# Integrated Research Project 3 (IRP3)

## Integrated Urban Planning

## Purpose and Background

1. **Project title:** IRP3 Integrated Urban Planning

**Summary:**
Aspiring water sensitive cities will have to embed water sensitive practices that influence the biophysical infrastructure and built form of the city. There are a range of integrated urban planning functions and instruments (PFIs) such as planning policy, regulation, legislation, incentives and standards that guide the form and application of such practices. Existing PFIs vary from city to city, as do the urban planning systems and processes that comprise the mechanisms for applying them and requiring compliance.

IRP3 aims to provide targeted guidance to multiple case study regions on how to effectively advance their city shaping, water sensitive practices by applying a framework for integrated urban and water planning. IRP3 project will develop this framework and supporting processes, software and guidelines through a number of industry case studies.

This guidance/framework will be designed to complement the framework and platform being developed in IRP1 to facilitate WSC transition strategies and implementation plans but will also be able to be used as a standalone support for strategies related to individual WS practices (eg WSUD standards) or WSC services for large precinct developments or municipalities.



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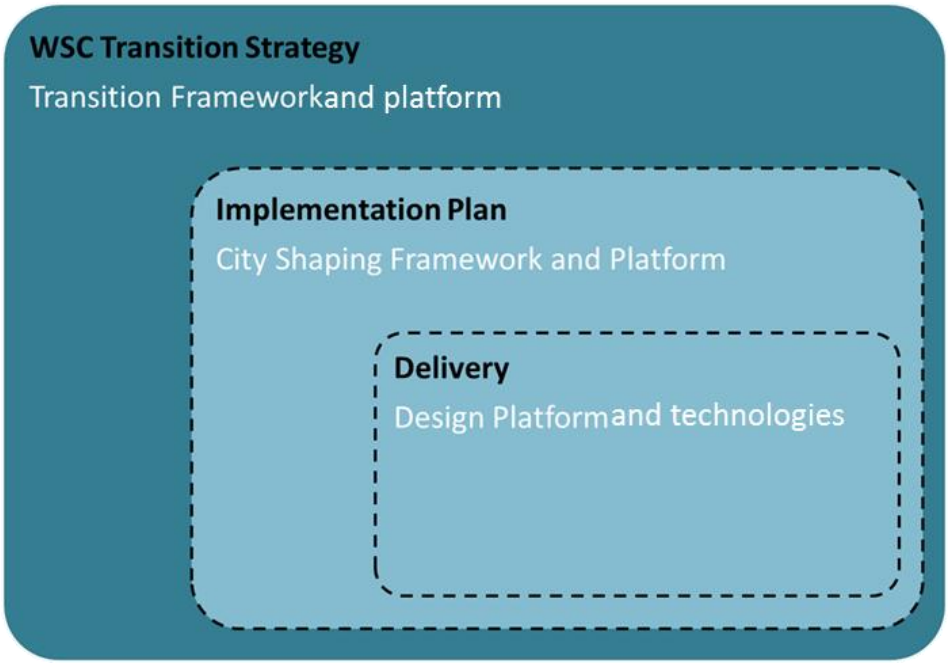
Fig. 1 Three ‘Platforms’ for outputs of CRCWSC research projects




The framework will be integrated into a ‘City Shaping Platform’ which will include modelling capability, methodologies and participatory processes for application of the framework and templates of integrated planning functions and instruments. The modelling capability in the Platform will be designed to assist evaluation of:

- urban planning functions and instruments that would be necessary to achieving a required set of WSC practices and biophysical outcomes and
- the biophysical outcomes and WS practices that would result from a particular set of urban planning functions/instruments ie the effectiveness of a set of existing or proposed PFIs

Fig.2 City Shaping Platform



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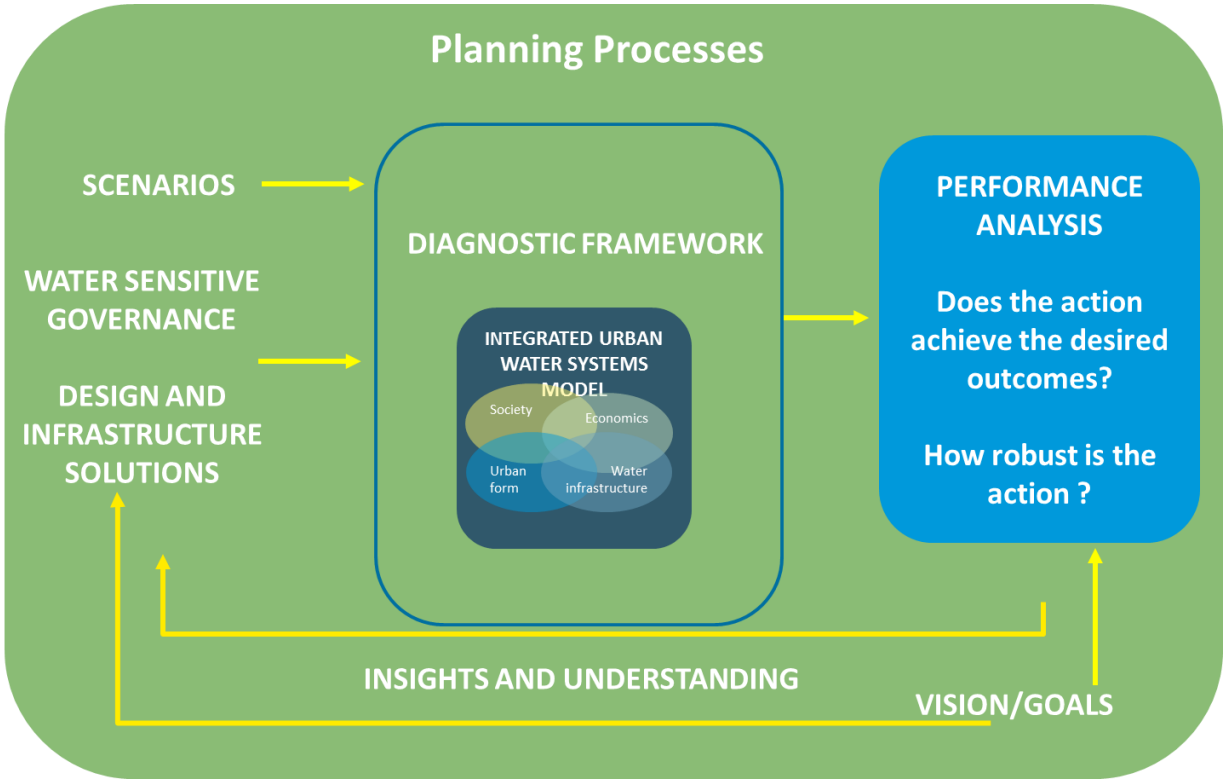



The project builds on several previous CRCWSC research outcomes in Tranche 1 and it will also draw on and integrate aspects of T2 research, particularly linking in with the IRP4 and TAP (Tools and Products) projects.

The case studies for developing, testing and validating the IRP3 framework and City Shaping Platform may also be common to these other T2 projects.

**Project governance:**
The Project will involve close collaboration between research and industry partners to ensure the project outcomes can directly influence the policies and activities of local stakeholder organisations to catalyse and accelerate their city's transition to its desired water sensitive future or effective implementation of proposed WS practices.

2. **Project leader:** Chris Chesterfield (Monash University)

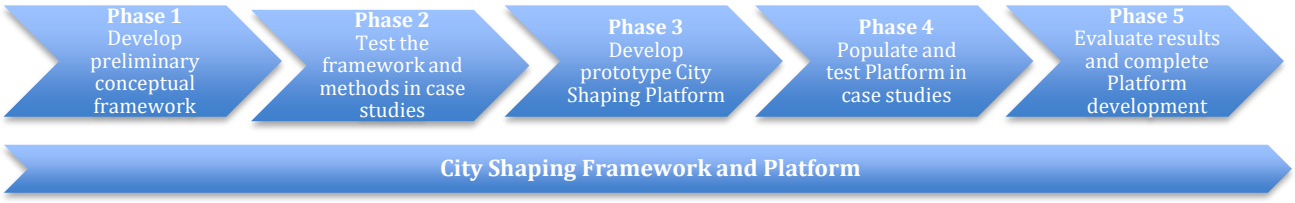
3. **Participating organisations & team structure:** People and resourcing of the Project are yet to be determined

4. **Project aim(s) and objectives:** The project's aim is to provide strategic guidance and support to cities and towns in the application integrated urban and water planning to embed WS outcomes. Building on Tranche 1 CRCWSC projects and Tranche 2 IRPs. The project has the following objectives:

    1) Develop, refine and implement the city shaping **planning framework** in selected regions/case studies through a diversity of scales, biophysical and governance contexts and cross sector professional perspectives.

2) Test and refine developed processes and methods for supporting application of the Framework through case studies.
3) Develop planning and governance functions and instruments for selected regions/case studies to advance their WSC strategies and practices.
4) Incorporate the Framework, methods, processes and templates into a City Shaping Platform together with modelling tools developed under the Tools and Products Project (TAP)
5) Evaluate the effectiveness of the Framework and methods and processes for application and the City Shaping Platform, with a view to equipping industry partners with knowledge and tools and steering policy and practice towards the WSC outcomes.

## 5. Project phases:




| | Goal | Approach | Approximate duration |
|---|---|---|---|
| **Phase 1** | Develop prototype conceptual framework | Industry or university research partner | 6 months |
| | | | |
| **Phase 2** | Prototype test framework and trial methods and processes | Project Team - Case studies with industry | 6 months |
| | | | |
| **Phase 3** | Develop City Shaping Platform | Integrate tested Framework, method and processes with Dance4Water Integrated Urban Water Systems model | 6 months (overlapping with Phase 2) |
| | | | |
| **Phase 4** | Test and validate Platform | Case studies with industry | 12 months |
| **Phase 5** | Evaluate and complete prototype Platform | Integrated development process with other CRCWSC platforms (WSC Transitions Platform and WSC Design and Delivery Platform) | 6 months (overlapping with Phase 4) |

## 6. Intended project outcomes:

This project will deliver both content and process outcomes. Content outcomes include:

1. A thorough analysis of the urban and water planning methods and approaches relevant to shaping water sensitive cities and embedding water sensitive outcomes.
2. A Framework for integrated urban and water planning



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3. Methods and processes for application of the Framework including a software platform
4. Outputs from application of the Framework as specific guidance for embedding WS outcomes in case studies
5. A City Shaping Platform that incorporates outputs of IRP3 and other T2 projects including TAP Dance4Water.

From a process perspective, project outcomes include:

1. Development of a deeper knowledge and understanding of integrated urban and water planning approaches that can advance WSC outcomes.
2. Methods and processes for applying integrated urban and water planning to advance WSC outcomes.
3. Methods and processes for cross sector engagement of professionals in developing and evaluating alternative servicing scenarios to deliver water sensitive city outcomes.
4. Improved capacity of professional stakeholders to understand and employ integrated urban and water planning.

**7. Targeted end-user group(s):**

Stakeholders across a city or region's urban water management and planning sectors, and potentially community members of the city or region, will benefit from the project outcomes, by either direct participation in the project or by direct use of the Integrated Planning Framework and City Shaping Platform.

Industry stakeholders will be better equipped to employ effective integrated planning to embed WS outcomes and drive their city's water sensitive transition agenda.

**8. Commercialisation and Intellectual Property (IP):**

It is expected that the City Shaping Platform will have some commercial potential. This could be realised through the parallel developments in the TAPs subprogram (see separate proposal).

**9. Industry/end-user participation:**

Industry participants form part of the project team that will work together to develop the specific activities of each region/case study. A project steering group that will meet regularly throughout the project in order to ensure the process is tailored to suit the specific needs of each region. Industry participants have a comprehensive understanding of the unique water issues that each region faces, the physical, social, and political contexts of each region, and the resources that may be available to implement this process. Industry participants will be actively involved throughout all phases of this project. The project team will communicate regularly through emails, teleconferences, workshops in each region, and an annual face-to-face meeting.

CRC for Water Sensitive Cities

# Tranche 2 Project Proposal

1. **Project title: Water sensitive outcomes for infill developments (IRP4)**

2. **Summary:** Most major cities in Australia, expect significant infill development over the coming decades. Without significant intervention, "business as usual" is expected to have considerable influence on hydrology, resources efficiency, liveability and amenity of our cities. This project aims to:
   a. Develop a performance framework to understand infill impacts.
   b. Develop design options, knowledge and processes and
   c. Identify improved governance arrangements and options.

