapidly growing cities are located in biodiversity hotspots and, by area, Australian urban regions are home to three times as many threatened species as their rural equivalents. Urbanisation remains one of the greatest drivers of biodiversity loss; addressing the negative impacts of urbanisation on biodiversity through sensitive urban design and development could benefit some of Australia's most threatened species, while also reconnecting urban residents to nature. Yet this will require a critical shift in the way we consider conservation in urban environments; away from off-site offsetting and towards the on-site provision of habitat and resources within the built form. We developed a protocol for biodiversity sensitive urban design that seeks to provide guidance for planners and urban designers about creating urban environments that make a positive contribution to biodiversity. Biodiversity sensitive urban design is a set of ecological principles as well as a process for reconciling biodiversity objectives with other urban development objectives. We introduce biodiversity sensitive urban design and provide a number of worked examples of how it can be applied to new and existing urban environments.

Urban living for black cockatoos: hazards and solutions

Christine Groom¹, Peter Mawson²

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Flocks of threatened Carnaby's cockatoo, *Calyptorhynchus latirostris*, Baudin's cockatoo, *C. baudinii* and Forest red-tailed black-cockatoo, *C. banksii naso*, are seen regularly in the suburbs of Perth. They feed on many native and exotic species in home gardens, road verges and parks, and roost at night in both native and planted tree species. Their proximity to humans, traffic and other hazards has meant that 2,195 black cockatoos were admitted to Perth Zoo for treatment between 2006 and 2018. Around one third of all cockatoos admitted to the Perth Zoo veterinary department had injuries directly related with human activities (i.e. vehicle strike, gunshot, collision with fixed objects, tree felling). The cockatoos are slow to gain height when taking flight meaning that food resources and drinking opportunities close to or on roads pose a significant hazard. Injured birds were reported from some suburbs more than others suggesting that there were attributes about the habitat in these suburbs that made them more attractive or hazardous to black cockatoos. Solutions to the problem include improved traffic management, providing advice on optimal choice of suitable roost tree and cockatoo food species, planting situations for providing safe foraging and advice on engineering and reticulation strategies to reduce the incidence of ponded water on or near roadways. Example projects aiming to provide safe foraging solutions for black cockatoos will be described.

The city versus nature, or the city with nature: Choices, barriers and opportunities

Richard Hobbs

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Perth is a rapidly growing city plonked on top of an area with a unique biological and cultural heritage. The original nature of the area was, for the most part, historically viewed as being unnecessary impediment to the development of the city. Only relatively recently have its importance and values begun to be more widely recognized. Perth's unique natural systems and the species they contain remain patchily protected and vulnerable to ongoing threats from development, with climate change and a range of other pressures added in. Where the city clashes with nature, the city usually wins - few development proposals fail on the basis of the values of the nature they are displacing. In addition, offsets have been shown to be of dubious value and the effectiveness.

How then do we move from an adversarial relationship between the city and nature to a more symbiotic one? Barriers include the various knowledge and management gaps that will be discussed at this meeting, but most important perhaps is the lack of political and social will to formulate effective planning and conservation measures. Opportunities include building on efforts by local groups, exemplified by Roe 8, to swing momentum towards a more balanced approach to incorporating nature in city life. I explore how simple changes in how we collectively and individually make choices can positively influence conservation outcomes.

Urban biodiversity and nature based solutions. Experiences from Europe, New Zealand and Australia

Maria Ignatieva

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Urban landscapes today use similar global patterns in urban planning and landscape design. Ecological and aesthetical homogenisation of the urban environment is a reality, which need be addressed. Native biodiversity is one of the most powerful components to creating of a new generation of landscape architecture aesthetics-biodiversinesque (as an antipode to dominant western picturesque-gardenesque styles) based on ecological principles. Nature-based solution philosophy roots in the knowledge of native and man-made ecosystems as well as on understanding landscape design principles. Our vision of nature-based solution is to design truly sustainable and resistant urban biotopes (biodiverse and water sensitive), which will provide a range of ecosystem services. There are several successful examples of practical solutions such as ‘plant signatures’ in New Zealand, ‘tapestry lawns’- a new version of biodiverse sustainable urban lawns and ground covers that would perform well in harsh urban conditions such as heavy tramping and droughts (examples from Sweden and United Kingdom) and urban meadows, implemented in Sweden, Germany, England and United States. Another innovative approach to designing public spaces in Germany is ‘Go Spontaneous’. There is a new generation of native private and public gardens in both Northern and Southern hemispheres. This presentation includes examples from real experimental sites in Sweden, UK, Germany, Australia, New Zealand, USA and China.

