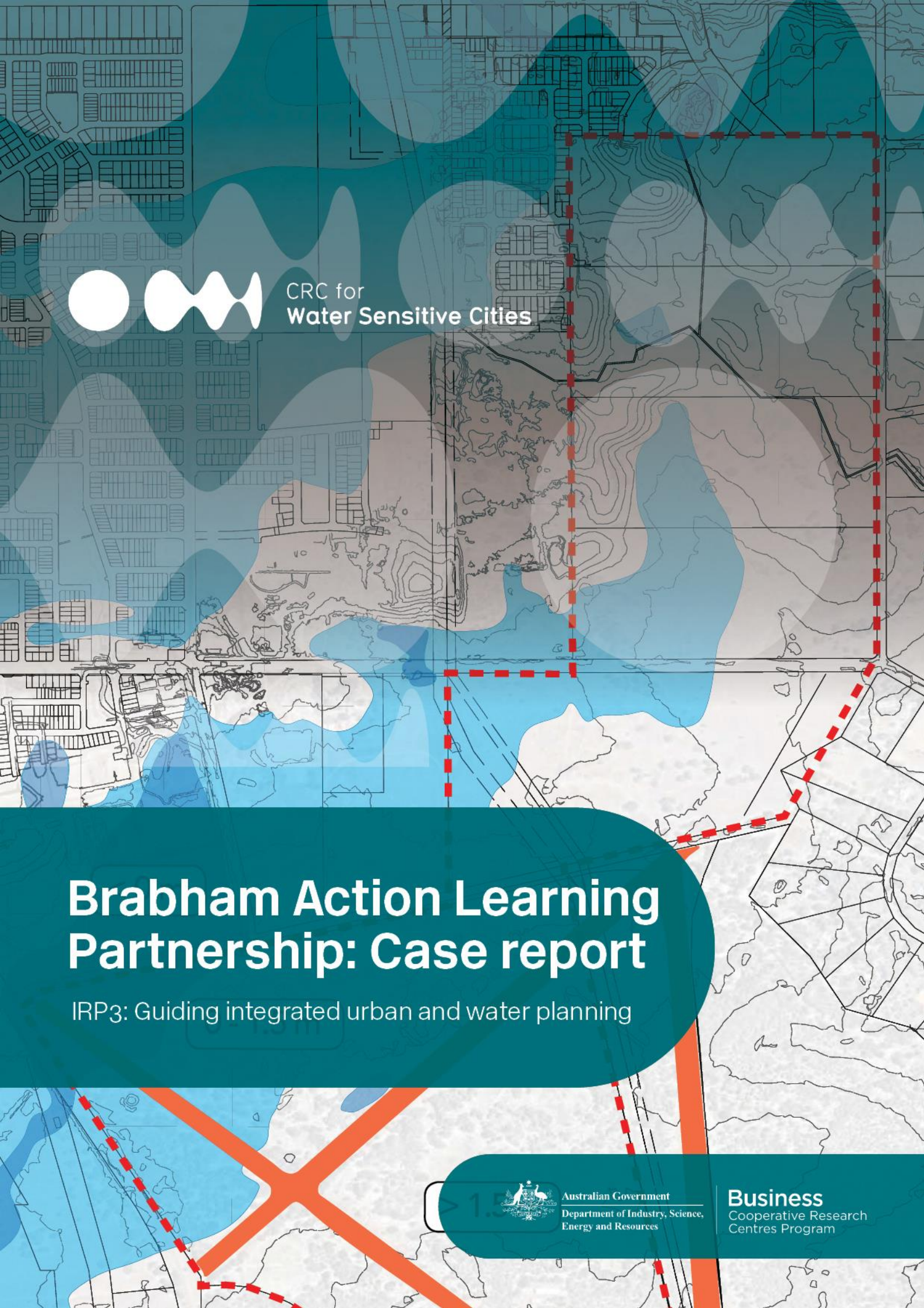

CRC for
Water Sensitive Cities

Brabham Action Learning Partnership: Case report

IRP3: Guiding integrated urban and water planning

Australian Government
Department of Industry, Science, Energy and Resources

Business
Cooperative Research
Centres Program

Brabham Action Learning Partnership: Case report
Guiding integrated urban and water planning (IRP3)
IRP3-1-2020

Authors
Sylvia Tawfik[1,2], Shelley Shepherd[3], Belinda Smith[1] and Chris Chesterfield[1]

[1]CRC for Water Sensitive Cities, [2]Monash University, School of Social Sciences, [3]Urbaqua

Publisher

Cooperative Research Centre for Water Sensitive Cities
Level 1, 8 Scenic Blvd, Clayton Campus
Monash University
Clayton, VIC 3800

p. +61 3 9902 4985
e. admin@crcwsc.org.au
w. www.watersensitivecities.org.au

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Executive summary

The Brabham Action Learning Partnership was established in March 2019 between the Cooperative Research Centre for Water Sensitive Cities (CRCWSC) and the Department of Communities, the Department of Water and Environmental Regulation (DWER), and Peet Brabham Pty Ltd. The collaborative partnership sought to explore the opportunity presented by the Brabham site to influence and navigate the planning approvals process to deliver sustainable and liveable communities. Efforts focused primarily on implementing innovative integrated water solutions for Brabham, as well as more broadly across the north-east growth corridor.

A three-stage program of activity was designed and implemented to enable productive interactions among stakeholders, to collectively resolve key technical and policy challenges. This report summarises the outcomes of the first two stages. It describes the key challenges and opportunities for Brabham identified through the context analysis, and identifies the critical considerations for the short-term and long-term implementation pathways developed through collaboration with key government and industry stakeholders. In addition, the report documents some lessons for effective multi-stakeholder collaborations that were derived from an evaluation of the research program. A companion report, *Enabling water sensitive urban development: planning and governance opportunities for Perth*, outlines the planning and governance ideas generated through the program's third stage.

The Brabham project itself is a partnership between the Department of Communities and Peet Brabham Pty Ltd. The development site is in the City of Swan and is expected to yield over 3,000 homes, as well as schools, shops and recreational areas close to the proposed Whiteman Park train station.

Planning for development in the north-east corridor has been proceeding for some years, with water planning largely focused on stormwater management. These activities have revealed some technical challenges associated with managing water resources at the Brabham site, including:

- understanding the site water balance and accurately reflecting the pre- and post-development conditions to optimise social, environmental and economic outcomes
- identifying a stormwater and groundwater quality management strategy that protects the groundwater and downstream ecosystems, minimises end-of-system treatment requirements, and can be sustainably managed by the service provider
- providing a wastewater service that reduces the requirements for fill to help retain vegetation and equitably apportions long-term infrastructure costs
- accessing a sustainable source of irrigation for public open space given the lack of available groundwater.

A key innovation at Brabham is the proposed use of subsoil drainage water to irrigate public open space. Other innovative approaches include adapting the urban and built form to high groundwater conditions, optimising wastewater servicing, and delivering amenity and enhanced environmental values through green and blue infrastructure.

Delivering innovative approaches is often associated with greater challenges, largely because of unclear assessment and approvals and uncertainty about project risk. The delivery or process challenges for Brabham are:

- lack of process for considering and approving the use of subsoil drainage as a water source for irrigation
- lack of whole-of-project benefit–cost assessment
- responsibility for reviewing and updating broader-scale water planning
- conservative assessment of innovative solutions by approval agencies
- conflicting interpretation of guidelines and criteria
- resolving differing (sometimes conflicting) agency objectives.

The options for addressing these process issues are considerably different from those for tackling the technical challenges previously highlighted. Generally, it takes effective relationships, trust, risk management and time to

achieve changes in processes. These challenges are therefore more likely to be solved through more effective collaborative relationships, which was a core focus of the Brabham Action Learning Partnership.

Evaluating the collaborative processes and outcomes of the Brabham Action Learning Partnership has revealed some lessons about designing and implementing multi-stakeholder collaborations. These lessons can be framed as six ingredients for effective collaboration:

1. *Time the collaboration*: Understand how external operating conditions may affect the ability to collaborate, and hence the likelihood of achieving lasting change through collaboration.
2. *Scope the problem and players*: Commit time and effort to defining the problem and identifying influential players.
3. *Develop and align goals*: Establish clear shared goals and expectations for the collaboration.
4. *Get broad stakeholder representation*: Make sure all stakeholders are appropriately represented throughout the collaboration to broaden understandings of multiple perspectives.
5. *Create safe spaces for interaction*: Design collaborative platforms to enable honest and meaningful discussions, and facilitate relationship building. This requires face-to-face interactions, inclusive language, and independent and experienced facilitators to lead the collaboration.
6. *Get clear on process and agenda:* Organise collaborative processes through a clear and logical framework, guided by a learning agenda.

The Brabham Action Learning Partnership has succeeded in generating shared understandings, particularly of the issues associated with using subsoil drainage water to irrigate public open space and what these issues mean for different stakeholders. It has also led to the development of new or stronger relationships between collaborators, and a desire to cooperatively drive further action to make sure the Brabham project delivers innovative on-ground outcomes. Collaborators also identified extra steps or actions as necessary to advance the innovative agenda for Brabham:

1. Establish a working group to continue a collaborative approach to the planning and approval of Brabham.
2. Address outstanding questions on the financing, operation and governance of the subsoil drainage harvesting scheme.
3. Explore barriers and opportunities for alternative built form and urban form.
4. Engage in ongoing communication and advocacy for the uptake of innovative, fit-for-purpose solutions.

Overall, all Brabham Action Learning Partnership collaborators will need to own the innovation agenda and continue to drive alternative water and urban solutions to achieve lasting changes in practice. This report recommends the Brabham Action Learning Partnership collaborators pursue all suggested actions, with support from the CRCWSC, the Water Sensitive Transition Network, and other key bodies as and when required.

1 Introduction

Perth aspires to become an innovative 21st century city that supports liveable and sustainable communities. The *Perth and Peel@3.5million* strategic suite of documents produced by the Western Australian Planning Commission (WAPC) seeks to guide the future growth and development of the Perth and Peel regions to accommodate an extra 1.5 million people by 2050. The strategy sets an ambitious vision for Perth as a liveable, prosperous, sustainable, collaborative and connected city.

State-level documents such as *Perth and Peel@3.5million* and its predecessors (*Metroplan* in 1990 and *Directions 2031 and Beyond* in 2010) have increasingly recognised that population growth and environmental constraints require different land use planning responses. However, on-ground practices to date still largely reflect a 'business-as-usual' approach to urban development. This business-as-usual approach—involving largely greenfield urban growth expanding the metropolitan footprint and conventional 'single dwelling on a lot' built form—places pressure on the fragile Swan coastal plain environment.

Realising the aspirations set out in *Perth and Peel@3.5million*—for liveable and sustainable cities that promote the health and prosperity of citizens, without compromising the natural environment—will require integrated approaches to urban planning that recognise the interlinks between water and urban systems, and promote cross-sectoral collaboration. Developing an integrated planning approach that strengthens these links is the key focus of the CRCWSC's Integrated Research Project 3 (IRP3).

1.1 IRP3: Guiding integrated urban and water planning

The CRCWSC's IRP3: *Guiding integrated urban and water planning* recognises that achieving innovative water sensitive outcomes requires an integrated approach to land use and water planning processes. Through an action research approach, the project seeks to explore how different types of urban development can be deliberately guided, at a range of planning scales, to achieve water sensitive outcomes.

The conceptual basis of this project is shown in Figure 1 as an 'integrated urban and water planning' framework comprising five distinct phases, underpinned by a collaborative planning process. The framework seeks to guide stakeholders to consider a range of development scenarios and water sensitive servicing options, collectively evaluate preferred options, and identify the financing, planning and governance mechanisms required to deliver desired outcomes. The phases are represented sequentially, but the planning process may not be strictly linear. Phases will overlap and often be highly iterative. Each phase can be characterised by different levels of practice. Successfully realising more ambitious aspirations for water sensitivity in urban development is likely to require higher levels of practice. These higher levels of practice will involve greater integration (across actors, sectors and disciplines), complexity, formality, scale of activities, and resources.