**The essentials:**

This project involves key outputs of

- An infill development evaluation framework to understand and manage infill impacts. The framework focusses primarily on quantifying hydrological performance of infill and related performance design. It allows identification of opportunities specific to different developments.
- A catalogue of water-sensitive design options for different scale typologies
- Identification of improved governance arrangements in conjunction with real world projects with modelling analysis to support selection of optimal outcomes.
- Case studies where the framework is applied.

This project will focus on development from individual lots through to "precinct". It will work closely with TAP, IRP3 (Planning) and IRP2 (economics). The work will be underpinned by strong stakeholder engagement, overseen and chaired by an end-user steering committee, already formed and meeting regularly. Ultimately, the work is expected to contribute to improved infill governance. The work is underpinned by strong stakeholder engagement, overseen and chaired by an end-user steering committee, already formed and meeting regularly. Ultimately, the work is expected to contribute to improved infill governance.

3. **Project leader & deputy:** Associate Professor Steven Kenway (The University of Queensland), and Dr Marguerite Renouf (The University of Queensland).

4. **Project type and activity:** IRP (Integrated Research Project).

5. **Participating organisations & team structure:**

| Name | Title | Affiliation | Contribution/role* |
|---|---|---|---|
| Steven Kenway | A/Prof | The University of Queensland | Project Leader. Oversee research, communication and contribute to research. |
| Mellissa Bradley | Ms. | Water Sensitive SA | Chair of Participation Committee. Lead local case study/ies, garner local in-kind and cash support, disseminate outcomes locally. |
| Geoffrey London | Prof. | The University of Western Australia | Project Researcher (Lead Design, Governance aspects, case studies) (to confirm) |
| Nigel Bertram | Prof | Monash University | Project Researcher (Lead Design, Governance aspects, case studies) (to confirm) |



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| | | | |
|---|---|---|---|
| Peter Newton | Prof. | Swinburne University, Victoria | Connect the project to other work nationally (eg CRC LCL and CRC spatial), Connect to the Advisory Committee. Infill specialist research advice. |
| Marguerite Renouf | Dr | The University of Queensland, Qld | Deputy Project Leader, stakeholder engagement, project reporting, PhD supervision. |
| Ka Leung Lam | Dr | The University of Queensland, Qld | Project researcher (framework, modelling analysis), (while Marguerite Renouf on leave). |
| Kieron Beardmore | Mr | Brisbane City Council, Qld | Lead local case study/ies, garner local in-kind and cash support, disseminate outcomes locally. |
| Sadeq Zaman | Mr | Inner West Council, NSW | Lead local case study/ies, garner local in-kind and cash support, disseminate outcomes locally. |
| Nigel Corby | Mr | City West Water, Vic | Lead local case study/ies, garner local in-kind and cash support, disseminate outcomes locally. |
| Greg Ryan | Mr | LandCorp, WA | Lead local case study/ies, garner local in-kind and cash support, disseminate outcomes locally. |
| Nigel Tapper | Prof. | Monash University | Lead transfer of T1 outcomes to inform/position project. Project researcher (to confirm) |
| Pam Kerry | Ms | South East Water, Vic | Lead local case study/ies, garner local in-kind and cash support, disseminate outcomes locally. |
| Zhiguo Yuan | Prof. | The University of Queensland | Lead transfer of T1 outcomes to inform/position project. (to confirm) |
| Lisa McLean | Ms | Flow Systems, NSW | Lead local case study/ies, garner local in-kind and cash support, disseminate outcomes locally. |
| Cintia Dotto | Dr | Water Technology, Vic | Lead local case study/ies, garner local in-kind and cash support, disseminate outcomes locally. |
| Nicholas Temov | Mr | Department of Planning, WA | Lead local case study/ies, garner local in-kind and cash support, disseminate outcomes locally. |
| Matt Stack | Mr | Department of Planning, WA | Lead local case study/ies, garner local in-kind and cash support, disseminate outcomes locally. |
| Christian Ulrich | Dr | Monash University | Support linkages to TAP project. |

**All members participate in periodic (~6 per year) project meetings, review documents and reports, and mobilise local resources (eg. for local case study analysis).*

## 6. Project aim(s) and objectives:

Most major cities in Australia expect significant infill development over the coming decades. Developing these spaces has *significant potential impact on (i) hydrological performance, (ii) resources efficiency, (iii) amenity and liveability of urban areas*. For example, this can include increased proportion of impervious surfaces leading to exacerbation of stormwater flows and impacts, reduced evapo-transpiration (and accompanying urban heat influences), and overall loss of amenity and liveability. However, to date, quantification and evaluation of infill performance has not been undertaken, and guidelines and design need to be more performance-based.

A key goal of CRCWSC is to change the way we build our cities by valuing the contribution water makes to economic growth and development, our quality of life and to the ecosystems of which cities are a part (CRC WSC Strategic Plan 2016/17-2020/21). This project contributes to this with particular attention on specific infill issues (and addressing legacy issues at a range of scales), with the following objectives:

Objective 1: Developing and applying a performance framework to understand and manage infill water impacts:

a. Scale-independent performance assessment including water mass balance performance at various urban scales (using mainstream hydrological modelling and CRCWSC-developed tools),

a. Identification of opportunities specific to different developments (ie lot-scale, and precinct-scale changes and renewal).

Objective 2: Create new designs and inform design tools and processes through engagement with real projects (case studies). This includes applicability at different scales, (grouped/single structures to the built form of precincts), and co-benefit infrastructure, including parks and roads.

Objective 3: Identify improved governance options / arrangements. This includes public-private partnership options and solutions including developers/builders, costs and benefits / economics, value-capture, and enabling mechanisms.

**Project scale and focus:**

This project principally focuses on:

- Scale of developments: Primarily from individual lots through to "precinct" (with attention to supporting change from current "knock down-rebuild" to more planned and water sensitive precincts up to around 5,000 households scale).
- Issues and challenges: The project principally addresses water-related impacts such as flooding, waterway health, stormwater management, via performance analysis and design of infill. Additional issues of alternative vs traditional water supply and sewerage, urban heat impacts, and governance options are also included but of secondary focus. Liveability, energy efficiency, life-cycle impacts and risks, are important topics but are not part of the core work undertaken under this project but may be addressed with targeted co-funding and/or PhD projects.
- Linkages and interactions: The infill project (IRP4) works closely with TAP (using CRCWSC Solutions and Design platforms), IRP3 (Planning) and IRP2 (economics). In IRP4 we mainly will be utilising TAP outputs rather than developing new models or tools, with the exception of a scalable urban metabolism (mass-balance tool). Similarly, IRP4 does not look at planning issues, upscaling, or economics but will directly provide input and collaborate with the respective IRPs in these areas. Much of IRP4 focusses on urban design, with some consideration given to implementation, particularly as part of research case studies or for a potential demonstration precinct/village (See Figures 1 and 2).
- Note: no physical experimentation, broad-ranging workshops, specific field work (unless part of PhD project), training, city-scale analysis/upscaling, or economic evaluation, is proposed as part of IRP4. Specific, tailored activities as part of research case studies will be incorporated, but may be dependent on available co-investment.



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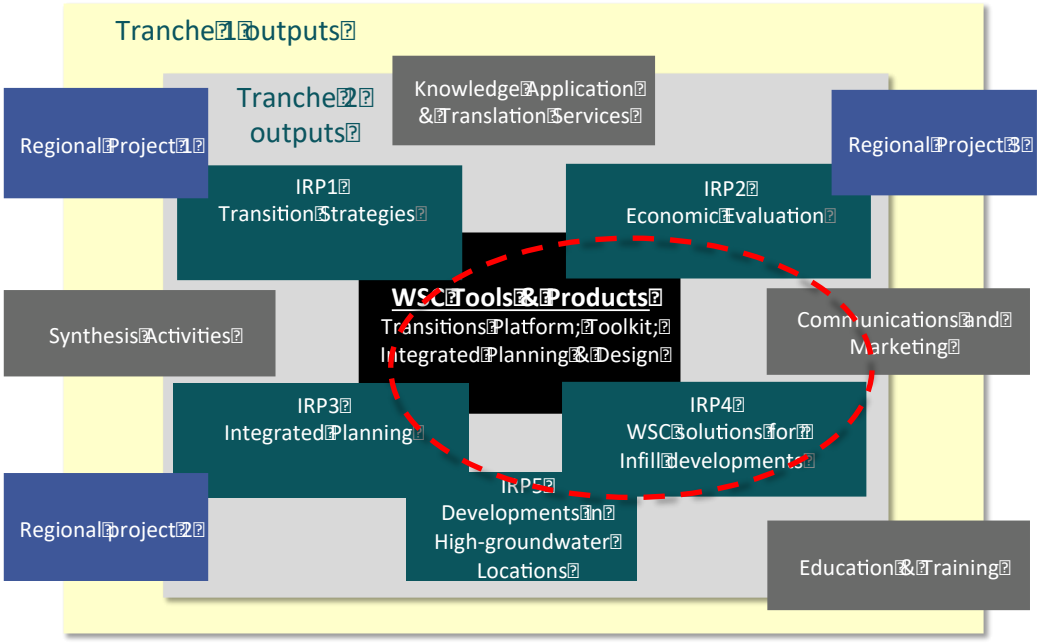


Figure 1. Relationship of IRP4 to other IRP's and TAP

| Scale | Plan | Design | Implement |
|---|---|---|---|
| City | IRP3 | | |
| Precinct | | IRP4 Performance criteria, options, guidelines, impact assessment. | Application via cases studies |
| Lot | | | |

Figure 2. Relationship of (infill) IRP4 with IRP3 (planning)

7. **Identified transition needs:** There is a need to shift away from detrimental incremental changes in hydrology related to infill within cities. Instead, there is a need for robust and inclusive evaluation frameworks for decision-making, which quantify all water cycle impacts and benefits of WSC investments. A starting point requires uniting the fragmented management of water in cities: water supply, wastewater, groundwater, stormwater, but also the diverse multiple functions / values of urban water through new design (housing, water systems and urban form), and identifying implementation pathways. These transitions are required across most Australian capital cities.



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## 8. Knowledge base and research gaps:

| Tranche 1 work | Anticipated outputs and incorporation into the project |
|---|---|
| Urban metabolism framework (B1.2) | A key component for evaluation of baseline conditions and identification hot spots in the catchment and determine opportunities and constraints. The urban metabolism (water mass balance) framework, developed through the CRCWSC is particularly relevant for use in this project. |
| Urban Design and Infrastructure (D5.1) | This project delivers knowledge of Water-Sensitive best practice developed through knowledge of issues, processes and design and developed through project-based case studies in Victoria, Perth and South East Queensland. It will help guide scenarios of future infill development, enable rapid implementation of selected case studies and help position the work for national design and governance relevance. |
| Urban Heat Island (B3.2 and 3.1) | Project B3.1 (Green Cities and Micro-climate) and 3.2 (Design of public realm) have developed a range of tools and knowledge sets which quantify and demonstrate the beneficial effects of WSC practices in urban renewal works. Thermal comfort models tools and knowledge (and bigger-picture vulnerability analysis) will inform frameworks and case study analysis. |
| CRCWSC toolkit (TAP) | The TAP program is further developing a range of tools and models which have come from T1 projects. This includes the WSC Solutions platform (based on D1.5) and the WSC Design platform (based on A4.3) that include scenario-based urban water modelling tools for assessing the dynamics of urban infrastructure in response to social and environmental drivers of change on the water system. Other tools, applicable to Perth conditions (dependency on groundwater and desalination) will be also considered. |
| Tools and technologies (Program C) | Inputs to help guide technology selection at various scales. For example, the decentralised water supplies risk assessment (from C3.1) informs risk assessment of alternative water supply configuration options for infill developments. |
| CRC Water Sensitive Cities Index | Project D6.2, 'developing a water sensitive cities assessment tool' has developed an index that offers users the ability to benchmark cities (at the metropolitan or municipal scale), based on performance against a range of urban water indicators. The index covers many attributes (social, economic, ecological) of cities, and the urban metabolism framework provides a quantitative benchmarking process relevant to resource-efficiency. |
| Community participation and behaviour change (Program A) | A range of consultation events and city envisioning at a range of sites likely of high relevance to case studies (eg in Melbourne, Perth, Gold Coast). Relevant visioning may inform infill design options. |
| Design WA | The knowledge base will be explored and included. |
| NSW Medium Density Design Guide | The knowledge base will be explored and included. |
| CRC Spatial, CRC Low Carbon Living and AUDRC research outcomes | The knowledge base will be explored and included where possible. |

## 9. Research questions and approach:

Research questions for Objective 1 (Performance and impact)

- How might performance be defined, measured and assessed, both generally for urban developments and specific to infill?
- What are the impacts on impervious fraction (and overall water mass balance), on-site water storage, potable water flow reduction, wastewater flows and

evapotranspiration, achieved in various developments (both water-sensitive and non-water-sensitive)?
- What are the relative hydrological and resource efficiency impacts/benefits of different existing and new infill development typologies in different contexts (different soil type, climates, densities, drainage typologies)?
- What water performance objectives/targets are being established for infill development (eg impervious fraction, water storage, changes in flooding, water efficiency) and including related impacts such as urban heat island?