Are we failing future generations? The challenges of promoting natural sciences in a climate of urban expansion, relentless change and digital dominance

Kevin Kenneally

Western Australian Gould League Inc. at Herdsman Lake Wildlife Centre
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Protection of our unique environment is an inter-generational responsibility. Since its establishment in 1939, The Western Australian Gould League (WAGL) has made significant and critical contributions to environmental education throughout Western Australia. The Gould League recognises that field excursions are important part of STEM, as not all learning is done in the classroom.

The environmental and indigenous programs conducted at the Herdsman Lake Wildlife Centre (established in 1984), are based around the importance of urban freshwater ecosystems and their composite food webs and life cycles of the plants and animals. Herdsman Lake is a living scientific laboratory that simply cannot be replicated in a classroom or elsewhere, and provides hands-on experiential learning for over 7000 students, annually, at one of the few remaining large wetlands on the Swan Coastal Plain.

Economic pressures brought about by ever increasing operating costs, loss of State government funding for the Wildlife Centre staff and minimum investment of State and Federal governments in environmental protection and education, are all impacting on the functional role of the Gould League.

In order to continue providing an essential educational role to the schools and public of Western Australia, the Gould League has adopted new marketing strategies in seeking support funding as well as enhancing its digital resources profile online; all with the aim of fulfilling its mission statement to ‘Nurture a passion for nature through education, innovation and communication’.

Bandicoot-in-a-box: Educational resource for teachers and community groups

Amanda Kristancic, N. Tay, P.A. Fleming, G.E.StJ. Hardy, C. Baudains

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Western Australians are lucky to share our many of our urban areas with quenda (*Isoodon fusciventer*), who play a pivotal role in maintaining the health of urban bushland, e.g. through dispersal of fungi spores and positive impacts on tree health. These native bandicoots use remnant urban bushland as well as private residential gardens, but are threatened by habitat loss, introduced predators (including pets), vehicle strike, and negative interactions with humans (e.g. baiting/trapping, and being fed inappropriate food). Engaging with and educating the local community is crucial to address these threats and improve the success of urban conservation projects. Our multidisciplinary research team have developed a range of novel methods to communicate quenda ecology and the importance of conserving quenda, to the general public. This has culminated in the 'Bandicoot-in-a-box' curriculum-linked educational resource, which includes activities and games that can be used by teachers and community groups to provide information about quenda ecology in a fun and engaging way. This presentation will describe the development of the resource, outline the results of evaluation completed to date, and summarise feedback that has been received. It is hoped this may serve as inspiration to others looking to engage the community in novel ways.

Living on a higher floor level is a deterrent to leading a 'naturalistic' lifestyle – rethinking design of apartment buildings

Danica-Lea Larcombe

Edith Cowan University

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The term 'grass roots' makes one think of our evolutionary past living amongst grass plains, trees and caves, hunting and foraging for our food. Of course our lifespan was much shorter then, as food could be scarce and predators and illness had to be dealt with naturally. To help guard the immune system against parasites and pathogens the human microbiota was very diverse; developed through being in constant contact with nature and soil.

As we have come through the Ages, this microbial diversity has decreased through hyper-sanitation, overuse of antibiotics, and decreased exposure to nature. Today people living in high-rise apartments are the most removed population from our 'grass roots', and this is concerning, particularly because the human population is living longer, chronic disease is rising, new 'super' viruses emerge, and reproduction of the human species diminishes microbiota even further for future generations.

To enable analysis of the connectedness to nature of a group of the population living in our current symbiocene, high-rise apartment dwellers were given a Nature Relatedness survey of 21 questions, and a comprehensive lifestyle survey of which some questions were focused on naturalistic behaviours, such as visiting green spaces, spending time outdoors, eating natural foods and growing plants.

Leaf my neighbourhood alone! Will densification destroy Perth's urban forest?

Alexander Saunders, John Duncan, **Emma Ligtermoet**, Joe Hurley, Marco Amati, Peter Caccetta, Joanne Chia, Bryan Boruff

University of Western Australia

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Urban vegetation contributes to a range of ecosystem services including the enhancement of health and wellbeing, amelioration of urban heat islands, filtration of storm water and air pollution, and the provision of habitat for species diversity. Urban vegetation also generates economic benefits through reduced energy costs and increases property values in our green leafy suburbs. However, with a trend toward a more compact and dense urban form, less space is available for planting on private land and it is becoming important to understand the reasons for this through an analysis of the historic drivers of the extent and variability of urban vegetation on both public and private land.