The project team is working with government and industry stakeholders on real-world projects across Australia to develop and apply a new framework for integrated urban and water planning. The Brabham development, jointly delivered by the Department of Communities and Peet, is one of several case studies that IRP3 will explore. An action learning partnership was established in March 2019 between the CRCWSC and government and industry partners in Western Australia to support the delivery of the Brabham project.

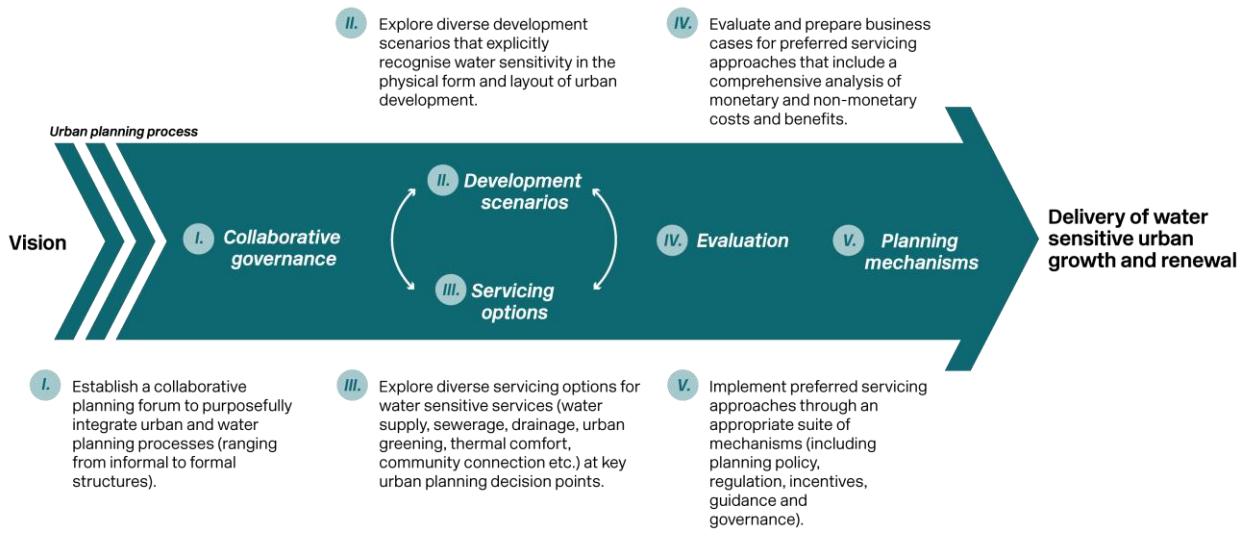

Figure 1. Integrated urban and water planning framework

1.2 Brabham Action Learning Partnership

In June 2018, the CRCWSC held an 'Ideas for Brabham' workshop to develop innovative technical interventions that could be used to address the challenges facing the Brabham project. It focused on the need for more innovative development approaches that combine water management and urban design to create sustainable and liveable communities in areas affected by shallow groundwater. The Brabham project team considered the outcomes of this workshop, summarised in *Ideas for Brabham* (CRCWSC, 2018), and it supports the following strategies and outcomes:

1. **Staging the development** in response to the specific groundwater challenges across the site, and prioritising the least challenging areas as the first stage. This approach also allows continued testing of shallow groundwater solutions over time and the showcasing of alternative building typologies

2. **'Village in a wetland' development typologies** that celebrate water in the landscape. Adapting the built form to the groundwater environment allows alternative housing solutions to be explored. The hard stand areas in high groundwater areas can provide cool and pleasant spaces by using blue and green infrastructure

3. **Minimising fill** by delivering water service infrastructure differently, using alternatives to gravity sewers and varying the parameters for subsurface drainage

4. **Harvesting water from subsoil drains**. The additional water discharged by urban development (non-permeable surfaces) and land use change could be harvested and used to provide a local water source

5. **Expand the non-potable water network** for Brabham and the broader corridor with supplies from a range of sources such as treated wastewater, rainwater, surface drainage, and storage using managed aquifer recharge (MAR)

6. **Fit-for-purpose governance solutions** that enable the implementation of innovation at Brabham and wider adoption for future developments, expanding the scope of business-as-usual.

The Brabham project team recognised that to advance these ideas, planning and approvals processes need further attention, to ensure they effectively consider innovative practices and alternative service delivery approaches in light of the specific characteristics of different areas. Accordingly, the Brabham Action Learning Partnership was established in March 2019 between the CRCWSC and the Department of Communities, the

Department of Water and Environmental Regulation (DWER), and Peet Brabham Pty Ltd. The collaborative partnership sought to explore the opportunity presented by the Brabham site to influence and navigate the planning approvals process to deliver sustainable and liveable communities. Efforts focused primarily on implementing innovative integrated water solutions for Brabham, as well as more broadly across the north-east growth corridor.

1.3 Case methodology

A three-stage program of activity (Figure 2) was proposed to enable productive interactions among stakeholders to collectively resolve process challenges, with a focus on approvals, financing and ongoing management of new assets. By engaging with key government and industry stakeholders, the program sought to:

- **identify and resolve current policy constraints** to delivering innovative development outcomes
- encourage stakeholders to **cooperatively negotiate and approve innovative approaches** to deliver water sensitive communities
- **identify pathways for implementing innovative solutions** through the planning and regulatory system in a timely manner.

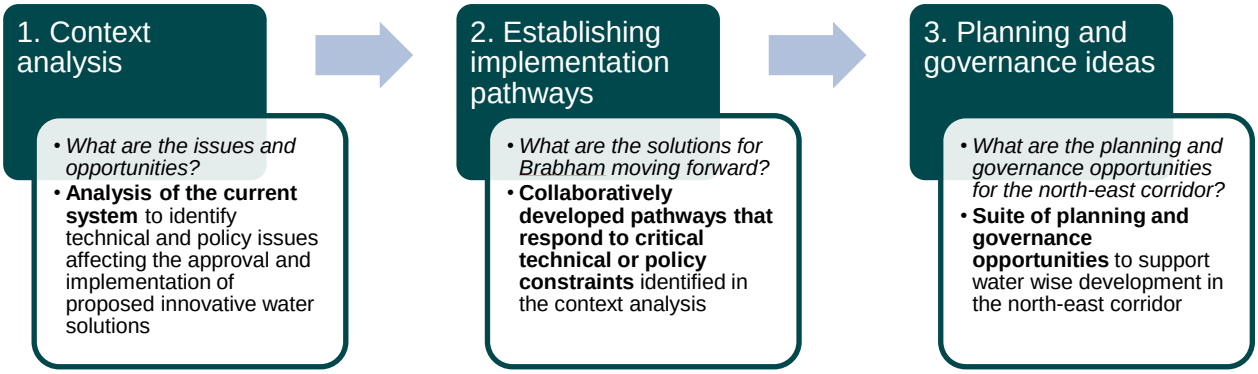

Figure 2. Brabham case study research program

This report summarises the outcomes of Stages 1 and 2 of the IRP3 Brabham case study research program. A companion report, *Enabling water sensitive urban development: planning and governance opportunities for Perth*, outlines the planning and governance ideas generated through Stage 3 of the program.

1.3.1 Stage 1: Analysing the context

The context analysis (summarised in Chapter 2) explored the technical and policy issues affecting the approval and implementation of the innovative water solutions proposed for Brabham in the context of land use planning and water resources governance systems in Perth. An initial draft report used primary and secondary data sources. Six interviews with seven relevant stakeholders who influence decision making identified potential barriers to approving the Local Structure Plan and Local Water Management Strategy for Brabham Stages 2 and 3. A review and mapping of available policies, planning documents and decision making processes supplemented the analysis.

The IRP3 project team presented the preliminary findings at the first (of four) collaborative workshop held on 16 April 2019 and attended by 29 representatives from water, planning, housing, development and environment government agencies and organisations. Following the presentation, a table-based activity and group discussion tested and validated key policy, process or technical constraints relating to Brabham, and captured any additional issues. The final context analysis report reflected the workshop outcomes, and informed the design and delivery of subsequent workshops, including the issues and solutions requiring further investigation.

1.3.2 Stage 2: Establishing implementation pathways

The next stage of the research project sought to unpack the short-term and long-term implementation pathways relating to the proposed non-potable water supply system (summarised in Chapter 3). The second and third collaborative workshops explored and developed these pathways.

At the second collaborative workshop on 7 June 2019, attended by 24 government and industry representatives, participants considered the steps to using subsoil drainage water as a water source for irrigating public open space at Brabham in the *short term*, highlighting the issues to be addressed and a process for resolution. A summary of the workshop outcomes outlined the agreed implementation pathway.

At the third collaborative workshop on 26 July 2019, attended by 31 government and industry representatives, lead agencies updated participants on progress against the agreed short-term pathway. After group discussion clarifying immediate next steps to using subsoil drainage water at Brabham, participants considered opportunities for enabling the *long-term* use or 'mainstreaming' of alternative water sources for future developments within the north-east corridor. The workshop summary report captured a number of 'needs', which were explored further in the final stage of the research program.

1.3.3 Stage 3: Planning and governance ideas

Building on the outcomes of the third collaborative workshop, interviews with planning and development practitioners unpacked the long-term opportunities for change. Eight interviews involving 10 practitioners from state and local government and industry were held in August 2019 to understand the strengths and weaknesses of Western Australia's current planning system. The interviews focused on the roles of different authorities in directing land use planning outcomes, barriers to integrated land use and water planning, and opportunities for more effective implementation of water sensitive outcomes. Insights were combined with tacit knowledge and experiences with urban planning in other states to formulate a set of planning and governance ideas, which were then tested with practitioners in the last collaborative workshop.

The fourth and final collaborative workshop on 27 September 2019, attended by 19 government and industry representatives, provided a forum for trialling a new way of thinking about integrated planning, adapted from existing academic research. Participants rated Perth's performance on different 'dimensions' of integration through a live polling exercise. The exercise was designed to seed in-depth discussion of weaknesses and opportunities within the current planning framework, to test and further develop ideas for strengthening Western Australia's planning and governance systems for delivering water sensitive urban development. These ideas were captured as opportunities for change in the companion report, *Enabling water sensitive urban development: planning and governance opportunities for Perth*.

1.3.4 Evaluating the research program and collaboration

Following the workshops, a summative evaluation program captured the strengths and weaknesses of the research program design, as well as early outcomes of the collaboration. Quantitative, indicator-based measures were combined with in-depth qualitative information to ensure robust and comprehensive findings.

The evaluation program commenced with a short questionnaire, asking workshop participants to reflect on the process and outcomes of the collaborative partnership. The survey was open for the month of October 2019, collecting 14 responses in total. These data informed targeted evaluation interviews with key project participants. Nine interviews held in late October and November 2019 gave insights into participant experiences with the process and workshop outcomes, and opportunities to improve future project design and implementation.

2 Brabham development project

2.1 Project proposal

2.1.1 Project objectives

The Brabham project is a 220 hectare greenfield development located in the City of Swan (Figure 3). The site is approximately seven kilometres north of the Midland Strategic Metropolitan Centre and 18 kilometres north-east of the Perth central business district. The development is expected to provide over 3,000 homes, with a mix of low, medium and high density options. Schools, shops and recreational areas are also planned close to the proposed Whiteman Park train station, which is slated for construction by 2022.