Research questions for Objective 2 (Design and implementation)
- What information is critical to guide selection of solutions? How much of it is context/location specific?
- What key measures are needed to achieve WSUD outcomes within each typology set?
- What housing typologies, streetscapes, public realm, landscape designs and planting options enable best WSUD outcomes in a selection of Australian site conditions for infill in suburbia, brownfield, and greyfield sites.
- What measure or guidance is helpful in the selection of technologies such as greywater recycling, decentralised water supply, rainwater tanks, purple pipe for Water Sensitive Infill Development?

Research questions for Objective 3 (Governance)
- Where have collaborative governance arrangements (between private entities, private-public partnerships, local government/water utilities and developers, state departments eg public housing) been successful?
- What lessons have been learnt in successful and unsuccessful delivery of valuable/highly performing Water Sensitive developments?
- How can the process of infill development be harnessed to transform communities and improve liveability?
- What opportunities or pathways/processes (including incentives and precinct-scale water and energy opportunities) exist for implementing new governance or planning arrangements for Water Sensitive infill developments?

Appendix 1 includes some related research questions not specifically part of this project, but potentially able to be addressed with co-investment and/or by PhD projects.



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The research includes the following stages, and phased implementation.

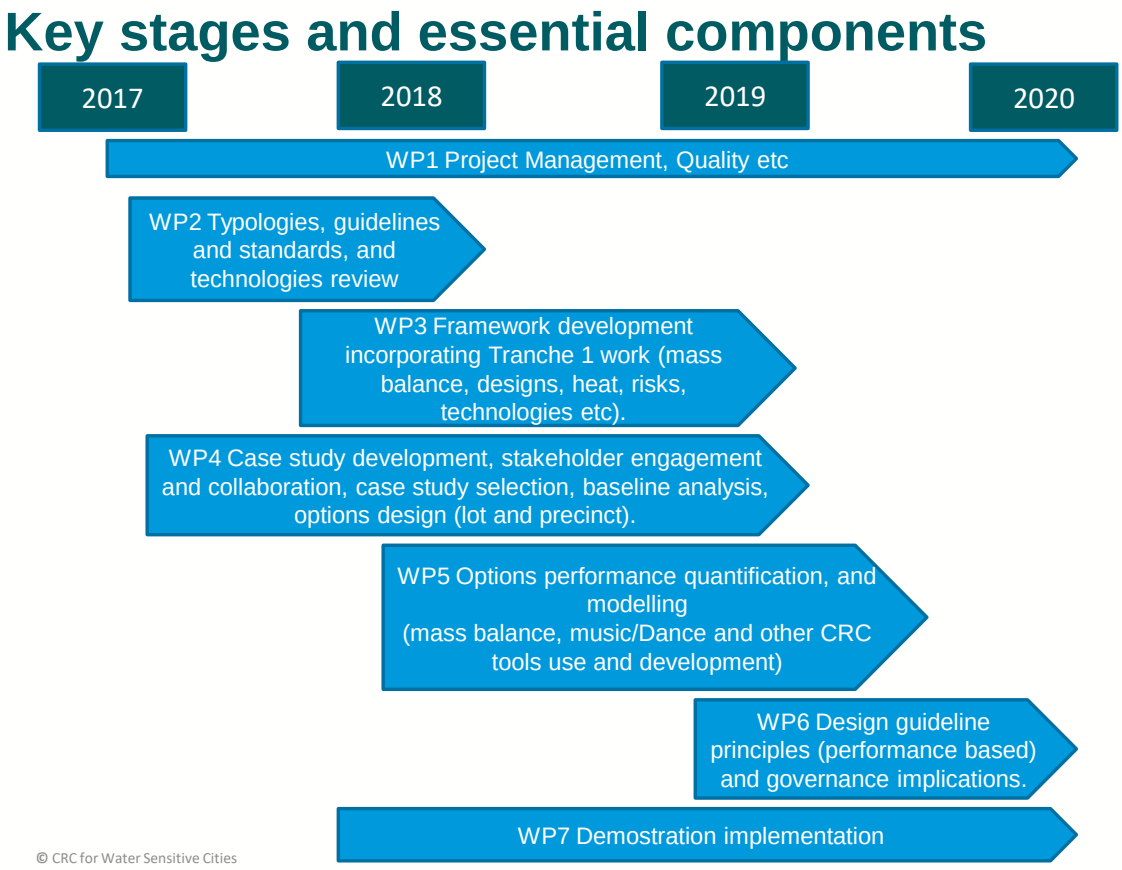


Figure 3. Stages and main work packages of project implementation

The overall approach is to focus on Research Objective 1, but progressing all three objectives in parallel is important. For example, early identification of key outcomes desired in governance and design will help focus the performance framework development and analysis via case studies.

**Work Package 1 Project management, quality, and stakeholder engagement**
This tasks includes development of implementation-oriented work packages, and related project and quality management tasks, such as: project data plan, quality plan and gates, publication plan, communication and stakeholder engagement plan, ethics plan (including data management) and quality assurance tasks. The work package also includes ongoing project management, communication efforts (internal and external communication) and evaluation and monitoring. As a component of stakeholder engagement and connecting to key scientific resources, we will collaboratively convene a workshop with the CRC Spatial Information, the Australian Urban Design and Research Centre (AUDRC) and CRC Low Carbon Living (to build knowledge and understanding of their infill and precinct-analysis work).

**Work Package 2: Conceptual background of WSC infill development: Typologies, technologies and governance**
This is a critical work package that ensures integration of distributed knowledge and disciplinary expertise of different team members in different fields. Establishing a common



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knowledge base builds the context of the project. This work package includes review of the existing institutional context (guidelines, legislative frameworks, policies) and current design practice (technologies, typologies of urban infill development). Tasks undertaken at this stage will inform case study development (typologies of urban infill), options design (based on available technologies) and guidelines for water sensitive design. They will also provide initial insights into potential barriers to water sensitive infill implementation that will be diagnosed in Work Package 6. This package includes the following tasks:

WP2.1. Literature review and content analysis of guidelines and standards for WSUD, WSC, infill development. This will lead to identification of gaps in the existing institutional framework that need to be addressed but will also highlight state and city-scale differences related to infill development and water sensitive standards that need to be accounted for in the project implementation. It will include analysis of relevant legislation, regulations and policies, urban design guidelines, standards and codes, systems, processes and work instructions.

WP2.2. Literature/ project review of typologies (typologies audit).
This task will identify and define categories of contemporary urban infill development relevant to current Australian urban conditions. Infill development is implemented at a range of different scales – ranging from a single lot to mixed-use large urban renewal precincts of several thousand dwellings. Therefore, establishing a typology of infill projects is the necessary first step to assess performance of these developments. The list of current/ existing typologies will be based on literature and project review, and consultation with practitioners.

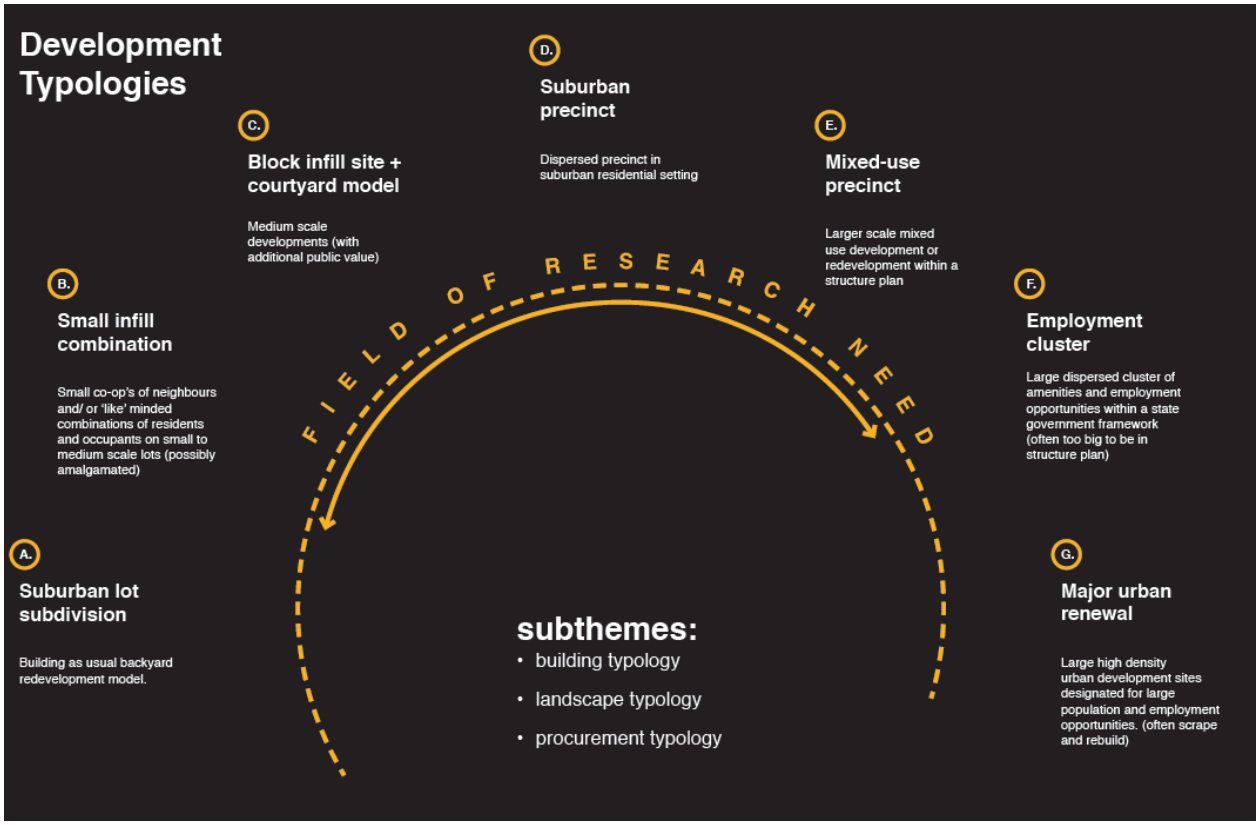


Figure 4. Draft typologies (noting the focus of this project is likely on typologies B-E (and identifying how to move large-scale development in "A" towards "B-E" options.



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WP2.3. Designing a catalogue of relevant infill typologies for collaborative evaluation. Drawing on the collection of existing national and international typologies in WP2.2, a suite of relevant potential refined building and landscape/ public realm typologies for water-sensitive infill development will be designed and diagrammed to a schematic or concept level (scales relevant to categories 'B' to 'E' above). These designs will be sufficient in three-dimensional detail to enable evaluation with respect to different performance criteria by other members of the IRP4 team, and to enable assessment of relevant technologies at different scales in WP2.4/ 2.5. Designs will include built form, private realm open space and public-realm landscape elements. Previous design work by the D5.1 team that will be drawn on and extended includes:

- Infill Opportunities, 2-block and 3-block assemblies (Vic.)
- Redcliffe Connect: 2-block and 5-block assemblies (WA)
- Reservoir 1km square suburban precinct (Vic.)
- Redcliffe 1km square suburban precinct (WA)
- Elster Creek catchment infill block/ small infill precincts/ '6-pack' flats (Vic.)

WP2.4. Literature review of technologies at different scales.
Infill development typologies will enable a review of technologies available and recommendable at different scale: from lot-size opportunities related to impervious pavement use to blue-green corridors around urban waterways possible at large precinct scale redevelopment. The technologies team will provide appropriate/ available technologies for the various scales: eg. local precinct wastewater treatment and pressurisation, precinct water storage, stormwater retention, filtration and re-use, smart tanks, trunk/grid issues, managed aquifer, aquifer storage and recovery etc. Outcomes of this task will also inform designing options for selected case studies (work package 4).

WP2.5 Assessment of performance of different typologies:
Assessment of individual typologies from lot-scale to precinct-scale (categories B-E) in relation to thermal comfort, water mass balance and related performance indicators, water storage and retention, energy use etc. Report results back to design team to make adjustments to design of typologies to maximize benefits against multi-criteria assessment.