We approached the question of increasing densification and its relation to greening by identifying the drivers of canopy cover across Perth's residential neighbourhoods and examine the extent to which these drivers are associated with variability in tree cover. Using high resolution digital aerial imagery acquired as part of CSIRO's Urban Monitor Program we i) quantified the distribution of tree canopy on private and public land within Perth's residential neighbourhoods, ii) examined the complex, non-linear interactions between different components of urban form and tree canopy across public and private land with the specific aim of developing models capable of predicting tree canopy under a range of future land-use scenarios using machine learning models (Random Forests), and iii) development scenarios to test how current planning policy could impact on the quantum and distribution of vegetation in Perth's leafy suburbs into the future.

Bush-stone Curlew Reintroduction to Metropolitan Perth

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The Perth Zoo in collaboration with Caversham Wildlife Park and Whiteman Park has successfully reintroduced Bush Stone-curlews into metropolitan Perth. Thirty birds have been released into Whiteman Park during 2013-2018. Dispersing birds have also been reported from several locations around the Perth metropolitan area during past five years. Most of those have been single records from five different birds, but one bird has proven the greatest of travellers having been seen at no fewer than seven locations and has now completed a circuit of the inner metropolitan area before returning to an earlier haunt. Sightings of dispersing birds and breeding birds reported by members of the public are received by email, i-Phone (with good quality pictures showing coloured leg bands), and from the Australian Bird and Bat Banding office. The resident flock of more than 10 birds provides great viewing for the citizens visiting Whiteman Park who love the 'Road Runners' when they see them strolling around on the grassed picnic area. To date only two birds have been confirmed dead, one having been taken by a goshawk and the other was euthanised after sustaining leg injuries. Breeding and successful fledging of nestlings has been reported every year since 2014. This species provides a case study for how locally extinct fauna species can be reintroduced into suitable habitat within the Perth metropolitan area.

Natural settlements : past, present and Future.

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Community gardeners care for land they don't own and share its produce. In that sense they are contemporary custodians of country. Community gardens are also places where people come together to share knowledge particularly about gardening and food. However the knowledge shared extends into community and individual well being, sustainability and cultural exchange. Increasingly, community gardeners are connecting with First Nations food and plants. Together with nurturing the land this enhances peoples connection to country.

The Importance of Green Infrastructure in Sustainable Development of National Capital of Australia, Canberra

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Canberra is an almost new city based on 'Garden city' theories. From the very beginning landscape elements have deliberately been regarded as an important part of planning and design concept. Green infrastructure and its elements, such as remnant native bushlands and planted exotic and native trees and shrubs played a significant role in planning the city's structure. The major green open spaces which are created by these plants are symbols of nature in the city which are playing ecological and socio-cultural role, defining Canberra's character and liveability. Accordingly, Canberra is known as 'Bush capital' and 'Natural capital' among people and tourists.

Meanwhile, landscape is a dynamic phenomenon. It is changing all the time by natural and anthropogenic forces, which brings new challenges for the design and planning. The process of fast development and urban growth in Canberra intensified since 1990. In the 21st century, Canberra continues to grow and develop new suburbs. This city as the national capital of Australia shares similar urban challenges with sustainability and try to find a sustainable way for urban landscape development using knowledge of landscape ecology and nature-based design.

In this presentation an overview of the role of green infrastructure in the creation and shaping the landscape character of Canberra will be provided and some outlines of its importance in future sustainable development will be presented.