Site location	18 km NE Perth CBD
Development area	220 ha
Public open space area	At least 22 ha
Number of lots	2,600
Number of dwellings	3,300
Expected population	12,300

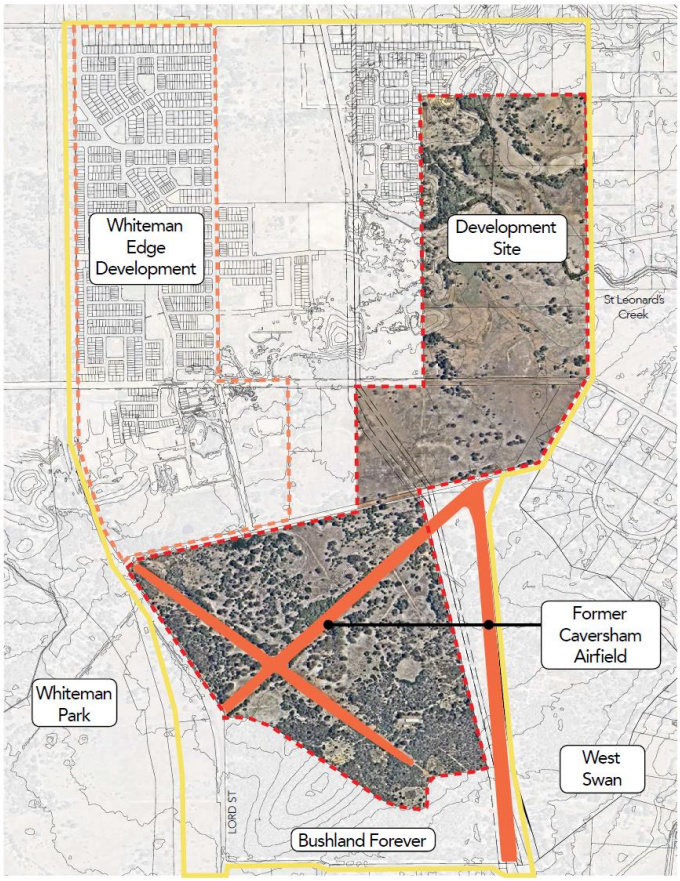

Figure 3. Brabham development location (Source: Realm Studios)

The vision for the Brabham development is to set a new standard for master planned communities that enhance the wellbeing of their residents. The project will embrace the natural and historic recreational links, transit connections, educational opportunities, and the strengths of project partners to deliver key objectives around affordability and diversity, community connections, education and economic development, and environmental sustainability. In pursuing an innovation agenda, the Brabham project offers a unique opportunity to demonstrate what an exemplar water sensitive development in Perth's north-east corridor could look like.

Development is proceeding over three stages. Earthworks for Stage 1 commenced in October 2019 (Peet, 2019), and planning for Stages 2 and 3 is currently underway. Stage 1 is expected to provide approximately 825–875 dwellings of varying residential densities and 2.7 hectares (gross) of public open space (Department of Communities and Peet, 2019).

2.1.2 Project governance

A Development Management Agreement between the Housing Authority and Peet Brabham Pty Ltd (Peet Limited and Perron Developments Pty Ltd) underpins the project management structure for Brabham. Through this structure, Peet Brabham Pty Ltd is the appointed Development Manager and is engaged to perform the services required to complete the development.

A Management Committee was established to provide the overarching management and control of the development. The Management Committee was formed after the project commenced (May 2018), with three

senior representatives of the Department of Communities and three representatives of Peet Brabham Pty Ltd (Development Manager). The Management Committee meets about every four to six weeks or as the Committee determines. The Development Manager provides support services. The detailed terms of reference is in the Development Management Agreement.

2.2 Planning background

This section looks at the planning background to date, and the substantial amount of guidance that applies to the site. This includes strategic planning and water management reports for the proposed development area, as well as standard state and local government policy and criteria.

2.2.1 Land use planning

Over the past decade, several plans were developed to guide development in the north-east corridor. They include the *North-East Corridor structure plan* (2007), the *Sub-regional structure plan for Swan Urban Growth Corridor* (2008), and the *Albion District structure plan* (2009).

The Brabham development site is currently zoned Urban in the Metropolitan Region Scheme (Figure 4) and largely Special Use 10 (Albion) in the City of Swan Local Planning Scheme No. 17 (LPS17). Part 5A and Schedule 4 of LPS17 requires a local structure plan prior to development over all or part of the land falling within the 'Special Use – Albion' zone, to achieve coordinated subdivision and development. Schedule 4 (Albion – SU10) also sets out the environmental management plans that are to be provided as part of a local structure plan, including an urban water management plan.

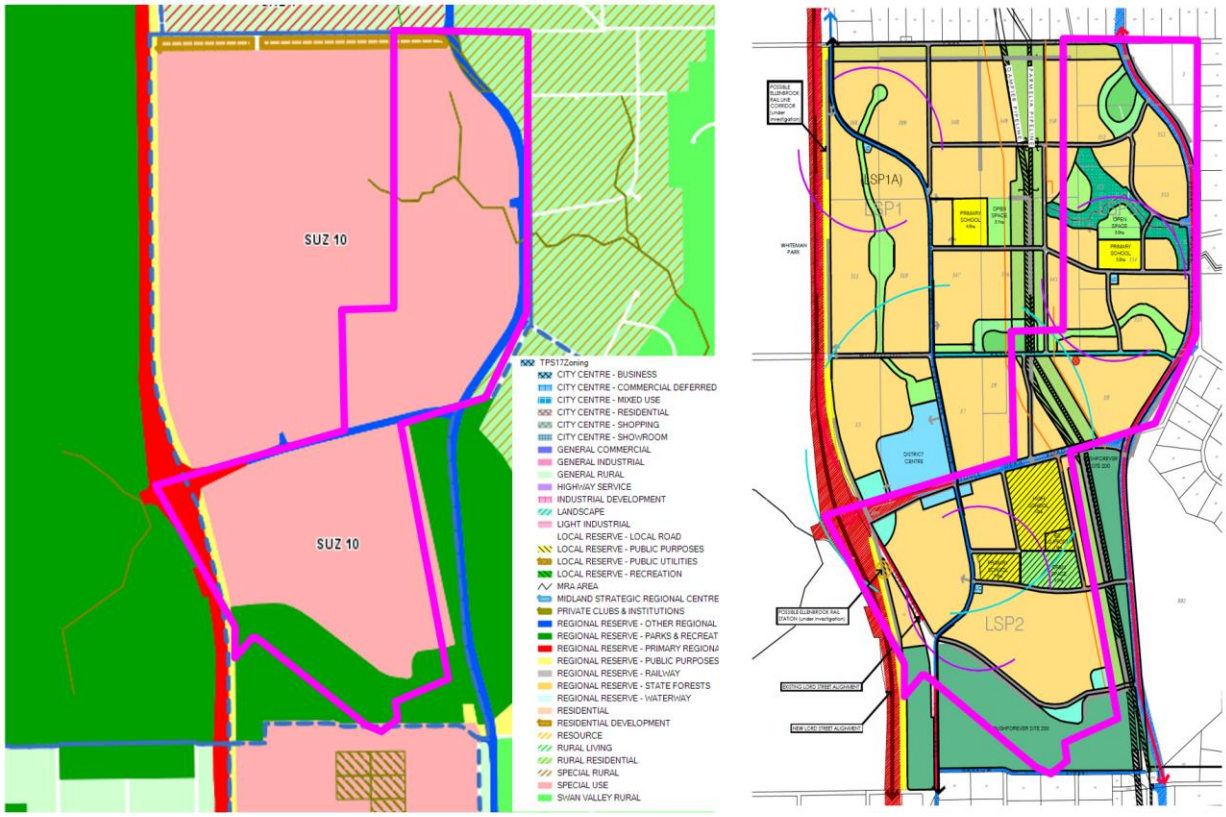

Figure 4. Metropolitan Region Scheme (left) and Albion District structure plan (right). The Brabham development area is shown in pink. (Adapted from City of Swan and Western Australia Planning Commission, 2009)

The *Department of Communities/Peet first stage Brabham local structure plan* (First stage LSP) has been lodged with the Western Australian Planning Commission and the City of Swan for consideration. The LSP is the first of

several local structure plans to be prepared over the Brabham landholdings owned by the Department of Communities (Figure 5). The local water management strategy prepared by RPS Group, in support of the First stage LSP, aims to demonstrate how water resources will be managed in accordance with the *Albion District structure plan*, State Planning Policy 2.9: Water Resources, and *Better urban water management*.

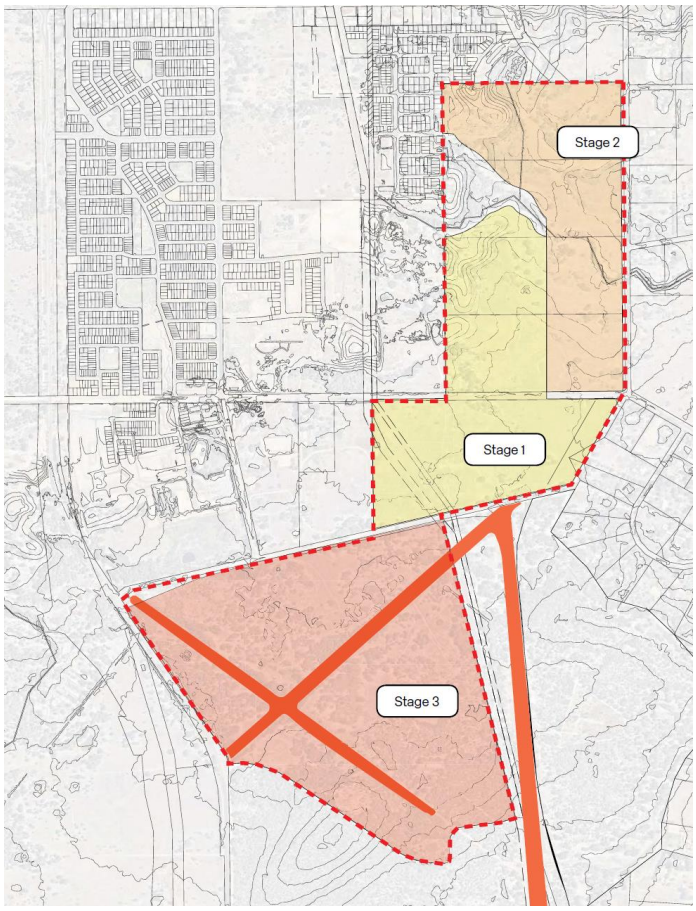

Figure 5. Development staging (Source: Realm Studios)

2.2.2 Water planning

Although water planning in the north-east corridor commenced before *Better urban water management* (Western Australian Planning Commission, 2008) was released, the applicable water management documents were prepared consistent with the objectives of State Planning Policy 2.9: Water Resources and the requirements of Schedule 1. Water planning at the corridor level (GHD, 2007) was followed by more detailed planning at the district level (City of Swan and WAPC, 2009), and finally at the local level (RPS Group, 2019a). As such, the following documents guide water management at Brabham:

- *North-east metropolitan sub-regional structure plan regional water management strategy* (Urbaqua, 2018)
- *North-east corridor urban water management strategy* (GHD, 2007)
- *Swan Urban Growth Corridor drainage and water management plan* (Department of Water, 2009)
- *Albion local water management strategy* (City of Swan and Western Australian Planning Commission, 2009)
- *Local water management strategy – first stage local structure plan, Brabham* (RPS Group, 2019a)
- Urban water management plans
- City of Swan policies (for example, City of Swan, 2017 and 2018).

While these documents provide wider guidance for surface water management, they do not address the lack of a water source for irrigating open space—particularly since the groundwater management subareas are over-allocated—but rather defer measures to subsequent stages of land use planning. Accordingly, a key innovation at Brabham is the recent proposal to use subsoil drainage water as a water source for irrigating public open space. Other innovative approaches include adapting the urban and built form to high groundwater conditions, optimising wastewater servicing, and delivering amenity and enhanced environmental values through green and blue infrastructure. Appendix 1 has a detailed description of the water planning relevant to the site.

2.3 Technical challenges for development

Some technical challenges are associated with residential development at the site. These water management challenges, largely a factor of the site conditions, are:

- accurately reflecting the pre- and post-development water balance to optimise social, environmental and economic outcomes
- ensuring adequate water quality treatment of stormwater and groundwater
- providing a wastewater service that limits short- and long-term impacts
- accessing a sustainable source of irrigation for public open space.