**Work Package 3 Framework development and informing tool development**
This work package aims to develop a performance evaluation framework for infill development. The developed framework will provide performance indicators to be used to evaluate proposed infill development and alternative configurations. It will build on a range of frameworks that have been developed in the CRCWSC. This includes the Urban Metabolism (water mass balance) Framework (B1.2) relevant for performance quantification, but also an existing infill framework (from D5.1). In addition, scientific outcomes across the CRCWSC (including insight into new technologies, decentralised systems risk, energy consumption, and urban heat island impacts) will be incorporated into this infill development performance evaluation framework. The work by Renouf et al. (2017) and Farooqui et al. (2016) provide foundation for work package 3. Their work built on concepts of water sensitive urban design (See Figure 5), to develop a quantitative evaluation framework. Figure 6 presents the core of the CRCWSC "Urban metabolism evaluation framework for water" (UMEF4Water). Noting that the inputs include modelled and empirical data, for a defined boundary. Quantitative indicators derived include (i) hydrological performance (ii) water supply internalisation and (iii) overall water efficiency. Stakeholder discussion and literature review are necessary component tasks of framework development.



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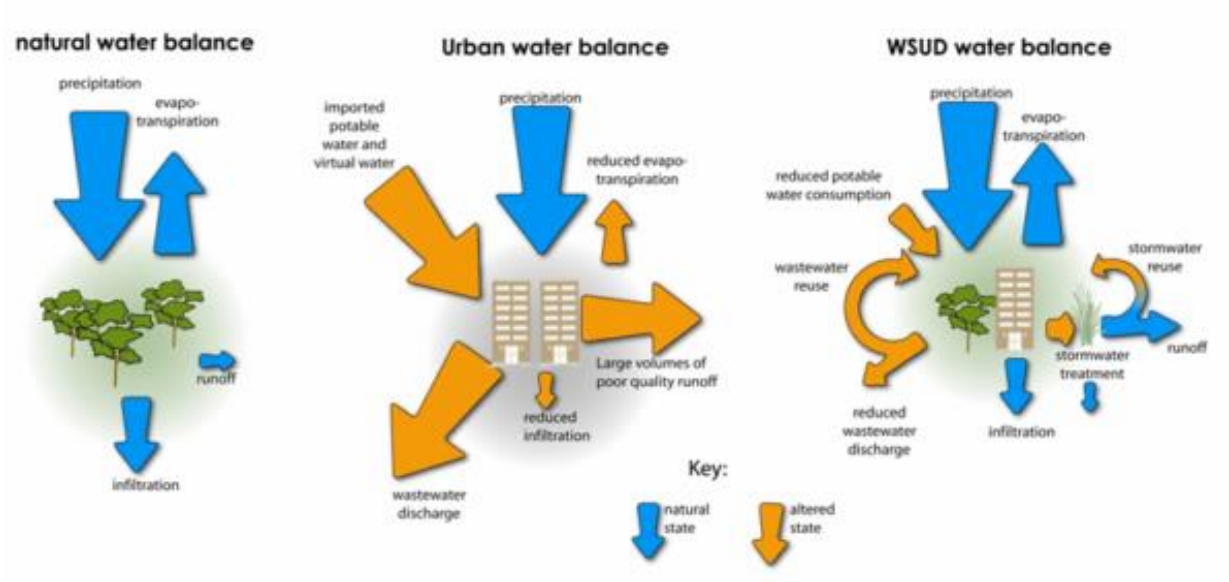


Figure 5. Natural, “urban” and WSUD balances (Source Healthy Waterways Ltd cited in Renouf *et al.* 2016)

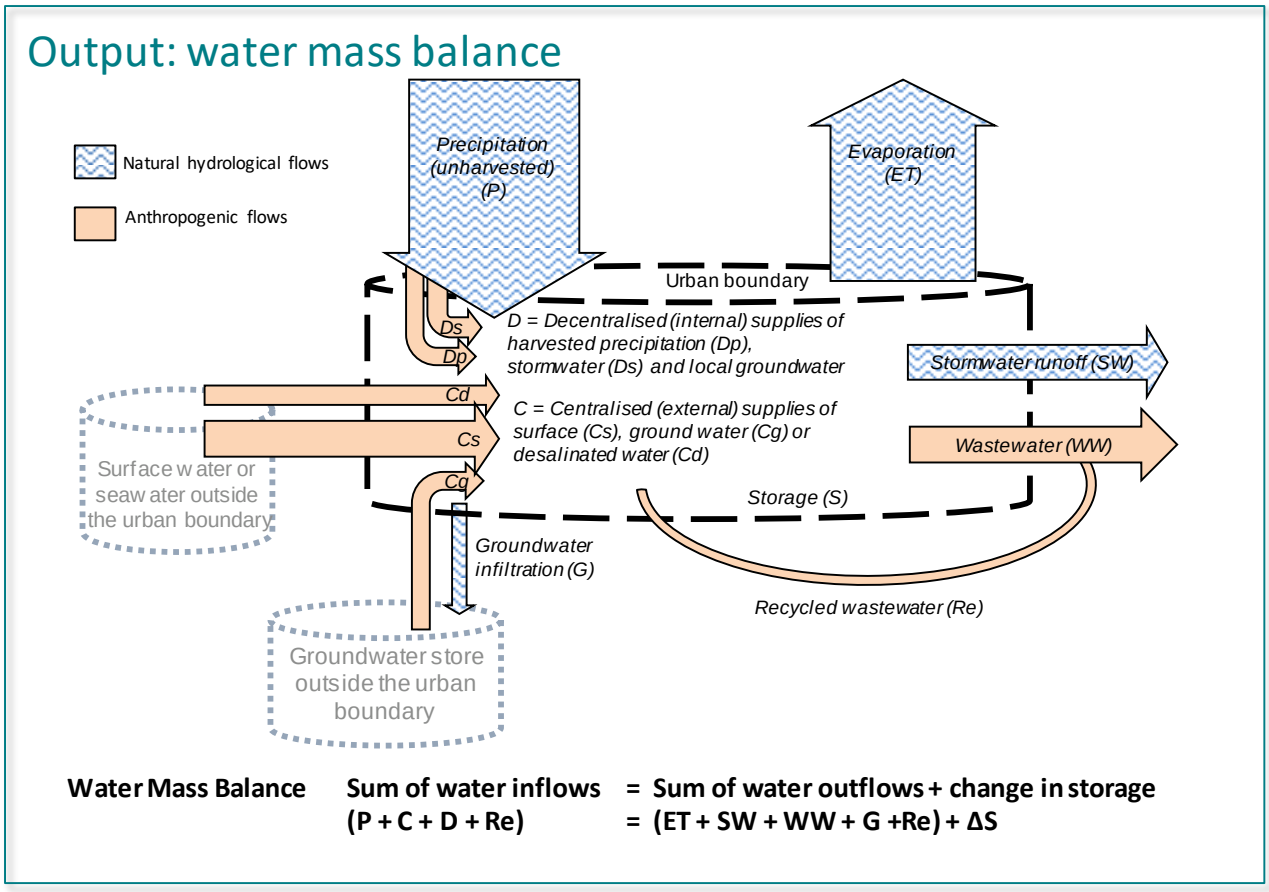


Figure 6. Urban water mass balance analysis framework (See Renouf *et al.* 2016)



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Work package 3 will include the following tasks:

WP3.1. Literature review of evaluation frameworks to ensure that the framework accounts for technological (data availability) and conceptual (the concept of urban metabolism, its application elsewhere) advances and the best-to-date- science

WP3.2. Identifying performance indicators to make sure that the framework responds to the needs of practitioners in identified stakeholder groups we will undertake an analysis of the performance indicators that can best gauge performance that the stakeholders want to measure. This task will include literature review and stakeholder consultation.

WP3.3. Development of the evaluation framework for application to infill development (including the addition of thermal performance). Development of the framework will be informed by the current state of knowledge on the topic, summarised above. In particular, the framework will build on UMEF4Water framework developed under project B1.2. The novelty of the framework will be its adjustment to its application at the scales identified in the typologies of infill development. With additional industry input we account for energy.

WP3.4. Consultation with other CRCWSC projects (obtaining input, addressing overlaps, synchronising outcomes). Efforts will be made to ensure alignment of the project with other CRCWSC projects. For example, the team will develop interfaces with policy and planning objectives parameters of IRP3, with cost/ benefit parameters of IRP2, and with community visioning aims and methods of IRP1.

WP3.5. Consultation and peer-review of the framework will be undertaken with representatives of target audiences and key stakeholders, to make sure that it responds to the practical needs of the practitioners.

**Work Package 4 Case study development**

This work package focuses on identifying case studies of infill development and designing options that can make them water sensitive. It is envisioned that at least 2 case study areas from different states will be identified, according to specific criteria. This work package has a strong focus on architectural design and will inform options for performance assessment.

Key tasks in this work package include:

WP4.1. High level assessment of potential case studies (with industry partners), which includes the following subtasks:

- Case-study criteria and template development (including steps to undertake case study and related information needs).
- Partnering with key industry/government organisations
- Identification of research and industry-led case studies (or case study components)
- Impact assessment (selected areas) of business as usual and scenarios.
- Development of a site-specific urban design brief/ issues and opportunities analysis for each case study

Case Studies: criteria for consideration include:

- Alignment with key research questions, aims and objectives
- Representativeness of infill development type (transferrable results to other sites)
- A commitment to on-ground change (eg a demonstration village), to meet quantified performance goals and governance innovation.
- Industry partner contribution including cash, in-kind, and implementation priority.

A complete list of case studies in consideration in IRP4 is presented in Table 1.

**Table 1 Case studies in consideration in IRP4**

| Possible Case study | Summary information |
|---|---|
| ***Victoria*** | |
| Arden Macaulay* | Medium-high density infill Regeneration/brownfield development; commercial/light industry/residential use; some flooding (link to IRP2 case study). DAnCE4Water model largely set up. IRP4 could use D5.1 demonstration. Existing D5.1 project work can be developed/ extended. |
| Elster Creek catchment* | Low-medium density infill; flood affected, more implementation focussed now. Could test urban metabolism model here. More driven by TAP. Existing D5.1 project work can be developed/ extended. |
| Monash National Employment Cluster | Precinct, Infill, Commercial/residential/educational, more. Perhaps larger scale, but a portion of the cluster could be assessed. |
| Aquarevo | SEWater: longitudinal research on water & energy usage impact of novel technology solutions and behaviour change (whether this is this infill was questioned). |
| Fisherman's Bend | Large scale urban renewal in Melbourne, (80 000 residents and 80 000 jobs planned) |
| ***Queensland*** | |
| Norman Creek* | Residential infill, Brisbane City Council; opportunity to take it to next stage; overland flows. DAnCE4Water model mostly set up, needs building footprint data. One catchment of Norman Creek has high resolution in DAnCE4Water. GHD did all of Brisbane in 1-D, 2-D. D5.1 demonstration. Existing D5.1 project work can be developed/ extended. |
| Coorparoo Creek Park | Evaluation of approach and future up-take. |
| UQ Living laboratory | Precinct scale redesign. |
| Fitzgibbon | Suggested. |
| ***South Australia*** | |
| City of Salisbury* | The study area, located adjacent to the eastern perimeter of Salisbury City Centre, has been identified as one of the "first stage" of urban rejuvenation in accordance with the City of Salisbury Growth Action Plan. Infill activity has commenced within the study area, including single dwelling replacement, dual occupancies, and unit and townhouse developments. Recent infill development within the study area is typified by highly impervious unit and townhouse developments, devoid of any green space in common or private areas. |
| Renewal SA - Kilburn, Blair Athol | Lot, street and precinct scale solutions for 2-on-1 and 3-on-1 developments, multiple contiguous allotments paving way for innovation in infill delivery & apartments; significant public housing fraction (Housing SA); commercial interface; approximately 50-60ha; has industrial buffer zones and some green spaces |
| Greenhill Precinct | Infill; on Transport route; commercial/residential (multiple use) development; adjacent southern parkland; water balance issues; alternate water available (Glenelg-Adelaide pipeline); stormwater harvesting at source, highly impervious sites (90%). |
| Redcliffe-Connect* | Infill expected. Needs redevelopment. Close to airport. Housing Authority land, transit-oriented, new housing typologies, high groundwater. Current MOU between City of |

| | |
|---|---|
| | Belmont and Dept. of Communities. Existing D5.1 project work can be developed/ extended. |
| Hamilton Hill | Residential infill precinct (T1 D5.1 demonstration/case study tbc). Residential low to medium density, mixture of single lots and grouped housing sites. 12 Ha , 300 – 400 dwellings. Potential demonstration on the cottage lots. Development stage: Planning and Design through to construction and built out of first stages |
| Bentley Regeneration | Precinct. Department of Housing. |
| Canning City Centre* | Mixed use precinct. |
| ***New South Wales*** | |
| Central Park Sydney | World's biggest recycled water facility in the basement of a residential building. 1 ML/ day recycled water servicing toilet flushing, washing machines, irrigation and air cooling. Recycled water will also be exported across the road to UTS through new infrastructure currently being installed |
| Carrington Rd Urban Renewal (Marrickville) | Suggested by Inner West Council. |

* Existing data/ analysis/ modelling work underway and ready to start and with current industry partner engagement. For more detailed case study documentation prepared see Appendix 2 for examples.