Native gardens on street verges: perspectives from residents and ongoing research into the social and ecological values of verge transformation

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Street verges provide green space benefits to urban dwellers. Verges provide opportunities for passive recreation, food production, social interaction, shading, water infiltration, and habitat for wildlife. The management and use of street verges is a rapidly evolving area of policy change and community interest. In Perth, many LGAs permit residents to convert the verge to a low-growing garden, providing certain conditions are met. Our research uses mixed methods to gain insight into the motivations of residents who have converted their verges to native gardens, while also investigating the policy settings, perspectives, and key flows of information and resources among a diverse stakeholder set. We present an overview of our research on street verge gardens (supported by the Australian Government's National Environmental Science Programme through the Clean Air and Urban Landscapes Hub), and selected results from interviews and verge mapping with residents in inner and middle ring suburbs in Perth. Residents hold a diverse range of views on the reasons for transforming their verges, and exhibit a diversity of gardening practices, plant species used, sources of inspiration, and access to resources and incentives. Limited knowledge of native plants and animals did not appear to be a major barrier for residents, with many gaining knowledge and interest through verge gardening. The social interaction and community component of verge gardening was noted by many of the participants. Our study demonstrates tangible means of connecting urban nature and people through individual and collective action, as well as the considerable challenges involved in this undertaking.

Rediscovery of the presumed extinct Douglas's Broad-headed bee in Perth's northern suburbs, and why it matters

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Vegetation clearing in Western Australia has happened at very high rates and, when associated with other impacts such as land use intensification and land development, it imposes serious threats to native fauna and flora species. In the Swan Coastal Plain, urban development has spiked over the last decades and natural woodlands are being cleared at alarming rates. The region was originally covered by Banksia woodlands, an extremely diverse ecosystem that has suffered a severe decline in extent. Nowadays only 35% of the original woodland cover persists and is under increasing pressure from land clearing and fragmentation due to land development, which is expected to expand even further in coming decades. Given the current worrisome scenario for biodiversity in the region, it is heartening to report that a female specimen of the presumed extinct native bee Douglas's Broad-headed bee (*Hesperocolletes douglasi*) was rediscovered in Perth's north suburbs 80 years after the collection of the only other known record of the species. The rediscovery of the enigmatic Douglas's Broad-headed bee shows that urban remnant vegetation still has great conservation value and highlights the importance of preservation, restoration and proper management of remnant vegetation in order to safeguard habitat for fauna and flora. This rediscovery provides an opportunity to save the species from extinction and is a wake-up call for the need to act now to protect and manage urban landscapes in order to sustain biodiversity.

Saving Urban Bushland, piece by piece, year after year, again and again

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Why is it so hard to save urban bushland from destruction? Let's look at one battle as an example of many fought piece by piece, year after year, again and again across the metropolitan area. The battle to protect Bush Forever 242 - the rich and rare Anstey - Keane Damplands.

We have

- A community that deeply values its unique, rich and diverse natural heritage
- a policy framework designed to protect these values - Bush Forever, established in 2000 but not completed
- a budgetary mechanism to support this policy framework - the \$400 Million Metropolitan Region Improvement Fund
- government agencies to implement Bush Forever and manage the conservation estate - WAPC, DBCA
- legislative environmental protections of the EPBC Act - TECs, RAMSAR wetlands, MNES etc

Yet have they protected places like Anstey Keane? Anstey-Keane is an enormously biodiverse region in excellent condition but remains under threat from:

- significant damage through illegal access
- parts are still in private ownership
- the site is not managed as one
- State agencies regularly propose projects deleterious to environmental values.

Who cares and advocates? The Friends of Forrestdale Lake care. They have campaigned since 1990 to protect this rare jewel. Their efforts are played out again and again across the metropolitan area, in pockets of our last-remaining beautiful bushlands and wetlands.

Conserving our urban bushland for our grandchildren requires perseverance and resilience. We must increase community awareness of environmental issues and continue our advocacy and activism. We need a united voice to speak on behalf of our native flora and fauna through friends' groups or peak bodies such as the Urban Bushland Council. We need stronger environmental laws.

Putting more nature into Natureplay

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Many of us know the importance of 'nature play' and its many benefits. The 'nature play' movement provides schools an opportunity to be leaders in regenerating our natural landscapes by replanting endemic plants while gaining health and educational benefits. This talk showcases why and how Bold Park Community School has started to replant their campus with local plants.

We live in a biodiversity hot spot. Our native plants are beautiful yet often unfamiliar to many of us. These increasingly rare plants create a sense of belonging and place. They have stories to tell. Warran *Dioscorea hastifolia* or Yams once grew widely our region. Our Kitchen Garden has a 'Yam patch' and students learn about this plant and its significance to Noongar people.

At our school, the notion of a 'Kitchen Garden', is extended to the school grounds with local edible and useful plants thriving alongside well-loved European herbs and vegetables. The school has transformed a barren area into a 'Garden Room' outdoor space surrounded by plants growing informally, where students can play and find calm. We also have a 'Wildspace', another well used green play space, which all classes at the school access throughout their school week. It is a patch of remnant bushland that we are regenerating with the students.