2.3.1 Understanding the water balance

The Brabham site is flat with predominantly sandy soils underlying it. This results in a site with low runoff and infiltration potential, which means that when groundwater levels are low, a very high proportion of rainwater falling on the site is recharged into the superficial groundwater aquifer and little runoff is generated. But during winter months, substantial areas of the Brabham site have groundwater within 0.5 metres of the natural surface, and many areas are known to be inundated throughout winter (Figure 6). This inundation is caused by a combination of broad-scale seasonal rise in the groundwater table and rainwater falling locally on the site which fails to soak into the ground because the aquifer is relatively thin and quickly saturated, as well as an underlying clay layer that prevents water from infiltrating into the deeper aquifer system. In addition, because the site is generally flat, water remains in the landscape without running off, except where there are drains and natural water courses to drain the land. As such, inundation can last for long periods until groundwater levels subside or the water evaporates. The local rainfall component of this seasonal inundation is sometimes called ‘rejected recharge’ because it is water that could recharge the groundwater aquifer but is rejected by an already saturated system.

As development proceeds, it is likely the site’s natural surface will be elevated to provide well drained lots and parks without substantially lowering groundwater levels and potentially impacting on nearby groundwater-dependent ecosystems. Without underlying subsurface drainage, the local groundwater level would most likely rise in response to increased soil storage capacity (in the imported fill), reducing the proportion of potential recharge that is naturally ‘rejected’ prior to development. This groundwater rise could result in reduced amenity or ‘boggy’ backyards and open spaces. To prevent this, it is common practice to install subsurface drainage at the same time as fill to elevate the ground surface, but ‘subsurface drainage and fill’ can lead to complete loss of existing vegetation and trees on the site, which in turn reduces evapotranspiration and increases recharge and further exacerbates the potential for groundwater rise.

Determining an appropriate level for subsurface drains and sufficient fill requires careful consideration of the hydrological conditions that support nearby groundwater-dependent ecosystems, other groundwater users, and the amenity levels required for different parts of the site (lots and public open spaces). The level at which the subsurface drainage is set (known as the controlled groundwater level) will need to be presented in a water management report for DWER’s assessment and endorsement, as the water resource manager.

Another consideration for how much fill is used on site are the levels required to provide for connections to existing infrastructure and services (typically sewers and roads; see Figure 6), as well as the likely construction method of the built form. Creating A-class sites requires fill to be imported where unstable underlying geotechnical conditions, such as reactive clays, exist. While a separation from groundwater is not specifically required for constructing buildings (Institute of Public Works Engineering Australasia, 2016), the wetting/drying

cycle is likely to affect the structural integrity of a conventional housing product (generally built with double brick on concrete slab) which requires a flat, dry, sandy site. The presence of shallow groundwater is likely to require an alternative built form. More opportunities to minimise fill and appropriately control groundwater could come from alternative urban form, which explores ways of locating and using public open spaces to retain existing vegetation and trees rather than to simply achieve a proportion of the site area.

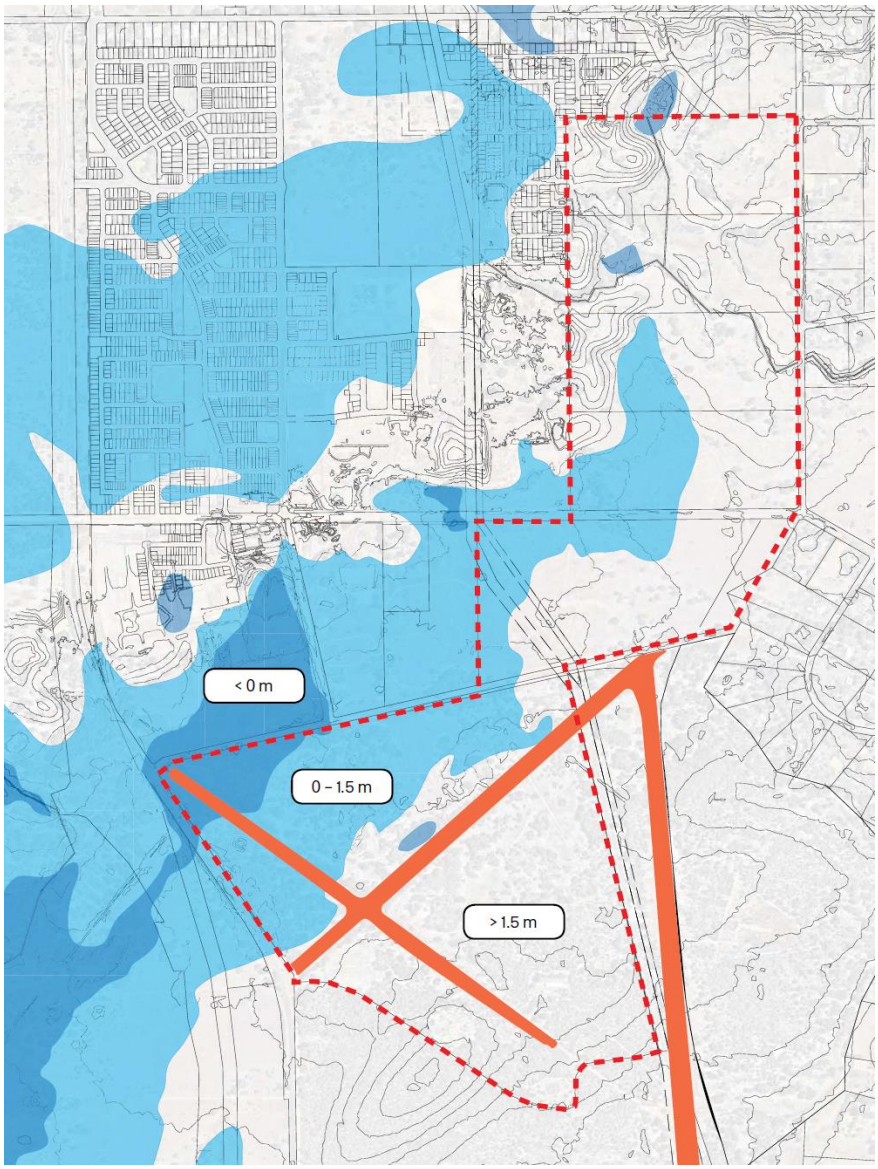

Figure 6. Depth to groundwater (Source: Realm Studios)

2.3.2 Managing water quality

Some important environmental values in the development area's catchments must be protected through appropriate stormwater and groundwater quality and flow management approaches. The City of Swan and the community will need to support these approaches, which generally involve using biofilters, tree pits, swales and detention storages in areas of the public realm, so they can be adequately maintained into the future and provide public amenity while protecting the values of local waterways.

As mentioned, the Brabham site generates little runoff under normal conditions because it is flat and has sandy soils, but it does contribute some runoff to downstream receiving water systems during larger storm events and from parts of the site that manmade drains and natural watercourses drain.

Water sensitive urban design (WSUD) strategies will be implemented as development proceeds, to try and maintain pre-development recharge rates and downstream peak flows, but it is likely that the changing landscape will result in less evapotranspiration and less natural storage of water in the landscape (surface inundation/rejected recharge). This excess water is usually removed from site as runoff into surface drains or more slowly via subsurface drains following development.

The downstream receiving environments at Brabham include Horse Swamp, which is a Conservation Category Wetland connected to Mussel Pool; Bennet Brook in Whiteman Park to the west; and St Leonards Creek and the Swan River beyond to the east. These systems are sensitive and require both hydrological and water quality protection.

In the past, water quality protection strategies focused on surface drainage systems that provide on-site management of small rainfall events, usually through infiltration and preferably including vegetated systems. This strategy provides opportunities for stormwater to pass through vegetation and soil, removing nutrients and other contaminants before entering downstream receiving water systems.

Installing subsurface drainage to manage and prevent groundwater rise allows infiltrated stormwater and some in-situ groundwater to be transported into downstream receiving water systems. This transport occurs much faster than would have been the case before development, and often entirely bypasses vegetated systems. This rapid export pathway and bypassing of vegetated systems may mean not enough water quality treatment can occur.

Recent CRCWSC research also notes that it is a complex matter to develop and implement effective WSUD strategies in areas with a shallow water table. These areas require a detailed understanding of the local water balance, an appreciation of nutrient cycling processes, and a ‘whole-of-catchment’ or ‘systems’ approach to designing a water quality treatment train that provides a range of redox conditions for attenuating nutrients (Ocampo et al., 2017).

Critically, the Brabham development must ensure adequate water quality treatment of stormwater and groundwater (including through the design and management of the proposed treatment wetland outside the project area), while creating public amenity through best practice WSUD.

2.3.3 Optimising wastewater service provision

Although there are no impediments to providing sewerage infrastructure to service this development area (RPS Group, 2019a), constructing the planned gravity sewer network will require substantial amounts of fill (up to 4 metres in some locations). This is a significant cost to the development and means clearing most of the remnant vegetation and mature trees on site, reducing liveability and the capacity for vegetation to control groundwater levels.

It was proposed to construct an extra pump station to significantly reduce the amount of imported fill material required for earthworks operations, and to create a better interface between the site and adjacent land/roadways (that is, lower retaining walls, reduced earthworks batters). Water Corporation WA will have to consider how the operation costs of the additional pump station will be funded into the longer term, which highlights the need for a holistic consideration of lifecycle costs and benefits (including ongoing maintenance) and discrepancies between payees and beneficiaries. As an alternative, Water Corporation has recently proposed a sewer strategy involving larger pipe sizes and shallower sewer lines that potentially negates the need for a second pump station while still achieving fill and cost savings. The Department of Communities is currently considering both options and how they compare with a business-as-usual approach.

2.3.4 Irrigating public open space

The Brabham site is in an area where there is no remaining groundwater for allocation as a non-drinking water source, and so while it is possible that some groundwater may become available through trading with existing users, it's likely an alternative source of water for irrigating schools and public open spaces will be required.

It was proposed to use subsoil drainage water as a non-drinking-water source for the site, by collecting and storing water from subsurface drains. Because the source is seasonal, this solution is likely to require substantial storage and the preferable option is storage in an underlying groundwater aquifer. But a benefit–cost analysis of the options, which may include using scheme water, local storage (tanks) in each park, and aquifer storage and recovery, will need to determine this. It will also be necessary to identify and get an agreement from a service provider who will operate the system into the future.

Recent work by RPS Group suggests subsoil drainage water is a viable source of water for irrigating open space year-round (RPS Group, 2019b). Work by the CSIRO, DWER regional studies, CRCWSC research, and monitoring at Brabham support this solution. The level at which the subsurface drainage system is installed largely determines the viability of subsoil drainage water as a water source. Previous research into the amounts of water potentially available through this methodology was undertaken on a neighbouring site (Whiteman Edge) where subsurface drainage was installed substantially lower than current practice. Therefore, the amount of water likely to be harvested at Brabham will be less than the discharge volumes at Whiteman Edge. There may be potential impacts on the environment if the controlled groundwater level is set too low, or on housing if the subsoil drainage system is not appropriately managed, or on the open space if the source proves unviable (given declining rainfall).

Extracting and using groundwater to irrigate schools and public open spaces usually requires a groundwater licence. It is unclear whether harvesting water from an installed subsurface drainage system would also require a licence. This may depend on the depth at which the drains are installed. If the drains are installed at a level such that they are not reducing recharge into the underlying groundwater system and are only collecting water that would have been 'rejected recharge' prior to development, a licence may not be required. But where drains are installed at a lower level and therefore may reduce recharge, a groundwater licence may be required. DWER will determine whether a licence is required, as part of its assessment of the controlled groundwater level.

2.4 Process challenges

This section explores the process challenges. The options for addressing these challenges are considerably different from those for tackling the technical challenges just highlighted. Generally, effective relationships, trust, risk management and time achieve changes in processes, so these challenges are more likely to be solved through more effective collaborative relationships. The context analysis identified these key process challenges:

- lack of process for considering and approving the use of subsoil drainage as a water source for irrigation
- lack of whole-of-project benefit–cost assessment
- responsibility for reviewing and updating broader-scale water planning
- conservative assessment of innovative solutions by approval agencies
- conflicting interpretation of guidelines and criteria
- resolving differing (sometimes conflicting) agency objectives.