WP4.2. Local/ regional natural environment, geology and water structure historical analysis: For each case study, the team will compile background information and undertake analysis on natural systems and structure, including groundwater, geological formation, soil conditions and properties, landscape-scale water characteristics (eg. Previous floodplain/ sand ridges with swampy deposits, etc.). This information will inform design options.

WP4.3. Local/ regional built environment and infrastructure historical analysis (including 'BAU' current practice):
For each case study, the team will compile background information and undertake analysis on built forms, systems and structure, including historical and current land uses, predominant building types and construction systems/ materials, infrastructural systems including services and transport, and 'business as usual' contemporary practice (comprising housing, public realm, commercial, industrial and public uses as appropriate). This information will inform design options.

WP4.4. Design options for integrated urban precinct - landscape, built form and infrastructure/ systems: This will include: site analyses, appropriate housing typologies, landscape typologies, street typologies and relevant procurement methods to enable holistic long-term objectives to be met. We will illustrate yields, mixes of housing and other uses, public realm enhancements, public-private realm interfaces and interfaces with existing built context.

WP4.5. Design options for lot-scale typologies relevant to the urban plan and desired infill characteristics. Based on infill typologies established in work package 2 and current technologies used in them, the project team will develop *site-specific* design models for different categories of infill, suited to the particular needs and characteristics of each urban infill case study site.

WP4.6. Develop 3D attributes of building/ landscape/ systems typologies for evaluation and assessment. We will provide 3D physical attributes to performance analysis teams (including for example current and future building envelope, surface impervious fractions, storage volumes (water and soil), building footprints and heights).



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Business Cooperative Research Centres Programme

WP4.7. Multi-technology assessment against criteria developed in WP2. The team will conduct assessment of the designs based on 1) targets envisioned in each case study, 2) technology options relevant to the infill typology, 3) performance of the technologies relevant to these targets.

WP4.8. Refine designs in response to feedback from performance assessment(s) (WP4.7.) and WP5. The designs will be refined to respond to issues identified in multi-technology assessment (WP4.7.) and metabolic performance assessment conducted under WP5.

**Work Package 5 Infill projects performance assessment (testing the framework)**

We will apply the framework developed in WP3 to assess the possible case studies identified in WP4. This allows us to test and refine the framework. For each selected case study, the current baseline (~2017), BAU and pre-development status will be first characterised for their water-sensitive performance, representing by water mass balance and related performance indicators. This establishes a reference point against which different options can be evaluated.

In the options assessment, different water-sensitive options would be applied to each case study to assess their performance. Feedback and consultation with the design team will help identify possible options (based on input from WP4). Reviewing of national design guidelines (WP2) will also support option identification and development. Evaluation would be based on the key performance indicators in the developed framework. It is expected that the performance indicators would include (i) water efficiency, (ii) water supply internalisation, and (iii) hydrological performance. This options analysis would also allow us to identify what may be the best-practice water-sensitive solution for a given context.

Both the baseline characterisation and options analysis help test and refine the framework developed in WP3. An evaluation framework based on water mass balance integrated with modelled outputs from detailed modelling platforms such as MUSIC and SOURCE will be the expected outcome of this testing and refinement process.

In specific tasks in work package 5 will include:
WP5.1. Developing a template for case studies performance analysis that will allow collecting the necessary data.

WP5.2. Collection of relevant case study information required by the template (database of case studies), baseline characterisation of key case studies.

WP5.3. Developing a water mass balance screening tool (beta version), based on the framework described above. The tool will have a format easily useable for diverse audiences among key stakeholder (eg. XL spreadsheet). The tool will allow users to input the characteristics of an infill region of interest, and generate a water mass balance and the associated performance indicators. Users can also run scenario analysis to see how different scenario impact on the performance indicators. Performance analysis will include characterisation of for (i) natural (pre-developed), (ii) current and (ii) future options (guided by design). This task will be undertaken iteratively with work package 4. This will be vital in developing quantitative performance indicators for the development and infill more generally.



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Business Cooperative Research Centres Programme

Note: The urban metabolism (water mass balance) analysis framework is planned for incorporation into DAnCE4water (as a part of the TAP project) and hence close working with the DAnCE4water development work is expected as a part of this work package. However, water mass balance can also be progressed using a range of hydrological tools (eg source, music, hydrological partitioning factors). As a component of the method development review the efficacy of these tools will be reviewed.

WP5.4. Data collection and calibration for the design options that will be necessary to conduct the assessment. Design options that are based on data from elsewhere may need to be calibrated to the local context in some case studies.

WP5.5. Framework validation/calibration (conducting projects' performance assessment). – The framework may need to be customised based on the nature of case study (eg. scale, performance indicators of interest).

WP5.6. Identification and review of lessons learnt (collaborative evaluation) – factors determining the metabolic performance of selected case studies. This task will include a group reflection process on the outcomes of the performance assessment and formulating key lessons learnt that emerge from the analysis

WP5.7. Best-practice case study library (with performance assessment), that will be created to facilitate different stakeholders' access to the outcomes of the assessment. We envision that the library will enhance the interest in the framework as it will demonstrate its practical usefulness.

WP5.8. Microclimate work in Tranche 1 has shown that infill/urban consolidation will increase urban temperature and reduce human thermal comfort unless offset by heat mitigation including WSUD/irrigated green infrastructure. This task will use the VTUF-3D urban microclimate tool developed in Tranche 1 to test the microclimate benefits of WSUD/irrigated green infrastructure in one or more case studies compared to business as usual.

**Work Package 6 Governance review and design guidelines**

This work package will focus on translating the outcomes of the case study assessments into practice. It will focus of two main components: (i) developing design guidelines for water sensitive infill of different typologies, and (ii) exploring the interfaces between design and institutional framework and diagnosing the opportunities and barriers of guidelines implementation. The work package will include the following tasks:

WP6.1. Literature review - diagnosing/identifying barriers to effective integration of innovative water infrastructure solutions for infill developments will built on literature review from WP2.1. undertaken at the beginning of the project. The review will be complemented by stakeholder consultation (WP6.2) that will bring practitioners' perspective into the diagnosis.

WP6.2. Stakeholder consultation - diagnosing/identifying barriers to effective integration of innovative water infrastructure solutions for infill developments
These tasks (WP6.1. and WP6.2) will enable better understanding of institutional barriers that might be hindering uptake of ideas and designs generated in the project.

WP6.3. Literature review/policy content analysis of governance options for projects implementation (eg. financial, regulatory and institutional arrangements for WSC).
This task focuses on exploring institutional opportunities for mainstreaming the ideas, tools and designs generated in the project.

WP6.4. Developing a catalogue of urban design or technology approaches that enhance optimally integrated infrastructure solutions.
Once data is returned, on performance and technologies the design team will adjust typological designs in order to maximise performance and benefits. This will allow to establish and communicate design principles for water-sensitive infill development at middle suburban precinct scale. This may be based on Redcliffe Connect '10 principles', but will also include, where possible quantitative performance indicators for hydrology (eg naturalness, runoff increases (%), reduction in evapotranspiration (from natural) etc. This will also incorporate and reference 'One Planet Living' principles (ref. WGV). Water will be incorporated as a critical part of a holistic approach to sustainable, liveable infill.

WP6.5. Developing integration concepts/technologies/designs for decentralised systems. The guidelines that will be developed as part of this task will inform integration of decentralised systems (also for water supply augmentation) into the infill development.

WP6.6. Exploring partnership opportunities for optimal WSC outcomes,that can create opportunities for designs implementation. This will include review of grey literature but also networking efforts to identify potential partners.

**Work Package 7 Demonstration display village/precinct (requires industry investment)**

Realisation of this work packages is strongly contingent on receiving co-funding from local governments interested in implementing the proposed solutions in the area under their jurisdiction. If co-funding for this work package is obtained, a demonstration infill development will be constructed to showcase the implementation of the research outcomes and recommendations in practice. This work package could include identification of an appropriate site. It is envisioned that an appropriate site will be identified among the case studies that have not begun construction phase yet.

**Research skills and expertise needed for the work includes:**

- Urban water performance analysis, and water systems/urban evaluation.
- Urban design & architecture and governance
- Technology solutions and risk analysis
- Urban climate analysis and related heat impacts
- Public-private partnering in infill/impervious management
- Urban planning and governance.



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## 10. Intended project outcomes and expected project impact:

The project aims to influence instruments, logic, guidelines, method by contribute science and knowledge in key areas:

- the development of an accessible library of best-practice infill exemplars.
- Best practice WSUD concepts/visualisations for infill development.
- the development of built case studies that will be fully documented and performance-monitored
- validated performance-assessment framework (informed by multiple existing documents) supported by users/stakeholders and starting to be taken into local processes
- Guidelines/recommendations for water-sensitive infill development that could provide:
    - increased incorporation of science and guidelines relating to hydrological performance, green areas/infrastructure and associated life-cycle benefits.
    - slow-down in the rate of impervious area change (or faster shift towards more natural hydrological conditions) and related impacts on drainage, localised flooding and loss of stormwater retention; loss of urban green space and tree canopy cover, urban heat island effect.
- Information relevant to community engagement platform & behaviour change
- Project legacy could be guidelines, decision trees or options trees (with other IRPS).
- Policy statements in longer-term urban plans recognising infill issues, and setting a renewal or water sensitive cities direction.

## 11. Targeted end-user group(s):

| End-user groups | Anticipated benefits |
|---|---|
| Local government | Clearer methods for performance assessment and design. Information positioned to incorporate into process and influence governance arrangements. |
| Water/Wastewater Utilities | Greater certainty in a shift to performance-based assessment. |
| Land and property developers, builders | New/innovative ways to maximise benefits of development (eg yield) while strengthening water sensitive development outcomes. |
| State government (planning and water resources) | Inform drafting and review of planning policy, and contribute to the evidence-based justification of new measures (primarily this is understood to be IRP3). |
| Water-sensitive urban design practitioners (private industry) | New/innovative ways to maximise benefits of development (eg yield) while strengthening water sensitive development outcomes for developers. |
| Water-sensitive urban design practitioners and advisors | Clearer criteria for achieving water-sensitive urban design. |

Key opportunities for impact and uptake:

- Establishment of the infill design guidelines (residential design code reform and links to Water Sensitive / Liveable neighbourhoods ideally national scale guidelines)
- Integration with Bureau of Meteorology annual data compilation. This may enable greater automation of performance indicator analysis (eg drawing on the B.o.M. compilation of all major urban water datasets including rainfall, evapotranspiration, centralised flows, some decentralised and alternative water supply data etc).

Application of the mass balance framework to this data has wide potential to generate annual performance indicators of “urban hydrology” at sub-city scale.

12. **Commercialisation and Intellectual Property (IP):**
Knowledge of future expected infill development areas will be core IP developed. A mass balance analysis tool may offer commercialisation possibilities. It will be promoted as a product for local governments and is expected to be released as part of the TAP outputs. Commercial opportunities will be explored as part of the TAP project.

13. **Industry/end-user participation:**
The role of industry partners is presented in section 5 above. Key engagement will include case study materials and information, hosting workshops/meetings, and hosting PhD students (collaborative work with PhD students).

**Translation/adoption pathways:** Pathways will be identified for targeted communication and uptake/adoption during the project timeline. The project results (guidelines, assessment tool/framework) will promoted among the key audiences through: (a) Engagement strategies (direct involvement in the project). For example industry partners are already involved in project development and will be active in developing and assessing and developing selected case studies. Communication of the project outcomes. A set of publications tailored to specific audiences, infill case study library, demonstration display will be made freely accessible. Beta-version of the excel tool for metabolic assessment will be made available to interested parties free of charge. Details of the translation/adoption pathways will be provided in the Stakeholder Engagement Plan.

14. **Work plan, project timelines and milestones:** Describe the research work plan including methods and outputs. Provide timing of key tasks/activities with major progress, decision, communication and adoption milestones during project duration.