The talk also highlights the therapeutic benefits of investing in beautiful and natural spaces in ALL schools. We found that putting nature back into our schools, improves behavioural issues and reduce anxiety and stress in young people.

Banksia woodlands 30 years in review

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Banksia woodlands are iconic and synonymous with Perth and its surrounds. Thirty years ago, the Banksia Woodland Symposium was organised by The Royal Society of WA as a stock take of major issues and knowledge gaps. The 30th anniversary of the symposium is the perfect opportunity for a re-fresh and new stock take and review of scientific knowledge in relation to the now threatened Banksia woodlands of the Swan Coastal Plain. To address issues posed by the 1989 symposium group and to determine how we have advanced our understanding of Banksia woodlands since that time, we surveyed and assembled over 25 current researchers working across agencies and universities in restoration, disease, vertebrates, invertebrates, groundwater management, water relations, floristics and weeds, geology and soils, fire and urban development with the objective of creating a large single review paper. The review aims to identify 1) issues posed by the 1989 symposium and the degree to which those issues have been addressed, 2) additional topics/issues not posed in the original 1989 symposium that have emerged subsequently (e.g. genetics), and 3) key questions that should be addressed in future research. Our goal is to provide a document for future generations of researchers, managers and policy makers on the status of science knowledge in Banksia woodlands. Here we present an overview of what we have learnt about Banksia woodlands over the past 30 years of research and what we are still to uncover and where we should focus our research to conserve these woodlands.

Perth NRM's Community Capacity Survey

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Environmental volunteers make a significant contribution to the natural resource management of the Swan Region and adjoining areas.

The *Community Capacity Assessment in NRM* initiated by Perth NRM in 2013 measures the capacity of environmental volunteers across human social and organisational and financial capital. It has consistently found volunteers are motivated by the desire to protect and preserve the environment. This enthusiasm was evidenced by over 51,000 hours of on-ground work, and over 30,000 hours of administrative support, in 2017.

Whilst they are highly self-reliant most Friends Groups work closely with the land managers and value their on-going support and collaboration. Volunteers also articulated a desire to increase their effectiveness and believe that direct financial support, together with investment in training will leverage volunteers' skills considerably and better enable them to manage threats and conserve the natural areas they work in.

Using examples from the 2017 survey, this talk will highlight the contribution of community groups, their strengths and the areas where they need support to build capacity and capability. Perth NRM invites participation in the 2019 survey.

Integrating Nature and the Built Environment through Biophilic Design

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Global cities have predominantly been designed by economics, not by liveability, wellbeing, or as a healthy habitat for humans. Current pressures of increasing urban density and climate change are amplifying crises of human health such as stress, obesity and mental health issues, along with the heat island effect and water and air pollution. Biophilic urbanism, based on humans' innate connection to nature, is a rapidly expanding urban design approach initially driven as a response to these urban crises, but now being taken up by progressive and innovative cities who acknowledge the multiple social, environmental and economic benefits which result.

While integration of nature and the built human environment is improving, there are still many gaps between the two; both physical and biological. Biophilic urbanism has the potential to fill these spaces, and to unite nature and the urban fabric, both built and human. Recognising this potential for biophilic elements (natural forms, patterns, places, materials, greenery) to bring both physical integration and human connection and values, solves the problem of habitat fragmentation and human disconnect resulting from underutilised spaces and incompatible built elements. Recast in this way, urban environmental and social problems are replaced by the endless remedial possibilities of inserting cost effective biophilic elements.

The process of delivering these biophilic urbanism outcomes involves many professions and areas of knowledge. There exists opportunity for this collaborative approach towards integration to be supported and facilitated by local government through policy, planning and education. Global case studies are increasingly demonstrating this with successful outcomes involving creativity, innovation, collaboration and common sense.