Approval processes can be significantly obstructed when government agencies apply established standards and policies that were successfully applied in the past. In many instances, these policies were prepared for different development and site contexts and do not support new approaches. Many regulatory agency approval processes focus on an established set of criteria rather than the desired intent or outcome. This approach tends to stifle innovation rather than help explore new solutions.

Western Australia has never used subsoil drainage water as a non-drinking water source for irrigating public open space. While there is some policy and guidance for aspects of this proposal, including the requirements in *Better*

urban water management (Western Australian Planning Commission, 2008), the criteria for assessing, planning and delivering it are not developed.

DWER recognises the need to provide greater clarity in this space and is considering how to assess this proposal. This may include:

- agreeing on a controlled groundwater level that does not take water from the allocatable resource based on understood and accepted levels of tolerance (risk) to the environment and future community
- understanding and agreeing on the licence requirements or other appropriate authorisation for this system.

Considering the financial and non-financial lifecycle costs and benefits (including ongoing maintenance) is also critical to obtaining support for this innovative solution. This will likely mean identifying alternative risk and financing options that support the project outcomes and can be applied to similar innovative solutions in the future. Where possible, this should address the discrepancies between payees and beneficiaries. For example, the developer can't fully recover the cost of installing vegetated assets in greenfield areas, but the environment and the community benefits from them through enhanced liveability in the longer term. Further, consideration of an appropriate governance framework is required to facilitate agreed roles and responsibilities for detailed planning, design, construction and operation of the system. The proponent and the City of Swan are currently examining the commercial and economic feasibility of these solutions, along with the nature of ongoing governance arrangements.

Information requirements for assessing alternative proposals are often unknown and can be significant. This often results in increased time for, and a conservative assessment of, new proposals, to mitigate perceived risks. This is demonstrated where regulators may request information on alternative governance arrangements, including ownership of infrastructure and ongoing operation/maintenance, much earlier in the process than is achievable or may be appropriate. Some concerns were also raised about the capacity of regulatory agencies to assess technically challenging projects or the proponents in designing them.

Meeting the requirements of multiple guidelines and criteria often results in compromises and average or poor outcomes, particularly where the requirements conflict (for example, bushfire planning and revegetation and urban greening objectives). This issue has been observed where end-of-pipe stormwater treatment is proposed which can compromise the function and useability of public open spaces. Further clarity is also required about the barriers to delivering a diversity of housing which minimises the use of fill and tests alternative construction practices and building materials.

Similarly, the need for multiple agencies to agree to various aspects of water management with different objectives can result in poorly prioritised outcomes and business-as-usual approaches to mitigate risks. For example, DWER considers the potential impacts of groundwater management on the resource and local environmental values; the Department of Biodiversity, Conservation and Attractions considers the potential for downstream impacts on the Swan River; the City of Swan considers alignment with its current policy and strategies to create a liveable community; and Water Corporation WA considers operational effectiveness of its servicing strategy for drinking water and wastewater. Each agency assesses independently, with one agency sometimes inconsistent with another despite the information sharing required by planning and other approval processes. Resolving these conflicts requires the proponent to undertake protracted negotiations that often lead to compromises to satisfy competing objectives, and consequently the delivery of mediocre outcomes.

Further, different parts of one agency often assess subsequent stages of planning approvals, but those different parts may not support approaches in approved structure plans or subdivision. This, along with inadequate integrated water planning in earlier stages of land use planning, may require changes to designs at late stages, which also results in less than optimal on-ground outcomes. Improved intra- and inter-organisational processes for collaboration would enable more effective discussion and agreement of desired outcomes.

3 Implementation pathways

The second stage of the research program explored potential implementation pathways for Brabham in the short-term, and the north-east corridor in the long-term. These implementation pathways describe some considerations for planning, approving and delivering alternative water servicing solutions in shallow groundwater environments. The pathways were developed through the workshop component of the research program, in collaboration with water and land use planning practitioners in Perth.

3.1 Short-term pathway

The short-term pathway sought to progress Brabham as a demonstration project for using subsoil drainage water as a non-drinking water supply to irrigate open space in areas of shallow groundwater. Since Western Australia has never used subsoil drainage water as a source of non-drinking water for irrigating public open space, no criteria and process for assessing, planning and delivering this approach exist. Therefore, a three-step process was developed by workshop participants to deliver the desired short-term pathway, as shown in Table 1. These steps of assessment, authorisation and governance are not consecutive and should be undertaken in parallel.

Table 1. Three-step process of assessment, authorisation and governance to deliver short-term pathway

Considerations	Actions	Lead
*Step 1: What is the **assessment** for using subsoil drainage water as a source of water for irrigation?*		
• Can we take the water? • What is the acceptable controlled groundwater level? • What happens in dry years? What is the contingency? What are the criteria for acceptable level of supply? • Can we ensure water to environment is of appropriate quantity and quality (even in dry years or if turned off)?	DWER will work with proponent to agree on appropriate controlled groundwater level as part of the local water management strategy approval. This will require clarifying and testing modelling assumptions. DWER will assess viability of the source, in consultation with the local government. What level of service will the City accept for availability of the source (e.g. 100% of the time, or could it be dry every one in five years or every one in 20 years)?	DWER, with proponent
*Step 2: What is the **authorisation** for using subsoil drainage water as a source of water for irrigation?*		
• Can DWER regulate using existing mechanisms? • What other options are there? Consider ERA (operating licence) or City of Swan (development approval). • Who is assessing/authorising volumes in/out? • How will an appropriate monitoring and reporting framework be established and audited? Who is responsible if an impact is observed in future years?	DWER will confirm applicability or otherwise of *Rights in Water and Irrigation Act 1914* (RiWI) 5C licence, review existing mechanisms, and identify the most appropriate pathway for authorisation. Do any exemptions apply? All parties will consider this project as a demonstration and will acknowledge that this (and only this) project may be treated differently because it is 'new territory'. They will consider the need for a written agreement (like the DWER/Water Corporation Drainage for Liveability Partnering Agreement, or the Water Corporation Groundwater Replenishment regulatory framework).	DWER, with City of Swan Also involve Swan Valley planning committee, WAPC, and Water Corporation
*Step 3: What is the design/operation/**governance** for a scheme using subsoil drainage water as a source of water for irrigation?*		
• Can we manage risk of low/no supply after dry years? • Who pays for Capex/Opex? • What is the contingency plan and who is responsible for scheme or storage? • Who maintains the scheme or storage? • How will options be assessed?	City of Swan to 'approve': • business case • the review of operations of other subsoil systems (to guide maintenance) • risk assessment and contingency plan • DCS/structure plan (Stage 2).	Proponent and City of Swan, with DWER, Water Corporation, service provider, and DPLH

This short-term pathway only applies to the Brabham development. The project team notes that although the groundwater management strategy applies to the whole development area (Stages 1–3), the shortfall in water for public open space only applies to Stages 2 and 3. In progressing the short-term pathway, workshop participants recognised further considerations regarding water resources and the environment, infrastructure and planning. These are described in subsequent sections.

3.1.1 Water resources and environment

This consideration refers to identifying and securing a water source for irrigating public open space which does not result in detrimental impacts on the quality or quantity of the water resource or the environmental or social values of receiving environments.

The authorising environment for the water source is a critical consideration in securing the short-term pathway. DWER noted a lack of guidance on how to take or use subsoil drainage water, although there is publicly available information that explains the matters to be considered as part of assessing the controlled groundwater level (Department of Water, 2013). As part of this assessment, DWER will also consider the sustainable take of the water resource and what is needed to maintain water environments and systems, and the authorisation of take from any storage.

It was suggested that if the proposal could demonstrate that the water to be used was rejected recharge (that is, water that would not have reached the aquifer to become part of the allocatable resource under current legislation), then a water licence would not be necessary. This is critical since the aquifer is already over-allocated and so no allocation would be forthcoming if an application was lodged to take groundwater. Workshop participants recognised that an approval process for this proposal would need to be confirmed, but should form part of the approval of the local water management strategy.

DWER's role is to ensure the proposed groundwater management strategy will not impact on the quality or quantity of the water resource and dependent ecosystems. Since the aquifer is over-allocated, the proponent's modelling would need to demonstrate that the level at which the subsoil drainage is set would not reduce the allocatable volume. In principle, DWER would support the system if the controlled groundwater level was set at the Average Annual Maximum Groundwater Level (AAMGL), but DWER would need to review the modelling and assumptions used to confirm that there would be no aquifer drawdown on or off site and that appropriate nutrient reduction targets would be met. This would require understanding the parameters used in the modelling and considering the assumptions that DWER used during allocation planning. DWER would also seek input from the Department of Biodiversity, Conservation and Attractions.

3.1.2 Infrastructure

This consideration refers to the design, planning, funding, ownership and operation of the subsoil drainage harvesting and irrigation scheme.

For the infrastructure requirements, a proposal for direct reuse would likely involve subsurface drainage in road reserves discharging to the constructed wetland for storage/treatment and being recycled back for irrigation via a storage tank, with additional tanks at the parks. Assets would need to be sized, to meet the volume each park requires. Tanks would need to be regularly filled in summer, which has pumping cost implications. Additionally, the wetland would need to be appropriately sized to accommodate the additional water not used in winter.

The developer would likely construct the wetland, subsurface drainage and irrigation network, and then hand it over to the City of Swan to manage and operate. The City would need to approve the design of the collection and distribution network, to support their acceptance of the infrastructure after a specified handover period.

The City of Swan will require additional information for it to support the proposed irrigation system, which includes the City taking responsibility for the system's future operation. This information should be presented at a whole-of-Brabham development scale and include a discussion of water supply security, contingency options, scale and integration, water treatment, discharge locations, storage, and potential for MAR, distribution network design (including estimated positioning and size of each public open space area with details of supply network and tank

size), monitoring and maintenance, capital cost, ongoing cost of operation (including a $/L estimate) and replacement costs of all system infrastructure. The report should demonstrate technical and financial feasibility within a planning system that can deliver it. This information should be provided with enough lead-time prior to lodgement of the next structure plan so relevant agencies can review it effectively.

The City of Swan would then undertake an independent economic assessment of the proposal, which considers equity (that is, the system should not place an impost on ratepayers that is not borne elsewhere) and risk for its community (for example, impact on housing affordability). This report must also consider the system's manageability and replicability (that is, how such an approach could work for the rest of the corridor). The business case should be completed at the same time as the local water management strategy.

3.1.3 Planning

This consideration refers to land use planning, built form typology and liveability outcomes, including realisation of green infrastructure.

Considerable water planning has already occurred for Brabham, including at the district scale, but the preceding plan—the Albion LWMS, which is technically a 'district water management strategy'—was produced 10 years ago. Further, while the 2009 Gnangara Allocation Plan shows groundwater as limited or not available in Brabham subareas, no work (until now) has been undertaken to address the issue. DWER's *Guidelines for the approval of non-drinking water systems* require option evaluation and concept design at the district scale, but this was not included in the Albion LWMS. This issue raises the broader question of who is responsible for providing water for irrigation in areas that are already zoned for development? Should state or local government restrict development until a source of water for irrigation can be established?

Workshop participants recognised that the Brabham development must address urban form and built form so it can respond to changes in climate and challenges of landform, including tree retention. The developer proposes to incorporate some lightweight built form in an early stage, thereby challenging the current housing form predicated on double brick and concrete slab construction. The developer is committed to driving better built form outcomes around the station precinct (Stage 3), as part of transit-orientated development where groundwater is shallow.

3.2 Long-term pathway

The long-term pathway can be distinguished in two ways: the longer-term pathway for Brabham, and the longer-term pathway for the north-east corridor. The latter refers to advancing innovative and sustainable practices across the corridor by rolling out the non-potable water supply solution for public open space irrigation, implementing alternative built form and built form typologies, and retaining vegetation and waterways, particularly in areas of high groundwater requiring fill.