CRC for Water Sensitive Cities

## 14.1 Work plan

| | Leader | 2017 | | 2018 | | | | 2019 | | | | 2020 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Aug-Oct | Oct-Dec | Jan-Mar | Apr-Jun | Jul-Sept | Oct-Dec | Jan-Mar | Apr-Jun | Jul-Sept | Oct-Dec | Jan-Mar | Apr-Jun | Jul-Sept |
| | | before start | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 |
| **Work Package 1 Project management, quality, and stakeholder engagement** | | | | | | | | | | | | | | |
| WP1. Developing and refining project plan (work packages, schedule, budget, risks, milestones, quality gates) | SK | | Final Plan | | | | | | | | | | | |
| WP1. Project management, external and internal communication | SK | | | | | | | | | | | | | Final report |
| **Work Package 2 Conceptual background of WSC infill development: Typologies, technologies and governance** | | | | | | | | | | | | | | |
| WP2. Designing a catalogue of relevant infill typologies for collaborative evaluation | NB/GL | | | | | Report | | | | | | | | |
| WP2. Review and performance assessment of different typologies (comparison to BAU, with options) | SK/NB/GL | | | | | | Report | | | | | | | |
| **Work Package 3 Framework development and informing Tool Development** | | | | | | | | | | | | | | |
| WP3. Development of infill framework | SK | | | | | | Framework (report) | | | | | | | |
| WP3. Consultation of the framework | SK | | | | | | | Report | | | | | | |
| **Work Package 4 Case study development** | | | | | | | | | | | | | | |
| WP4.1. High level assessment of potential case studies (with industry partners) - issues and opportunities/ brief | NB/GL/SK | | | Case Study 1 | | Case Study 2 | | Case Study 3? (contingent on co-investment) | | | | | | |
| WP4.6. Develop 3D attributes of building/ landscape/ systems typologies for evaluation and assessment | NB/GL | | | | | | | | | | | | | |
| WP4. Develop case study designs and adapt them in response to feedback from performance assessment(s) | NB/GL | | | | | Case study | | | Case study | | | | | |
| **Work Package 5 WSC infill projects performance assessment (testing the framework)** | | | | | | | | | | | | | | |
| WP5. Collection of relevant case studies and baseline information (by template database of case studies), baseline characterisation of key case studies | SK | | | | Case study library | | | | | | | | | |
| WP5. Developing water mass balance screening tool (beta version) | SK | | | | Tool | | | | | | | | | |
| WP5. Conducting case studies performance assessment using the framework | SK | | | | | | | | | Report | | | | |
| WP5. Micro-climate work | NT | | | | | | | | | | | | | |
| **Work Package 6 Governance review and design guidelines** | | | | | | | | | | | | | | |
| WP6. Review of governance options for projects implementation (eg. financial, regulatory and institutional arrangements for WSC) | GL/SK/NB (confirm) | | | | | | | | | | | Report | | |
| WP6. Developing a catalogue of urban design, technology approaches and decentralised systems integration concepts that enhance optimally integrated infrastructure solutions (confirm) | NB/SK/GL | | | | | | | | | | | | Report | |
| **Work Package 7 Demonstration village precinct (funding contingent)** | | | | | | Contingent on co-investment | | | | | | | | |



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## 14.2 Project milestone & deliverables

| No. | Milestone/deliverable description | Accountable team members | Due date |
|---|---|---|---|
| | | | |
| 1 | Water mass balance screening tool, used for case study (Beta) | SK | June. 2018 |
| 2 | Design typologies (catalog/options) | NB/GL | Sept 2018 |
| 3 | Infill performance evaluation framework (draft) | SK | Dec. 2018 |
| 4 | Final Landscape design options for modelling case study 1 | NB/GL | Sept 2018 |
| 5 | Evaluation of infill projects in accordance with end-user agreed framework have commenced. | SK | Sept. 2018 |
| 6 | Evaluation framework for infill projects is agreed by end-users. | SK | Mar 2019 |
| 7 | Evaluation of infill projects with end-user agreed framework is completed. | SK | Sept 2019 |
| 8 | Report on infill projects publically released | SK/Team | Mar. 2020 |
| 9 | Final project report | SK/Team | Sep 2020 |



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Business Cooperative Research Centres Programme

**15. Resources:** Provide a yearly budget estimate including anticipated annual cash and in-kind budget over the duration of the project

| Expenditure | Detail | Year 1* 2017-18 | Year 2 2018-19 | Year 3 2019-20 | Year 4** 2020-21 | Total |
|---|---|---|---|---|---|---|
| Research Fellow (UQ) deputy leader | ARB106 0.6 FTE for duration | 64,010 | 85,347 | 85,347 | 21,337 | 256,040 |
| Research Fellow (to confirm location) | ARA106 0.5 FTE 6 months | 0 | 26,250 | 0 | 0 | 26,250 |
| Research Fellow (UWA) | ARA106 0.5 FTE for 18 months 2018-19 | 0 | 52,500 | 26,250 | 0 | 78,750 |
| Research Fellow (Monash) | ARA106 0.5 FTE for 18 months 2018-19 | 26,250 | 52,500 | 0 | 0 | 78,750 |
| Research Fellow (Monash) | ARA106 0.5 FTE Jul-Dec 2018 | 0 | 26,250 | 0 | 0 | 26,250 |
| Research Assistant (UQ) | 0.4 FTE | 22,500 | 30,000 | 18,750 | 3,750 | 75,000 |
| PhD top-ups | 2@UQ, 1@Monash/UWA | 18,000 | 36000 | 36000 | 9000 | 99,000 |
| **Total staffing including PhD top-ups** | | **130,760** | **308,847** | **166,347** | **34,087** | **640,040** |
| Operating costs | | | | | | |
| PSC meetings | | 6,000 | 6,000 | 6,000 | 0 | 18,000 |
| Computing and data | | 5,000 | 10,000 | 5,000 | 0 | 20,000 |
| Case studies travel | | 8,000 | 10,000 | 10,000 | 0 | 28,000 |
| Research case studies | | 5,000 | 30,000 | 30,000 | 5,000 | 70,000 |
| General operating costs | | 4,000 | 10,000 | 10,000 | 0 | 24,000 |
| **Total Operating** | | **28,000** | **66,000** | **61,000** | **5,000** | **160,000** |
| **Total CRC Costs** | | **158,760** | **374,847** | **227,347** | **39,087** | **800,040** |
| **Co-funding target from partners (to confirm)** | | **50,000** | **100,000** | **120,000** | **30,000** | **300,000** |
| **In-kind (to confirm)** | | | | | | |
| Steven Kenway | | 0.2 | 0.2 | 0.2 | 0.2 | |
| Mellissa Bradley | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Geoffrey London | | 0.05 | 0.05 | 0.1 | 0.05 | |
| Nigel Bertram | | 0.05 | 0.1 | 0.05 | 0.05 | |
| Peter Newton | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Kieron Beardmore | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Sadeq Zaman | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Nigel Corby | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Greg Ryan | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Nigel Tapper | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Pam Kerry | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Zhiguo Yuan | | 0.02 | 0.02 | 0.02 | 0.02 | |
| Lisa McLean | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Cintia Dotto | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Nicholas Temov | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Matt Stack | | 0.05 | 0.05 | 0.05 | 0.05 | |
| Christian Ulrich | | 0.05 | 0.05 | 0.05 | 0.05 | |

* 9 months ** 3months

**CRCWSC Tranche 2 Project Resources spreadsheet will be supplied with final version of proposal.**

In addition to the project budget above, budget approval is sought for costs of scoping the project between 1 August and 30 September 2017 and to enable continuation of key staff from Tranche 1 Project B1.2.

## 16. Risk assessment and management:

| Area | Pr | Co | Risk | Control measures to minimise risks |
|---|---|---|---|---|
| Scope is too big meaning little achieved in many areas. | H | M | MH | Keep developing the scope. Develop a method early and clarify further the adoption points. Refresh it annually. Keep major attention on a limited number of larger, more detailed case studies. |
| Case studies overwhelm the project leading to a "consulting" outcome with only superficial address of research questions or national impact. | M H | M | MH | Work with stakeholders to develop good information on a number case studies in early stages. Develop key criteria for implementing detailed case studies including (i) strong support (ii) a commitment to high quality design and (iii) desire to implement on-ground change guided by the CRCWSC. Address smaller number of studies in detail. |
| Expectations of end-users is high leading to difficulty focussing the project and frustration. | M H | MH | MH | Clearly convey the final scope of the project, keep seeking input to focus the work (and deepen it in particular areas), invite end-users to contribute in-kind or resources to generate additional outputs. |
| Interactions with other IRP's difficult or expectations hard to manage. | M H | M | MH | Define expected inputs to, our outputs to other IRP's (particularly TAP and IRP3). Connect with other IRP's as much as possible and note links in the project plan. Clarify what we need from IRP2 what we need as many infill decisions revolve around actual or perceived costs/benefits of different approaches. Include leaders of TAP on the steering committee. Communicate regularly with other IRP leaders (particularly IRP3 and 2). |
| Resources (Postdoc/PhD) take a long period to recruit and bring up to speed, or they leave due to uncertainty. | M | M | M | Establish contracts as long as possible ahead of time. Recruit fromT1 teams as much as possible. |
| End-users disengage leading to failure of case studies and reduced ability to fulfil project objectives. | M | M | M | Seek support during project development and negotiation. Design project as clearly as possible to meet end user needs, while delivering research. |
| Data management is complex | M | M | M | Develop good data directory structure, data register and communicate its use. Keep raw (unadulterated) data in a separate directory. |
| Policy risks. Possibly either seen as threatening or irrelevant. | M | M | M | Keep bringing stakeholders along the journey. |
| Key personnel lost during the project, leading to rework, refocus and impacts on delivery. | M | MH | M | Support researchers, create opportunities for career progression, recognise that research/industry/government have different agendas and needs to progress. Keep communicating expectations and celebrate success. Encourage presentations by early researchers to help motivate them, and to provide feedback opportunities. |
| Difficult to "energise" the entire team as so spread out. | M | M | M | Engage independent chair. Meet face to face at least twice per year. |
| Difficult to publish scientifically due to its applied nature. | M | M | M | Develop a publications plan early including industry and scientific publications. Work with multi-disciplinary journals and identify early. |
| Ethics approval takes time (eg for case study information or any data-seeking interactions) | L | M | ML | Work with members of the Participating Committee. Involve the CRCWSC in the ethics approval process. Submit approvals as early as possible. Recognise this takes time. |

*Pr=probability, Co=consequence; L=Low, M=Med, H=High*



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**Key CRCWSC-wide information/actions include:**
A common data platform across the CRCWSC (eg assembled city-scale data, case study data would enable and encourage integration. A matrix of case studies across the IRP's could help clarify which is being undertaken in which project.

## 17. References:

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## Appendix 1 – Related additional research questions

Additional questions related to Objective 1:

- How can a water mass balance analysis (and other tools) be used to demonstrate and quantify the benefits of up-scaling water-sensitive initiatives lot-to-precinct-scale initiatives to the city-scale and as part of a multi-criteria analysis?
- Can regular quantified performance analysis of the city/precinct water balance provide a performance time-series (eg Bureau of Meteorology and CRCWSC partners) and inform the Water Sensitive Cities Index?
- How can water-related energy, greenhouse gas emissions and nutrient impacts be integrated into the developed evaluation frameworks?
- What are the wider impacts of infill (eg life cycle/energy implications, urban cooling) and which methods and tools are most suited for this analysis and how can renewal (vs knockdown) realise more benefits?
- What are the key risks related to Water Sensitive infill developments from lot to precinct scale?
- Where are the key opportunities (technological, institutional) to mitigate and adapt to impacts?

Additional questions related to Objective 2:

- Can technological section guidelines be connected with existing tools developed in the CRCWSC (eg DAnCE4Water)?
- What is the financial/economic feasibility of water sensitive infill, with attention to lot yield and monetisation? This may include linking financial performance into the overall framework.

Additional questions related to Objective 3:

- What barriers in the regulatory and financing processes prevent an integrated and high quality approach to infill development?
- Can governance key performance indicators for infill be identified?

And a major area for discussion (contingent on stakeholder investment):

- Can the outcome of the project be connected with procurement in a real-life application (demonstration village or precinct) including prequalification lists for technologies/ providers or procurement models that enable new more sustainable business models for water management delivered either by private sector or council/government.