To catch a fox: the pest control program at Kalamunda

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Control of feral pests is important for the protection of biodiversity, as well as agricultural and private livestock. Foxes predate and negatively impact populations of native wildlife such as Bandicoots, Woylies and Possums and are one of the species which has contributed to the extinction of around 11% of Australia's mammal species. Reducing fox populations assists in the protection of our biodiversity. The city of Kalamunda is developing and delivering an improved pest management program with better outcomes from engaging with the community and regional stakeholders and using research and best practise management techniques. This program of monitoring and trapping and removal of pest habitats in local natural areas will reduce pest populations. Reducing pest populations may assist significant regeneration of native vegetation and population increases of native animal species. The city is working closely with the Department of Primary Industry and Regional Development regarding its legal obligations. It has engaged with research institutions such as Murdoch University to develop a program that adds rigorous science to better understand fox behaviour and drive management activities. Feral pests know no boundaries and the city has formed partnerships with stakeholders and land managers within and adjacent to the city such as Department of Biodiversity, Conservation and Attractions, Water Corporation and other Councils. The city provides education and awareness in citizen science to volunteers and is in collaboration with the community at large to solve problems. The program will see an increase in reporting of sightings using apps such as Pestsmart.

Prioritising solutions for improving urban biodiversity resilience

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A major challenge confronting policy makers, industry leaders and land managers in Western Australia is to find strategies for the optimal management of biodiversity that are compatible with sustainable development. There are few places where these issues are more pressing than our urban landscapes. While we have already lost over 80% of our wetlands on the Swan Coastal Plain and endangered remnants of the banksia woodland communities remain under threat, there is also a need to increase development to meet population projections. A diverse set of stakeholders and land managers with an equally diverse set of interests, motivations and constraints can make it challenging to achieve goals that balance outcomes across social, economic and environmental domains. Each of these interest groups are working within their given remit, often with a focus on asset management rather than an integrated view across all aspects of the urban landscape. These challenges, however, also come with opportunities. A broad group of stakeholders gives access to greater resources, knowledge and expertise to identify, prioritise and execute best practice land management. It is within this remit that WABSI are exploring the value of developing a program of research on urban biodiversity resilience. Within this focal area, we are proposing to connect stakeholders, identify and prioritise end user requirements and shared knowledge gaps, and facilitate addressing these knowledge gaps through targeted and coordinated research. Developing this initiative has recently commenced, with knowledge gathering and initiative framing the current priority. Here I outline the WABSI approach to developing a prioritised research program, provide an overview of insights from stakeholder engagement thus far, and discuss ideas for future engagement, in order to encourage stakeholders to continue to share their high level initiatives, management challenges and knowledge gaps relating to urban biodiversity resilience.

Botanic gardens as unique urban bee habitats and places for interaction with nature

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With the rapid advancement of urbanization and the impact of climate change, native plant communities disappear fast and replaced by novel planted ecosystems. Thus, native component of urban biodiversity especially suffers in the urban areas. As the most important pollinators, bee communities play a vital role to natural and urban landscapes. European honey bees were introduced to Australia in the 19th century, foraging mostly on native plants, and serving as an important part in agriculture. However, the fragmentation and degradation of habitats and the loss of native foraging plant communities lead to a decline in the number of bees and honey yields. As a crucial part of green infrastructure (GI), botanic gardens are highly recognised for their conservation values, such as providing nectar and pollen for pollinators, as well as restoring local remnant vegetation.

Perth Region is one of 35 internationally recognized biodiversity hotspots. Taking into consideration the rapid disappearing of unique native habitats in Perth, there is a need of developing botanic gardens, which preserve and design special demonstration displays of native biodiversity. Special designed bee-friendly collection-display could be a good educational facility in such botanic gardens. In this presentation, the best-known bee-friendly precedents of botanic gardens and collections around the world were reviewed. Planting, bee-friendly design principles and bee-related art installations were summarized, which can be applied for creation of new demonstration sites of unique honey bee-friendly garden and plant communities in Perth Region.

What is a water sensitive city?

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Perth and other cities have been grappling with the question of how to use water management as a means of delivering better liveability outcomes and benefits in relation to biodiversity, public open space, health waterways, productive and connected communities. The Water Sensitive Cities framework helps deliver liveable communities by bringing together water supply, wastewater disposal, drainage and water quality into a shared vision for Perth as a Water Sensitive City. This vision aims to foster stewardship, protect the wellbeing of people and the environment, sustain the long term use of precious resources and integrates with the built and natural landscape.

One of the CRC Water Sensitive Cities' research streams explores market and non-market values related to greening our suburbs. This presentation will provide an overview of everything from the economic benefits of urban cooling, the impact on house prices due to access to living streams and the market value of an individual tree. It will also discuss the challenges in delivering long term public benefits through greening where risks, benefits and costs accrue across multiple stakeholders and different timeframes.

Nature City Seminar

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