Workshop participants recognised that a solution for public open space irrigation is required for the whole corridor. Estimates predict a 2.2 GL shortfall for public open space irrigation and a 2 GL shortfall for agriculture in the corridor by 2050 (DWER, 2018). Water Corporation is undertaking a feasibility assessment of using subsoil drainage water for the corridor. This will include an economic assessment and understanding of the process and information requirements for replication. Since many new developments in the corridor are on government-owned land, efficiencies of scale could be achieved if all the developments are considered together. The longer-term option also needs to consider the feasibility of MAR to ensure reliability and security of source.

From a planning perspective, workshop participants highlighted these issues for further consideration:

- *Improving planning for irrigation of public open space where no groundwater allocation remains* – In the longer term, better higher level planning is necessary at regional or district levels which ensures the fundamental questions of water supply and infrastructure provision are achievable. Although this is stipulated in *Better Urban Water Management*, it has received limited consideration to date. The importance of this issue is evident from the substantial amount of water required for a population of 3.5

million at 2050—almost double the amount being used today. It was suggested that the sub-regional frameworks should contain concept planning and costs for irrigation. It was also noted that a cultural shift is required to pay for public open space irrigation, but it is unclear who is or should be responsible for ensuring there is water for irrigation of public open space.

- *Revising water management strategies to account for changing water conditions* – Water management reports are currently tied to the land use planning process, so if there is no planning action, there is no planning trigger to revise these documents. But it was noted that, if the plan is substantially different, the Metropolitan Redevelopment Authority would require an update to an earlier document. At the very least, a review every 10 years should be achievable, since this is the new life of a structure plan (post changes to the Planning and Development (Local Planning Scheme) Regulations 2015). There is also an opportunity for the new water resources legislation to provide a trigger, assuming regulation is required to drive the review. It is also possible that a less formal collaborative approach could be used to achieve the same outcomes.

- *Improving the implementation of the current water planning framework* – While public open space irrigation is non-critical infrastructure, it should still be considered at the time of urban zoning. The low cost of water and need for affordable housing can often diminish the significance of this issue and the pursuit of innovation. Providing more benefit–cost information, particularly demonstrating competitive advantage, could help to strengthen the importance of this issue. Further research is required to: (a) understand how to shift cultural practices away from a project-by-project focus to a shared, community focus on infrastructure; (b) understand the opposition to increased density and changes in built form typologies; and (c) demonstrate high amenity non-irrigated spaces suited to a Mediterranean climate.

These issues demonstrate that the long-term pathway for the north-east corridor requires changes to planning and governance arrangements, to overcome implementation issues that hinder the delivery of water sensitive developments. This pathway, and specifically the changes in planning and governance required, are addressed further in the companion report, *Enabling water sensitive urban development: planning and governance opportunities for Perth*.

The rest of this section focuses on the longer-term pathway for Brabham, but the project team recognises that the solution for Brabham is tied to the solution for the north-east corridor, and should not be considered in isolation. The longer-term pathway for Brabham is concerned with the seasonal and long-term security of the source, which can be optimised by using MAR. For example, subsoil drainage water during wetter months can be stored via injection in the deeper aquifer system as MAR, then later recovered and used in drier periods (for example, summer) when required for irrigation. This option would need further investigation and approval in line with the Department of Water (2010) Operational Policy 1.01 for Managed Aquifer Recharge in WA, which is consistent with the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Managed Aquifer Recharge. If a MAR system is used for storage, RiWI licences would potentially be needed for establishing the bore and abstraction (recovery), but this would be managed separately from the allocation limit.

While in most years there appears to be enough water to irrigate the proposed areas of public open space, uncertainties in availability have led to a general support for MAR, possibly at a larger scale and as a solution for the corridor. DWER's assessment of the subsoil drainage proposal will also review the sustainability of the source. It's likely some guidance will be needed on the proportion of time (years, months or days) during summer that it is acceptable to have no water available and what the contingency supply would be, if the direct supply scheme is established. But it was noted that the groundwater management areas in this location may create an administrative problem for the MAR proposal since Brabham straddles both the Mirrabooka aquifer (where parks are located) and Leederville aquifer (where injection can occur). DWER would consider whether the MAR scheme could be established to allow water to be injected in one area and extracted in another, or whether piping is needed. It is possible that a new special MAR zone, to trade water, could be created if it was demonstrated that the management areas were hydro-geologically connected.

Both the Water Corporation and the City of Swan indicated they would consider operating a MAR system. It was suggested that the amount of maintenance or 'de-clogging' of the system (pre-treatment to allow injection) would be considerable.

In the longer term, it would be better if the assessment of the source (and controlled groundwater level and available volumes) were undertaken at the development scale through the district water management strategy. It was also highlighted that in the future, it is likely that local government (the community) may need to pay for water for public open space. This will require detailed district-scale modelling which may be more appropriately done by the State or jointly with industry. This modelling will need detailed information and this will take time. Participants noted the need for better science to inform modelling parameters and assumptions.

4 Ingredients for effective collaboration

The Brabham Action Learning Partnership provided a unique opportunity to observe a multi-stakeholder collaboration dealing with a complex planning problem in action. The four workshops between April and September 2019 provided government and industry practitioners with a platform to collectively navigate and influence planning approval processes, to facilitate site-responsive approaches to integrated water solutions in the north-east growth corridor.

This platform for collaboration was the subject of a program evaluation, conducted in October and November 2019. Analysis of the data collected from workshop participants through an online survey and evaluation interviews provided some learnings about the design and implementation of multi-stakeholder collaborations. The project team has framed these learnings as ingredients for effective collaboration, and further categorised them as either ideal starting conditions or processes for collaboration in the subsequent discussion. Illustrative participant quotes (in single quote marks) are included throughout this section. The insights from this project are consistent with the academic literature on the design and implementation of multi-stakeholder collaborations (see, for example, Bryson et al. 2015; Ansell and Gash, 2008).

4.1 Starting conditions

The institutional, political and economic conditions under which a collaboration forms can have a strong influence on its overall effectiveness, particularly where the collaboration seeks to address a complex public issue. Accordingly, potential collaborators should have regard to the broader contextual conditions in which they operate and how this might affect the purpose, structure and outcomes of the collaboration.

4.1.1 Understand the impact of external conditions

Ingredient 1: Understand how external operating conditions may affect the ability to collaborate, and hence the likelihood of achieving lasting change through collaboration.

Before commencing a collaboration, it's important to consider how broader socioeconomic conditions may affect collaborative efforts. The possible impacts must be balanced, to determine whether to proceed with a collaboration or wait for more favourable conditions. The answer is unlikely to be clear, particularly where contextual conditions have both positive and negative implications for collaboration. For example, where a collaboration is focused on a greenfield development, such as Brabham, the state of the property market is a key consideration. The property market moves in a cycle, with periods of low growth (that is, downturn) followed by an upturn and high growth (that is, boom) before market corrections are implemented to moderate prices. Following the peak of the mining boom, house prices in Perth have steadily fallen since 2014. Accordingly, the pace of development has slowed down, providing developers with the breathing space to (re)strategise approaches to land release and appeal to different buyers. This would suggest an opportune moment to collaborate with developers, since they have the time and incentive to participate, particularly where the collaboration offers a way to set themselves apart and add value to their lot product. But a property downturn often reduces the appetite for innovation, with efforts (re)directed towards maximising efficiency. So, while opportunities for both collaboration and innovation exist, they may occur at mutually exclusive phases of the property cycle, creating challenges for uptake, particularly once collaboration ceases. This creates a further risk that the collaboration yields a one-off solution, with practices reverting to business as usual on completion of the project.

4.1.2 Scope the problem and players

Ingredient 2: Commit time and effort to defining the problem and identifying influential players.

Before committing to collaborate, it is helpful for the proponent to undertake a detailed analysis of the problem under investigation and the potential solutions. They should define this problem context as clearly as possible, drawing on specialist knowledge to discuss any contentious issues. They may need to adopt an iterative approach and continually refine the problem context as more information becomes available. Framing the problem context to emphasise a sense of urgency or a critical turning point, by highlighting the inappropriateness of business-as-usual approaches, can help to encourage greater participation and commitment to the collaboration. This was particularly evident in Brabham where the lack of available groundwater for public open space irrigation required stakeholders to investigate an alternative approach.

To understand who to involve, it is imperative that the regulatory and institutional decision-making environment is clearly understood. This involves identifying the key players, and developing a shared understanding of the different motivations, risks, operating constraints and opportunities at play. Accordingly, a detailed stakeholder and contextual analysis should be undertaken at the start of the collaboration to more effectively guide and inform the collaborative process.

4.2 Collaborative processes

The way in which collaborative processes and structures are designed and implemented play a critical role in determining whether the collaboration delivers desired outcomes. Collaboration must be built on shared goals. It should also promote diverse perspectives (through inclusive processes), support regular and meaningful interactions, and tailor engagement and communication mechanisms to the needs of different stakeholders.

4.2.1 Define and align goals

Ingredient 3: Establish clear, shared goals and expectations around the scope and process of the collaboration.

Clearly defined goals and a shared understanding of what will (and will not) be collectively pursued and achieved must guide collaborative processes and activities. The purpose of uniting stakeholder efforts must be one that produces benefits for all. In other words, there must be a clear advantage to be gained through collaboration, which a stakeholder could not otherwise achieve alone. Accordingly, setting up a multi-agency collaboration to tackle a highly complex regulatory issue that falls within the remit of a single agency is not likely to be an appropriate goal. In the case of Brabham, it was suggested that multi-agency collaborations should be set up to address issues that cannot be solved through traditional planning processes and give effect to state policy positions that require a whole-of-government approach, such as how to enable alternative built and urban forms to create cool, liveable, green and sustainable urban communities. Aligning the collaboration purpose with a broader policy agenda, such as transitioning Perth to a leading waterwise city by 2030 (WA Government, 2019a) or the current reforms of the Western Australian planning system (WA Government, 2019b), more readily demonstrates a collaborative advantage and can generate broader buy-in.

Different stakeholders are likely to bring different aims, expectations and agendas to a collaboration, so drawing a boundary around the problem is an inevitable source of tension. Conflict often emerges in public–private partnerships involving government agencies with different remits tied to broader public interests and private industry pursuing project-specific goals. Accordingly, it is important for collaborative processes to recognise and appropriately manage these different drivers to make sure no individual agenda supersedes, dominates or derails the overall purpose of the collaboration. Private industry goals focused around immediate project challenges can encourage greater participation and industry commitment to the collaboration. But the longer-term public interest,

such as achieving systemic changes to land development in high groundwater areas, must also be a key focus. For the Brabham workshops, it proved difficult at times to elevate discussions from streamlining immediate approvals to advancing longer-term sustainability and innovation goals for the north-east corridor. The immediate problem for developers and local government was the lack of groundwater for public open space irrigation, but this narrow framing was sometimes at the expense of higher order public interest goals around delivering systemic change to the planning system.

Similarly, the research aims for the project did not always align with the specific needs of industry and government partners. Therefore, it is necessary to clearly define and agree up front what the collaboration will and will not accomplish, as well as the overall outcomes or outputs it will produce. These should be framed in a way that addresses the needs of target end users.

Goals are not only diverse, but they can change over time. For Brabham, the goals of the Brabham Action Learning Partnership were initially framed quite broadly around a water sensitive, innovative agenda for Brabham as a microcosm of development in the north-east growth corridor. They then narrowed in on the alternative water solution for public open space irrigation in Brabham, and then broadened once more to consider changes to planning and governance systems to enable innovation. Collaborators must expect this evolution of goals as the collaboration progresses, but it is imperative that any renegotiation of goals involves all collaborators to make sure commitment and support for the collaboration continue. Leaving some collaborators out of this renegotiation risks isolating and disengaging them in the latter stages of the collaboration.

4.2.2 Engage relevant stakeholders throughout the collaboration

Ingredient 4: Make sure all stakeholders are appropriately represented throughout the collaboration to broaden understandings of multiple perspectives.

Collaborative processes should be inclusive, and represent all stakeholders who are affected by or have an interest in the issues. Complex public issues often affect a broad range of stakeholders, so it is important to capture this diversity within the collaboration so it can achieve a more comprehensive understanding of the issue and cross-organisational learnings. For Brabham, the range of people and perspectives from state and local government and private industry allowed participants to understand the ‘bigger picture’ by learning about the ‘many players’ and ‘moving parts’ associated with Brabham. This resulted in a better understanding of different stakeholders’ motivations and the complexity of decision making surrounding the alternative water solution. As one interviewee put it, ‘I now see things from other people’s responsibilities, so that it’s not just an engineering solution, it’s more than that’.