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**Appendix 2 – Preliminary information (case study template) and preliminary case study information (example/indicative).**

# Integrated Research Project 4 (IRP4)

## Achieving water sensitive outcomes for in-fill developments

*Potential case-study preliminary information template*

## City of Salisbury (Salisbury East Precinct) (SA)

| Case study | Salisbury East precinct rejuvenation project |
|---|---|
| Key stakeholders: | • City of Salisbury<br>• Housing SA<br>• Renewal SA, as service provider to Housing SA to renew public housing stock<br>• Water Sensitive SA |
| Stage of development (% constructed, anticipated years of construction) | The study area, located adjacent to the eastern perimeter of Salisbury City Centre, has been identified as one of the "first stage" of urban rejuvenation in accordance with the City of Salisbury Growth Action Plan. Infill activity has commenced within the study area, including single dwelling replacement, dual occupancies, and unit and townhouse developments as demonstrated by the typical examples in Figure 4.<br><br>Council has recently acquired land along the major waterway on the northern edge of the site for future storm water management and open space improvements.<br><br>A strategic Land analysis across council has recently been completed and identified a council owned parcel of land which could be development for residential housing within the study area.<br><br>Two footpath upgrades have been scheduled for 17/18 financial year and a number of road reseal programs have been completed in 16/17.<br><br>A Council road condition audit will be complete in September which will provide long term direction on road reconstruction and maintenance. The study area has streets from 1968 that have not been upgraded and will likely make their way into future upgrade programs. Council take the opportunity during this road reconstruction projects to look at improving all aspects of the street, including street trees, planting and footpaths.<br><br>A flood study has recently been completed which informs councils of high risk areas during major storm events and will inform future plans for storm water management.<br><br>Any plans developed as part of the research project could influence future asset upgrades and investment into the public realm. |
| Site context<br>(added criteria to template) | The City of Salisbury is a national leader in the delivery of large-scale stormwater harvesting re-use schemes. Through its business unit, Salisbury Water, Council provides an integrated approach to water resource management, encompassing local rainwater harvesting schemes, recycled stormwater and native ground water supply schemes to provide a reliable 'fit for purpose' alternative to mains water, supplying to the community, industry and schools.<br><br>As the major developer of residential subdivisions in their local government area, Council is uniquely placed to influence the character of urban growth in one of the fastest growing regions in metropolitan Adelaide. Council entered the residential development market in 2010 and have established a new |



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| | standard in design quality through subdivision design and streetscapes through to living options.<br><br>The project study area incorporates parts of the suburbs of Salisbury and Salisbury Plains. These suburbs, together with Salisbury Downs and Parafield Gardens, are expected to yield an additional 2500 new dwellings through urban consolidation, all within close proximity to public transport nodes (e.g. railway stations). The precinct subject of the study includes a section of the Little Para River to the north-west that provides recreational opportunities, in an area that otherwise has limited public open space.<br><br>Characteristics of the project study area include:<br>▪ close proximity to the Salisbury Town Centre, located on its eastern boundary<br>▪ good access to public transport opportunities: Salisbury Train Station 800 m to the west and metro bus services passing through the precinct<br>▪ poor connectivity to the Little Para River, however many opportunities exist for improved access<br>▪ poor amenity of this section of the Little Para, however improvements are envisaged to encourage community use and development overlooking the asset<br>▪ street tree planting is eclectic and often dispersed<br>▪ the footpath network could be significantly improved<br>▪ large undeveloped allotments. |
| Type of infill development (notes) | There is a potential mismatch between existing housing stock and household demographics, with an overwhelming majority of existing housing being 3- and 4-bedroom detached housing, despite a significant proportion of 1- and 2-person households within the City of Salisbury. The trend of single and two-person households is expected to continue to increase. This suggests increased demand for a variety of housing forms, smaller houses and/or fewer bedroom houses in the future. However, there is a strong preference for Torrens Title properties over Community Title.<br><br>Trends towards smaller allotments driven by affordability are noted. For example, delivery of 2- and 3-bedroom houses on allotments of less than 150 square metres, such as those available in new Council projects at Paralowie, reflect the changing demographic in the City and are popular.<br><br>Market demand for apartment development in general is subdued; however, there is recognition that enhancement of the quality of public realm in localities such as the adjacent Salisbury City Centre could help stimulate investment.<br><br>The existing housing stock within the study area is represented by modest homes on large blocks or unit developments surrounded by generously proportioned private green space. Many large vacant allotments exist within this area. Figure 3 illustrates the type and nature of sites expected to be subject to infill in the future.<br><br>Recent infill development within the study area is typified by highly impervious unit and townhouse developments, devoid of any green space in common or private areas as shown in Figure 4.<br><br>The nature of the streetscapes varies from narrow verge widths comprised only of concrete paths between the kerb and property boundary, to those with generous verge widths containing established native trees. The precinct also includes a series of vegetated and non-vegetated laneways that have the potential to increase connectivity within the study area. Images of typical streetscapes and laneways are shown in Figure 5. |
| Relevant state targets which have been set (include a link if possible) | **State targets**<br>– *Water sensitive urban design: Creating more liveable and water sensitive cities in South Australia*, known as the South Australian Water sensitive urban design policy, including stormwater runoff quality and quantity performance targets<br>**Regional strategies and objectives** |

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| | – Adapting Northern Adelaide Climate Change Adaptation Plan<br>**Council plan and objectives**<br>– City Plan 2030<br>– City of Salisbury Growth Action Plan |
| Key issues/research or management questions:<br>(please use questions from the draft project plan (IRP4), OR, if a new question, note it as NEW) | **Objective 1 (Performance and impact)**<br>**Research questions to be explored by case study:**<br>▪ How might performance be defined, measured and assessed, generally or specific to infill? (Objective a)<br>▪ What is the "hydrological impact" (changes to water mass balance and related performance indicators) of anticipated infill development? (a,c)<br>▪ What are the wider benefits and impacts of infill development (eg life cycle/energy implications, urban cooling) and which methods and tools are most suited for this analysis? (a,c)<br>▪ What are the key risks related to water sensitive developments related to infill from allotment to precinct scale? (d)<br>▪ Where are the key opportunities (technological, institutional) to mitigate and adapt impacts? (a,b,c,d,e)<br><br>**Response**<br>In an uncertain climate future, Council's key driver for the project is to integrate WSUD at the precinct, streetscape and allotment scales to deliver higher amenity and urban cooling for their community. This project will demonstrate how the management of stormwater flow, volume and quality within urban infill can provide multiple benefits, including supporting system efficiency and yields of large scale stormwater harvesting schemes.<br><br>**Objective 2 (Design and implementation):**<br>**Research questions to be explored by case study**<br>▪ What information is critical to guide selection of solutions? Of this information, how much is context/location specific?<br>▪ What housing typologies and planting options would enable best WSUD outcomes in a selection of Australian site conditions for infill in suburbia, brownfield and greyfield sites.<br>▪ What key measures are needed to achieve WSUD outcomes within each typology set?<br>▪ What links are needed between infill and the planning controls that have the greatest influence on water sensitive outcomes? (e.g. boundary setbacks, infrastructure planning, open space/landscape requirements, deep soil areas, parking) (primarily this is being undertaken in IRP3).<br>▪ What is the financial/economic feasibility of water sensitive infill, with attention to lot yield and monetisation? This includes linking financial performance into the overall framework (needs to be in coordination with IRP2).<br><br>**Response**<br>As the major developer of residential subdivisions in their local government area, Council provides leadership in design quality. Council now seeks to extend this role into the provision of a housing mix that is consistent with community need, to address a significant gap in dwelling types in the market. Council's understanding of the housing market, coupled with processes for financing and delivering residential infill, provides an opportunity to gain insights from both a developer and local government agency perspective. The relevant planning policy for the study area is not prescriptive about the built form and hence could enable flexibility to provide proof of concept for innovative infill housing typologies.<br><br>**Objective 3 (Governance):**<br>**Research questions to be explored by case study**<br>▪ Where have governance arrangements (including private-public partnerships, local government and water utilities, estate departments e.g. DEWLP) been successful?<br>▪ What lessons have been learnt in successful and unsuccessful delivery of valuable/highly performing water sensitive developments?<br>▪ How can the process of infill development be harnessed to transform communities and improve liveability?<br>▪ What barriers in the regulatory and financing processes prevent an integrated and high-quality approach to infill development? |

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| | **Response**<br>Council will seek to engage and partner with Renewal SA to realise the transformation of the significant quantity of public housing stock within the study area consistent with the proposed master plan for the precinct. The project offers opportunities to learn not only from Council's recent experiences delivering infill, but also what strategies are required to bring a public housing authority on the journey.<br><br>In accordance with the *City of Salisbury Growth Action Plan (2017)*, Council seeks to proactively enhance market demand, promote development investment and facilitate higher levels of growth, through a range of means including:<br>▪ *Encouraging **quality infill development** and urban consolidation within targeted locations, encouraging higher density development within and adjoining key activity centres, high frequency transit nodes, and areas of open space through supportive land use policies, **streetscape and public realm upgrades**, and provision of supportive infrastructure.*<br>▪ *Proactively planning for and developing mechanisms to support **provision of appropriate infrastructure** and services within identified growth areas, including transport, **stormwater** and social infrastructure, utilities, and open space.*<br>▪ *Ongoing **development of partnerships with key land owners**, agencies and State Government stakeholders to identify opportunities for high-quality, integrated redevelopment projects, including through the Renewal SA managed 'Renewing our Streets and Suburbs' program.*<br>▪ *Proactively identifying, investigating and developing surplus Council owned land, whilst balancing community aspirations and expectations, to stimulate private investment, **provide and demonstrate innovative diverse housing opportunities with quality design** outcomes whilst generating income to support the upgrade of Council assets.*<br>▪ ***Potentially acquiring and developing key sites in growth areas** to act as demonstration projects and catalyse wider redevelopment by the private sector.* |
| Importance/significance of the case study: (ideally clarify its relationship to the infill project aims) | ***Objective 1: Developing and applying a validated performance framework to understand the impacts and management of in-infill development:***<br>Council is currently investigating potential to monitor outflows. Flood studies have recently been completed which will be provided.<br>***Objective 2: Informing a design guidance tool/process for technology application/suitability***<br>The relevant planning policy for the study area is not prescriptive about the built form and hence could enable flexibility to provide proof of concept for innovative infill housing typologies.<br>***Objective 3: Identify options for innovative governance arrangements***<br>The City of Salisbury case study provides an opportunity to work directly with a developer (Council) who is committed to investigating a new approach to urban infill, with capacity to provide demonstration/proof of concept within the life time of the CRCWSC Tranche 2. With an international reputation for innovation and best practice for large-scale stormwater harvesting and reuse schemes, under their business unit, Council is now seeking to deliver best practice urban water management at the precinct, street and allotment scales.<br>Council acts as the land developer and in some cases will "partner" with developers to enable the creation of innovative housing outcomes to meet the needs of the community. Conventional lot types are sold as land for the owner to then source a builder of their choice and build their home. |
| Expected outcomes from the case study (how it will be useful for the infill project and related stakeholders): | 1. Demonstration of an innovative mix of model housing typologies and how they interface with street scale WSUD and public open space solutions, that optimise climate resilience in terms of alternative water supply, flood management and urban cooling.<br>2. An investigation into the governance structures and policy mechanisms that support the delivery of high quality, water sensitive infill developments.<br>3. Demonstration of the multiple benefits to large-scale stormwater harvesting schemes associated with the improved management of |



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| | stormwater runoff flow, volume and quality within urban infill developments. |
| Available support: In-kind (could include data, information, experts, etc.) | ▪ Council GIS data including stormwater models and asset management data, VPD data, Block sizes, ownership, Site cap ratios, etc etc.<br>▪ ArcGIS platform for urban analysis<br>▪ Corporate plans and strategies<br>▪ Councils Coordinator of Urban Policy is available as a day to day resource, with strong experience in the design and delivery of large and small scale urban development and renewal projects for both the private and public sector.<br>▪ A project working group can be established which would include experts from City infrastructure, asset management, maintenance, land development and water management. |
| Available support: Cash (co-investment) | A co-contribution in the order of $5,000 is envisaged. |
| Scale of case study (note the approximate size, e.g. population or household numbers) | No. of dwellings in the study area = 800<br>Population of the study area is 1600 persons<br>Population Density: 18 P/ha<br>Persons Per House: 2.0<br>No. of allotments with capital value/site value of 1.0-1.3 = 100 |
| Map/figure of spatial extent | Refer to:<br>- Figure 1 – Study area locality map<br>- Figure 2 – Site capital ratio within the study area |
| Other information considered relevant | Many of the roads, footpaths and related infrastructure in the study are reaching the end of their asset life and will be subject to renewal in coming years. This presents an opportunity to reinvigorate the suburb shifting from the traditional “like-for-like” approach to asset renewal to one that incorporates water sensitive urban design elements.<br><br>A section of the Little Para River linear park passes through the north of the study area. Other than this reserve, public open space within the study area is limited to “pocket parks” and two reserves consisting of stands of remnant trees with no active recreation facilities or capital improvements. The study area is severely deficient in local open space. Council is seeking to develop solutions for the study area that enhances walkability and amenity of the area underpinned by water sensitive urban principles.<br><br>Existing housing stock in the area includes 1920-40s bungalows, public housing units and new medium density townhouses through development that has intensified over the past 10 years. Significant infill opportunities exist, demonstrated by the large number of lots with a site capital ratio (capital value/site value ) of 1.0-1.3, as indicated by the areas shaded dark blue in Figure 2. This feature, coupled with a flexible planning zone that is silent on minimum lot size and has no “restrictive” residential character. provides opportunity for innovation in residential typologies. |


**Figure 1 – Study area locality map**



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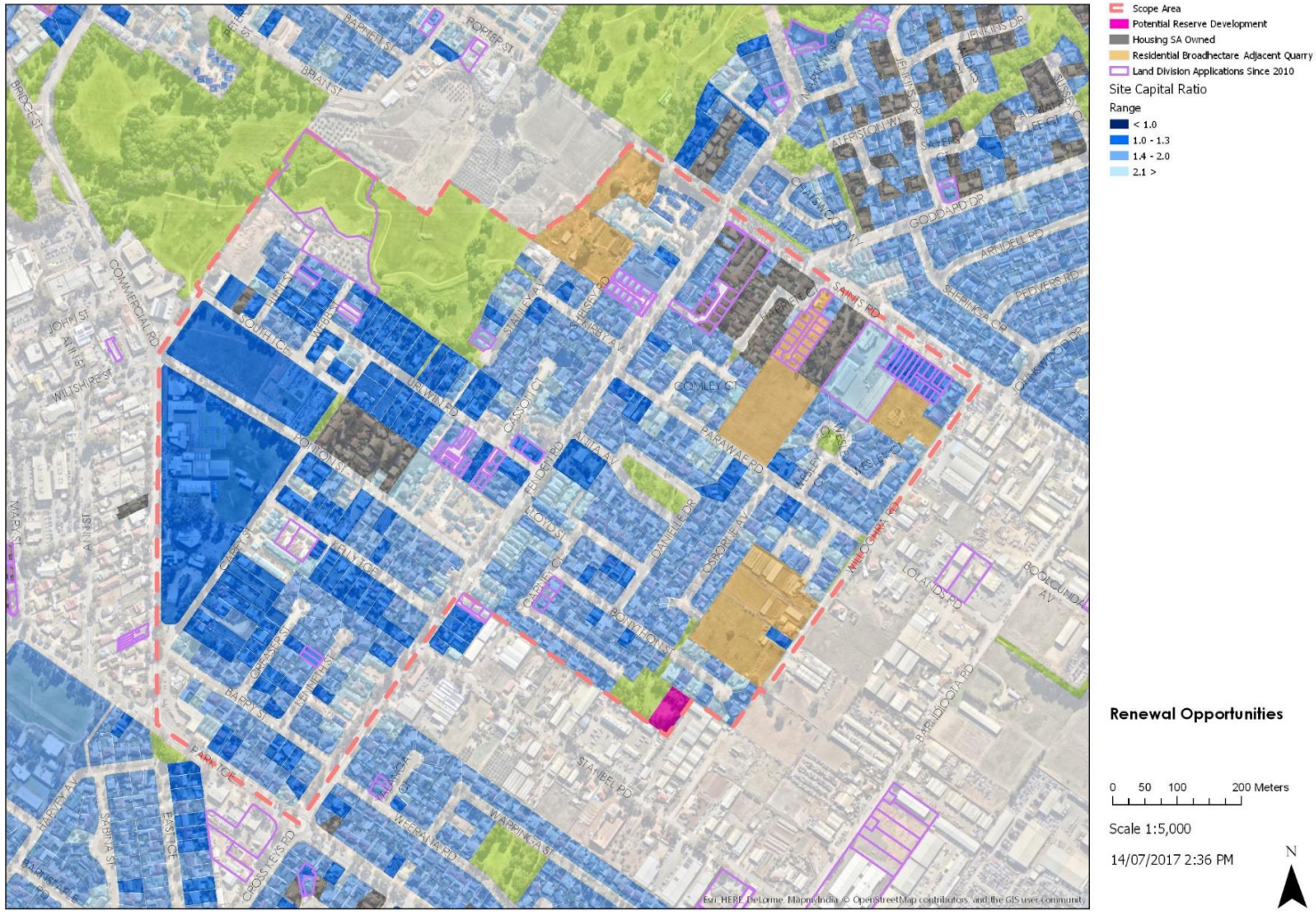


**Figure 2 – Site capital ratio within the study area**



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**Figure 3 Existing housing stock and vacant land**



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**Figure 4 Typical recent developments**



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**Figure 5 – Existing streetscapes and laneways**



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CRC for Water Sensitive Cities

# Integrated Research Project 4 (IRP4)

## Achieving water sensitive outcomes for in-fill developments

*Potential case-study preliminary information template*

## Norman Creek (QLD)

| Case study | Norman Creek |
|---|---|
| Key stakeholders: | Brisbane City Council |
| Stage of development (% constructed, anticipated years of construction)i | Coorparoo and Districts Neighbourhood Plan March 2017 - Early Stages https://www.brisbane.qld.gov.au/planning-building/planning-guidelines-tools/neighbourhood-planning-urban-renewal/neighbourhood-plans-other-local-planning-projects/coorparoo-districts-neighbourhood-plan |
| Type of infill development (notes) | Mixtures mainly Medium Density and Low Medium Residential and Mixed Use |
| Relevant state targets which have been set (include a link if possible) | See Neighbourhood Plan<br>Brisbane has a 94% infill target |
| Key issues / Research or Management questions: (please use questions from the draft project plan (IRP4), OR, if a new question, note it as NEW) | Reviewing Coorparoo Creek Park – lessons learnt re co-benefit infrastructure, investment and higher density outcomes<br><br>Co-Design and Implementation for Flood Resilience build form and design building upon the CRCWSCs Ideas for Norman Creek<br>• High Density Development to create Adventure Corridors (Value Capture with adjoining infill development)<br>• Low Medium Residential typology<br><br>Review of City Plan Codes (eg Multi-Dwelling Code, Stormwater Code and Desired Standards of Service for Stormwater Infrastructure) to Implement and Co-Benefit Infrastructure |
| Importance / significance of the case study: (ideally clarify its relationship to the infill project aims) | Norman Creek is an intensifying area and presents many water challenges to and the CRCWSC Ideas can be taken to the next stage and support Council priorities and the Coorparoo and Districts Neighbourhood Plan (released March 2017)<br><br>Norman Creek has a range of overland flow modelling and CRCWSC products/studies (including architectural studies (eg D5.1) and a partially-developed DANCE model. Consequently, it is well-positioned to undertake work which could quantify the current, baseline, and projected "water sensitive" hydrological performance. Methods, tools and products produced in the CRCWSC could be used including the Urban Water Metabolism Framework which has been presented several times to Brisbane City Council and is at the core of the infill project.<br><br>Kaan Ozgun from UQ is progressing the Small Lots project and is delivering a paper to a Conference in July titled “Urban Environment Qualities of Norman Creek”. His studies are delivering papers to him on their current course titled “Urban Environment Qualities of Norman Creek and its relationship with the Open Space Network”. Kaan is planning a course at UQ next Semester which will be focused on “Socio economic qualities of Norman Creek catchment”<br><br>Queensland Flood Community of Practice, is launching WATER FUTURES: An Integrated Water and Flood Management plan for enhancing Liveability in South East Queensland. |



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| Expected outcomes from the case study (how it will be useful for the infill project and related stakeholders): | • Flood Resilient Design<br>• Scaled-up hydrological performance<br>• Benefits Assessment<br>• Implementation Pathways |
| Available support: In-kind (could include data, information, experts, etc.) | Data, Information, Experts |
| Available support: Cash (co-investment) | Possibly |
| Scale of case study (note the approximate size, eg population or household numbers) | • Review Coorparoo Creek Park<br>• 1x Adventure Corridor (see CRCWSC Ideas for Norman)<br>• 1 x Low Medium Residential (See CRCWSC Ideas for Norman) |
| Map/Figure of spatial extent | Ideally paste in or attach below a map or figure showing the boundaries/dimensions of the case study. |
| Other information considered relevant | • The current infill project could undertake some of this in a limited way, but the Norman Creek development offers much wider synthesis and integration opportunities linking to alternative soft infrastructure and design solutions to traditional flood assistance and the newly released **Clean, Green Sustainable Brisbane**. For example, this could include:<br>(a) scaling-up results from Norman Creek to consider the city-wide benefits and challenges<br>(b) moving towards quantitative hydrological performance criteria which could add specificity to city-wide water targets (eg for 'sponge city' at source detention and flood impact, stormwater harvesting/decentralisation), including scaling-up of some of the DANCE modelling to city-scale<br>(c) improved integration of water-energy planning with the potential to convene a novel planning "tournament" spanning a range of **Clean Green Sustainable goals** with potential for much wider translation.<br>• The infill project (IRP4) aims to develop and apply a validated performance-analysis framework spanning not only water, but also energy. Brisbane's recent **Clean Green Sustainable Strategy (2017 - 2031**) has goals ecompassing not only water, but carbon/greenhouse gas emissions and parks/vegetation. The CRCWSC could enable integration analysis across this space (eg including urban heat island, vegetative shading benefits/thermal comfort, and energy-intensity of water systems and use).<br>• Developing links UQ Design, Council Urban Design team, and wider related stakeholders (eg Queensland Urban Utilities, Energex, Qld Health etc).<br>• The infill project leader Steven Kenway, is a former BCC employee (Brisbane Water) and the infill project is expected to have a strong presence in Queensland for the duration of the project (2017-2020+), making it ideally suited for strong engagement with BCC and related stakeholders. |



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CRC for Water Sensitive Cities

# Integrated Research Project 4 (IRP4)

## Achieving water sensitive outcomes for in-fill developments

*Potential case-study preliminary information template*

## Hamilton Hill (WA)

| Case study | Hamilton Hill |
|---|---|
| Key stakeholders: | LandCorp, City of Cockburn, Water Corp |
| Stage of development (% constructed, anticipated years of construction) | Planning and Design through to construction and built out of first stages |
| Type of infill development (notes) | Greyfield infill of former high school site. Mature trees, existing buildings and some topographic level changes across the site present opportunities and challenges to redevelopment. Proposed is a Residential low to medium density development, containing a mixture of single lots and grouped housing sites. Potential demonstration build out on cottage lots. |
| Relevant state targets which have been set (include a link if possible) | The State Target for infill is 47%, however is currently well below that. https://www.planning.wa.gov.au/dop_pub_pdf/plan_Central_Metro_Perth_Part6.pdf |
| Key issues / Research or Management questions: (please use questions from the draft project plan (IRP4), OR, if a new question, note it as NEW) | **Objective 1 (Performance and impact):**<br>• What are the relative hydrological impacts/benefits of different existing and new infill development types?<br>• How can water-related energy, greenhouse gas emissions and nutrient impacts be integrated into existing evaluation frameworks?<br>• What are the wider impacts of infill (e.g. life cycle/energy implications, urban cooling) and which methods and tools are most suited for this analysis and how can renewal (vs knockdown) realise more benefits?<br><br>**Objective 2 (Design and implementation):**<br>• What measure or guidance is helpful in the selection of technologies such as greywater recycling, decentralised water supply, rainwater tanks, purple pipe for Water Sensitive infill Development?<br>• What housing typologies and planting options enable best WSUD outcomes in a selection of Australian site conditions for infill in suburbia, brownfield, and greyfield sites.<br>• What key measures are needed to achieve WSUD outcomes within each typology set?<br>• What is the financial/economic feasibility of water sensitive infill, with attention to lot yield and monetisation?<br><br>**Objective 3 (Governance):**<br>• How can the process of infill development be harnessed to transform communities and improve liveability?<br>• What barriers in the regulatory and financing processes prevent an integrated and high quality approach to infill development?<br>• What opportunities or pathways/processes (including incentives and precinct scale water and energy opportunities) exist for implementing new governance or planning arrangements for Water Sensitive developments?<br>• Can governance key performance indicators for infill be identified? |
| Importance / significance of the case study: (ideally clarify its relationship to the infill project aims) | High importance and significance as it will be a real time case study demonstration that is in the design and construction phase during the projected time frame for the research project (2017-2021) |
| Expected outcomes from the case study (how it will be useful for the in-fill project and related stakeholders): | The outcomes of the Case Study will be highly relevant to identification of opportunities to improve the design and performance of infill developments in helping to achieving a Water Sensitive City in the western regional and beyond. |



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| Available support: In-kind (could include data, information, experts, etc.) | LandCorp Development and Sustainability Managers, Consultant Team including Josh Byrne and Associates for Landscape Water and Sustainability. Potential Smart Cities demonstration project. Centre for Built Environment and Health involved in data collection. |
| Available support: Cash (co-investment) | Project Funding for design consultancies, implementation construction |
| Scale of case study (note the approximate size, e.g. population or household numbers) | 12 Ha , 300 – 400 dwellings |
| Map/Figure of spatial extent |  |
| Other information considered relevant | The Hamilton Hill area was identified as an urban heat hot spot by the heat mapping undertaken by the CRCWSC T1 research. |



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