It is important to provide opportunities for stakeholders to come together and deliberate with others, but as an interviewee said: ‘It’s not about having everyone in the room; it’s about having the right people in the room’. The ‘right people’ can often mean those with particular personal and professional traits—notably, a willingness to actively participate in the collaboration and approach discussions openly and collaboratively rather than defensively and closed. The ‘right people’ must have the authority to speak on behalf of their organisation. Ideally, they are decision makers, so collaborators can collectively agree on actions, but it can be difficult to involve such people. As such, collaborators should, at a minimum, be representatives who can influence decision making within their organisation. Where those people wear multiple hats, they must clearly identify which interest they are representing and speaking for, so other collaborators can understand the significance of their inputs.

Where a collaboration spans a few months, it is important to ensure members consistently attend and contribute throughout the process so progress, through decisions and actions, can be made. This continuity reflects a commitment to the collaboration, which in turn will determine its likely success. For Brabham, while a core group of members participated in all four collaborative workshops, some participants contributed to only one or two workshops. While this changing attendance partly reflected the evolving scope, it made it difficult to progress particularly challenging issues and it may limit the potential reach or extent of influence generated.

Collaborations often demand significant time and energy, so it is important to clarify and manage expectations about each collaborator's role and responsibilities. This requires engaging with them early to clearly define the time and work commitments within both the formal stages of a collaboration (for example, meetings or workshops) and the interactions and activities that happen between these formal stages (for example, internal briefings, review of technical assessments), to progress collaboration goals. Each represented organisation's management should approve the time requirements on its representative. In other words, representatives must be supported to commit the necessary time and be empowered to make decisions and provide 'real advice' in a collaborative setting.

For Brabham, some key collaborators were from state and local governments, which are typically 'time poor'. Support at the director level, and the funds committed to the collaboration, made it possible for some of these representatives to devote significant time to the collaboration. But for others, water was considered to be a peripheral part of their day-to-day work and not their 'core business', and as such these people were unable to commit the same amount of time or energy to the collaboration. This suggests that more strategic and tailored forms of engagement are required, such as seeking input from some representatives only at particular stages in the collaboration when their input is most valuable. This approach minimises the time and pressure on those people, and prevents 'burnout' from the collaborative process.

4.2.3 Provide safe spaces for collaboration

Ingredient 5: Design collaborative platforms to enable honest and meaningful discussions, and facilitate relationship building.

Multi-stakeholder collaborations must provide forums for frequent, meaningful interactions among collaborators. They must be set up as safe spaces, where participants can have open and honest discussions about issues and opportunities without any fear of repercussions. To create such spaces, the following factors should be considered.

4.2.3.1 Use face-to-face interactions to foster trust and respect

Spaces for interaction have a physical element—collaborators are regularly brought together at a particular place and time to engage in direct, face-to-face dialogue. Participants identified 'having everyone in the same room' as a key success factor in the Brabham case study. These interactions were important for breaking down communication barriers, fostering trust, and developing an understanding of the issues and solutions from different perspectives. They allowed collaborators to have 'honest' and 'meaningful discussions', where they could 'feed off other people's thinking' to achieve clear direction on certain points, such as approval processes and information requirements. These forums also served to seed and strengthen relationships among collaborators, with a few participants indicating they now feel comfortable in 'picking up the phone' and contacting a colleague in a different agency to discuss an issue—something they could not do before the collaboration.

Talking with other collaborators and 'handing out business cards' outside formal workshop activities, such as during lunch breaks or side meetings, also provided important networking opportunities between collaborators, particularly those who do not frequently interact or 'wouldn't ordinarily get exposed to' the people who were present. These 'spin-off interactions' also served to create other opportunities. As one interviewee explained, 'other projects have fallen out the back of that, [which] wouldn't have happened unless the CRC engagement' had taken place. For example, participants felt the Brabham collaboration prompted Water Corporation to realise the opportunity for harvesting subsoil drainage water, and investigate this potential resource through a detailed study of the north-east corridor. This also led Water Corporation to organise a study tour of MAR schemes in South Australia.

4.2.3.2 Speak the same language

Given the multi-disciplinary nature of these collaborations, and the technical nature of discussions, it is imperative to use inclusive language in all interactions. This might mean avoiding highly technical, discipline-specific jargon,

or where this isn't possible, clearly explaining the terminology. For Brabham, terms such as 'rejected recharge' or 'average annual maximum groundwater levels' had to be clearly defined from the outset. In addition, some stakeholders saw some terms as value laden. For example, 'new water' can be interpreted as lacking constraints on its consumption notwithstanding the role it plays in groundwater recharge and the water cycle. Further, some participants used common terms in different ways to mean different things (for example, a policy position is different from policy implementation). In these cases, it is important to be clear about how certain terms are being used.

4.2.3.3 Help level the playing field

Power imbalances between collaborators can arise from many factors, such as uneven access to resources, level of influence or responsibility. For Brabham, the distribution of risk was perceived to create an imbalance between the collaborators, preventing participation on an equal footing. The risk in this case is tied to the consequences of failure should the proposed alternative water solution fail to deliver expected outcomes. This risk appears to sit primarily with the City of Swan, which is likely to take on the operation and maintenance of the system, and with DWER, which is perceived to have a level of responsibility through its advisory role. Accordingly, any interactions between collaborators that touch on these issues had to be appropriately facilitated to keep discussions open and meaningful, and to help participants feel respected, able to speak honestly, and with enough time and space to engage with an issue or solution either in the group discussions or outside of the open forum. It's therefore important to keep interactions positive and constructive so they build and facilitate an ongoing relationship between collaborators.

It takes a skilful and experienced facilitator to manage this type of interaction. Technical knowledge or understanding of the problems and potential solutions, as well as experience in dealing with a particular group of stakeholders, were identified as key skills for any facilitator steering or leading a multi-agency collaboration. The facilitator must have enough technical understanding of what is being discussed to appropriately guide conversations and identify optimal solutions. One key tactic for achieving this is to create breaks in a conversation or debate by drawing on relevant experiences to provide an alternative perspective. Similarly, the facilitator must be highly experienced in managing different agendas by ensuring one voice does not dominate a conversation, and managing any sensitivities that arise during discussions. Regarding the latter, it is essential that the facilitator acknowledges the emotions that any participant expresses and offers the participant a chance to explain their perspective to ensure discussions do not become hostile.

4.2.3.4 Provide independent leadership

The facilitator clearly plays a critical role in fostering a safe space for meaningful interactions among collaborators. Aside from the facilitator's personal skills, it's important to have the facilitator come from an organisation that participants view as independent and credible. For Brabham, the CRCWSC facilitated the four collaborative workshops for the Brabham Action Learning Partnership. Participants felt the advantage of using a research-led collaborative process involving a body such as the CRCWSC was that it provided a neutral or independent platform, which is often lacking in typical multi-agency collaborations where there is a clear regulatory imperative or commercial agenda at play. Participants saw the CRCWSC, with its proven track record, as an 'independent', 'credible' body with the 'weight', 'traction', 'gravitas' and 'pulling power' to attract the 'right people' who are willing to 'buy in' and participate in a meaningful way. As one interviewee noted, 'I think without the CRC we wouldn't be where we are now in the Brabham project, in terms of that collaboration across government agencies'.

4.2.4 Map out the collaborative process

Ingredient 6: Organise collaborative processes through a clear and logical framework, guided by a learning agenda.

It is not enough to have a clear purpose or goal for collaboration; it is also necessary to clearly articulate *how* the process of collaboration will achieve the desired outcomes. Formal collaborative arrangements require

organisation and structure. One way of structuring the activities of a collaboration is by establishing an ‘organising framework’ that outlines clear, practical steps or stages of activity. Each stage should have a specific purpose that is connected to the overarching vision or goal for the collaboration. As the collaboration progresses, it is important to clearly demonstrate how the collaboration is progressing against stated goals. One way of tracking overall progress is to undertake a benchmarking exercise at the beginning of the collaboration and then again at the end to assess whether there has been any change. During the life of the collaboration, progress should be regularly communicated through scene-setting updates. These updates should clearly show collaborators where they are in the process and where they are heading, what has been achieved, how the outcomes from the last stage are being carried through to the next stage, and ‘how it fits in’ or relates back to the broader vision or goal for the collaboration. It is important to maintain continuity in process through clear pathways of progression, so that each collaborator feels connected to the ongoing collaboration and the outcomes being achieved.

The timing between formal stages of a collaboration is an important consideration. Collaborators need to have enough time between each stage to progress the collaboration goals, undertake agreed actions, and carry out more targeted engagement to tackle discrete issues. For Brabham, the interactions between formal stages were highly focused on the ‘nitty gritty’ and the technical detail of the alternative water solution. The interactions between a smaller subset of participants with the relevant technical expertise, provided an opportunity to review and discuss relevant reports and schemes in detail. This highlights the potential importance of establishing small working groups, particularly for large, multi-disciplinary collaborations seeking to tackle a multi-faceted problem or issue. These smaller groups could be tasked with addressing a specific issue in between formal stages of activity. But these activities must be transparent to the larger collaboration group. They must also serve, rather than undermine, the collaboration’s objectives. This is particularly important where, for example, these channels are also being used to access senior decision makers to advance an individual agenda.

Within each formal stage of activity, there must be a balance between structured activities that clearly designate what will be discussed or undertaken at a given time and the space for free-flowing discussion and ideation. Since a collaboration is likely to involve different personality types, it is necessary to offer a range of interactive forums to suit various personalities or risk isolating and disengaging particular collaborators. For Brabham, it was considered important to provide clear workshop agendas in advance of meetings with enough detail on discussion topics to engage ‘process-oriented’ or ‘methodical’ thinkers who like to think things through before entering a forum. Similarly, it was essential to balance individual input, table-based discussions and whole group discussions. Some voices can dominate large group discussions so table-based discussions ‘give more voices’ a chance to be heard because they can provide a ‘friendly and collaborative’ environment for more honest discussions. Live polling, which was used during the Brabham workshops to gather real-time data, can also ensure all voices can be heard anonymously.

This discussion highlights the need to purposefully design collaborations with a learning agenda in mind. Research indicates that system-wide change requires social or collective learning (Bos et al., 2013). In other words, changing current practices relies on processes that allow stakeholders to interact and develop shared values and understandings, which in turn form the basis for joint future action. For Brabham, participants identified shared understandings and collegiate relationships as a key benefit of the collaboration. Participants saw the value in simply ‘going through the process, the collaboration and the engagement that facilitated the outcome’, and ‘sitting together and working on a solution’ as more important than the end product. This in turn led to a shared understanding of the issues, which was then communicated internally within participant organisations, particularly at leadership levels so that ‘the work and information [are] flowing through to the right places’ and can influence decision making. As such, collaborations should be set up to provide participants with a forum to engage, interact, negotiate and collaborate, in order to stimulate learning and influence decision making processes.

5 Next steps

The Brabham Action Learning Partnership has provided a forum for different stakeholders to come together to openly discuss the technical and policy issues affecting the approval and implementation of the alternative water solution proposed for Brabham. The collaboration process has led to a shared understanding, particularly of the issues and what these mean for different stakeholders, new or stronger relationships between collaborators, and a desire to cooperatively drive further action to ensure the Brabham development delivers innovative on-ground outcomes. Collaborators identified some additional steps or actions to advance the innovative agenda for Brabham.

1. **Establish a working group to continue a collaborative approach to the planning and approval of Brabham**

At the conclusion of the third workshop, collaborators agreed to establish a working group with Peet, the City of Swan, DWER and the Department of Planning, Lands and Heritage, which the Department of Communities would convene. The working group will seek to progress the solution for irrigating open space in Brabham. Since the time of writing, the working group has met several times. This form of collaboration represents the next evolution of the Brabham Action Learning Partnership. The partnership was an informal collaborative arrangement without an exact membership. This working group, while still retaining some level of informality and flexibility, operates more formally and with a clearer scope. The group should continue to evolve as necessary, with the Department of Communities initially driving its activities. But, as the focus moves beyond Brabham to solutions for the corridor, the collaboration should be elevated to higher levels of decision making across state government and driven with a whole-of-government approach.

2. **Address outstanding questions on the financing, operation and governance of the subsoil drainage harvesting scheme**

Before the alternative water solution for Brabham can be approved and implemented, there are some technical assessments and questions to address. Some topics need clarification, including water supply reliability, long-term security, treatment options and discharges, distribution network and storage options. This information is critical to understanding the optimal scale of the scheme, particularly if considered at the corridor level. From a funding perspective, understanding who pays and who benefits is important, as well as the distribution of risk. It was suggested that the state government should underwrite the longer-term risk associated with the alternative water solution. This needs more exploration. From a regulatory and governance perspective, more work is required to understand the regulatory arrangements for such schemes in the longer term, as well as the most appropriate service provider.

The current working group is a suitable forum for collaboratively resolving outstanding issues, with support from other stakeholders where appropriate. Since the time of writing, an Alternative Water Supply Economic Feasibility study has commenced. The study will focus on six different servicing options, which include variations of direct harvesting of subsoil drainage and MAR, and provide a commercial analysis and benefit–cost analysis of each option. The working group should play a role in overseeing the study. Initially, they could work together to set the assumptions for the study. The CRCWSC could be involved in the latter stages to peer review the economic analysis. Stakeholders recommended this potential validation role as a way of providing an additional ‘layer of comfort’ and confidence in the findings.

3. **Explore barriers and opportunities for alternative built form and urban form**

Beyond the outstanding technical and policy questions of the alternative water solution, a significant gap remains in pursuing alternative built form and urban form outcomes. The challenges and opportunities associated with, for example, lightweight housing alternatives to traditional double brick and tile on slab homes should be explored further. The ‘wicked’ nature of this challenge—a consequence of the lack of experience with lightweight construction in Western Australia, issues with supply chains and the availability of tradespeople, as well as limited builder and community acceptance of the product—suggests a need to initially focus efforts on building capacity among builders around alternative construction methods and investing in community awareness and education,

so the demand for lightweight alternatives is market-driven. Capacity building organisations like New WAter Ways and the Water Sensitive Transition Network could drive such activities.

It was suggested that the current provisions within the Residential Design Codes (R-Codes) might not support using light frame construction to deliver medium density development in Stages 2 and 3 of Brabham. Accordingly, the working group will need to work closely with the Department of Planning, Lands and Heritage and the City of Swan to understand whether the interpretation of R-Code provisions can encompass the desired residential development outcomes for Brabham, or whether alternative planning provisions may be required.

The proximity of Brabham to the future METRONET Whiteman Park station offers a unique opportunity to showcase sustainable development practices that go beyond alternative water solutions and lightweight housing options. As a catalyst for change, the METRONET program offers a once-in-a-generation opportunity to create sustainable urban communities with, for example, decentralised energy solutions, onsite stormwater treatment and reuse, passively irrigated street trees, and blue–green corridors. As a whole-of-government program, METRONET offers a mechanism for multi-agency collaboration to achieve integrated planning solutions that can transform Perth into a liveable, prosperous, sustainable, collaborative and connected city. It is suggested that the working group identify possible synergies with METRONET to advance sustainable outcomes for Brabham and other areas along the Morley–Ellenbrook Line.

4. **Engage in ongoing communication and advocacy for the uptake of innovative, fit-for-purpose solutions**

The Brabham Action Learning Partnership has identified some opportunities for innovation within Brabham, the north-east corridor and the Western Australian planning system, but widespread adoption and change in practice will require ongoing engagement and education of key decision makers and political leaders. Advocacy through key networks or peak bodies, such as the Water Sensitive Transition Network and the Urban Development Institute of Australia, is an important strategy. The CRCWSC can support these efforts where appropriate. For example, ongoing dialogue between the working group and the CRCWSC could help identify important engagement opportunities, such as presenting the Brabham Action Learning Partnership outcomes to the Waterwise Perth Steering Committee responsible for overseeing the implementation of the Waterwise Perth Action Plan. Overall, all Brabham Action Learning Partnership collaborators will need to take ownership of the innovation agenda and continue to drive alternative water and urban solutions if lasting changes in practice are to be achieved.

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Appendix 1: Water planning

These documents guide water management at Brabham:

- *North-east metropolitan sub-regional structure plan regional water management strategy* (Urbaqua, 2018)
- *North-east corridor urban water management strategy* (GHD, 2007)
- *Swan Urban Growth Corridor drainage and water management plan* (Department of Water, 2009)
- *Albion local water management strategy* (City of Swan and Western Australian Planning Commission, 2009)
- *Local water management strategy – first stage local structure plan, Brabham* (RPS Group, 2019a)
- Urban water management plans
- City of Swan policies (for example, City of Swan, 2017 and 2018).

The key aspects of these reports are summarised below.

***North-east metropolitan sub-regional structure plan regional water management strategy* (Urbaqua, 2018)**

This strategy provides guidance for managing water resources as part of future land use planning and development in the North East Metropolitan Sub-region. The strategy is consistent with the requirements of *Better urban water management* (Western Australian Planning Commission, 2008) and is guided by the vision of Greater Perth as a water sensitive city in 2065, developed with the support of the CRCWSC.

Objectives and strategies outlined in the regional water management strategy aim to ensure that development:

- addresses limitations of existing infrastructure (including the use of new technologies)
- maximises water efficiency and fit-for-purpose use (limit irrigation and consider public open space that does not require irrigation)
- delivers functional and integrated public open space (incorporate green infrastructure to create shade and habitats)
- protects the water quality and hydrology of receiving environments (manage runoff at source and install water quality infrastructure)
- protects development from flooding (maintain pre-development flood regime).

***North-east corridor urban water management strategy* (GHD, 2007)**

This strategy was prepared to support the North East Corridor structure plan. It was prepared as a regional water management strategy to update the previous 1995 Drainage Management Strategy which recommended the use of water pollution control ponds.

The document provides broad strategies for water management, consistent with WSUD principles. These strategies include maintaining pre-development hydrology by retaining or detaining onsite, establishing (in district water management strategies) water quality targets, using subsoil drainage to control groundwater levels, and retaining existing drains within conservation and resource enhancement wetlands.

This highest priority area was identified as the Henley Brook–West Swan–Caversham area, including catchments south of Gnangara Road.

***Swan Urban Growth Corridor drainage and water management plan* (Department of Water, 2009)**

This plan was prepared to support development of the sub-regional structure plan for the Swan Urban Growth Corridor. It includes groundwater and surface water modelling and proposes an arterial drainage strategy including these elements:

- catchment-scale peak stormwater discharge criteria

- catchment-scale flood detention volumes
- longitudinal sections for arterial watercourses
- indicative floodway widths for arterial watercourses
- culvert dimensions and proposed upgrades at critical locations
- modelled wetland water levels (including Horse Swamp)
- modelled groundwater levels with and without groundwater drainage systems installed.

Key findings of groundwater modelling undertaken by GHD for this document (p.38) are:

> *Groundwater modelling has indicated that development of the Swan urban growth corridor is likely to result in a general increase in predicted maximum groundwater levels in the study area with some areas increasing by as much as 1 m for average rainfall scenarios and 4 m for high rainfall (no groundwater drainage) scenarios. Outside of the study area the impact is much less marked, and increases are less than 0.5 m with average rainfall and 1 m with high rainfall.*
>
> *Groundwater modelling also investigated the impact of subsurface drainage (located at controlled groundwater level) within the Swan urban growth corridor. Scenarios including subsurface drainage resulted in less change to predicted maximum groundwater level. With average rainfall, there was less than 0.5 m increase within the study area and virtually zero change outside.*

Controlled groundwater level for the purposes of this study was set at the maximum groundwater level from a nominated 'current climate' scenario (average of last 20 years).

Albion local water management strategy **(City of Swan and Western Australian Planning Commission, 2009)**

The local water management strategy (LWMS) was prepared to the City of Swan's Town Planning Scheme No. 17. The document provides a dual role in providing detail to satisfy both the district and local level drainage information, building on the north-east corridor urban water management strategy (GHD, 2007). The LWMS noted the shallow groundwater across most of the study area and the limited groundwater resources for non-potable uses.

Groundwater management strategies include a controlled groundwater surface at average annual maximum groundwater levels (AMMGL) using subsoil drainage. Clean fill would be imported to achieve at least 1.2 metres of separation between floor slabs and groundwater levels.

For the limited groundwater availability, the LWMS proposed possibly transferring groundwater entitlements or obtaining an irrigation supply (partial or full), planting of up to 35 per cent of public open space areas with native vegetation, and minimising irrigated amenity grassland. For licence entitlements, the LWMS suggested supplementing recharge in Whiteman Park with surface flows from Albion (western catchment) and using additional recharge for irrigation in the development.

Although these strategies were proposed, DWER has recently advised it will not endorse any LWMS in the area without an alternative non-potable water supply solution that has been verified (RPS Group, 2019).

Local water management strategy – first stage local structure plan, Brabham **(RPS Group, 2019a)**

This strategy was prepared by RPS Group to support the First Stage Local Structure Plan. It is consistent with the broader drainage objectives and principles in the Albion district structure plan LWMS (City of Swan and Western Australian Planning Commission, 2009).

While the LWMS provides guidance for stormwater and groundwater management as well as water conservation, it does not address the shortfall in irrigation for public open space. The document notes in Appendix 6 (p.4) that:

> *The alternate water supply strategy will not be approved via this LWMS, which documents the drainage design and land use planning elements. Rather, the approval framework will be via a water licence*

> *application and the approval for either direct harvesting or a managed aquifer recharge (MAR) scheme through the DWER (2010) Operational Policy 1.01 for Managed Aquifer Recharge in WA which is consistent with the 2009 Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Managed Aquifer Recharge.*

But as part of the complete suite of water solutions for Brabham, resolving all the requirements of *Better urban water management* including documentation of 'infrastructure and management requirements and proposed locations for proposed water, wastewater and stormwater systems, having consideration of infrastructure already existing and identifying any necessary approvals' is likely to be required in later versions or documents (Western Australian Planning Commission, 2008, p. 28).

In addition, the *Interim guidelines for developing a local water management strategy* recommend that the report outlines the 'conceptual urban water management system, providing proof of concept which includes … documentation of alternative water supply, stormwater conveyance and stormwater treatment infrastructure including proposed locations and management requirements' (Department of Water, 2008, p. 7) and to 'Identify alternative water source where possible including service provider' (Department of Water, 2008, p.19).

Urban water management plans

Consistent with *Better urban water management*, urban water management plans will need to be prepared to support each application for subdivision. Depending on the level of detail agreed in the local water management strategy, these plans will either provide critical criteria for design to support the application or be required as a condition of subdivision, depicting the detailed design solutions to the satisfaction of the City of Swan. It is also likely that an operating strategy will be required for operating the irrigation network.

City of Swan policies

The *City of Swan Urban Growth Corridor Local Area Plan* (City of Swan, 2017) noted that the implementation of WSUD principles through urban water management strategies was a high priority with regards to protecting and enhancing existing waterways and valuable natural areas.

The City has two key local planning policies (LPP) that are relevant to creating public open spaces and integrating WSUD:

- POL-LP-1-12 Public Open Space and Community Buildings (2018)
- POL-C-104 Environmental Planning (2018).

Under the Public Open Space and Community Buildings LPP the City provides guidance to developers on delivering new public open spaces. Regarding water for irrigation, the policy notes that *'water allocations for proposed public open spaces are to be identified during the structure planning process and the licence must be transferred to the City via the Department of Water at a time of open space handover following the agreed maintenance period'.* (City of Swan, 2018, p. 8)

The Environmental Planning LPP provides detailed guidance for integrated water management including specifying requirements for local water management strategies. These include, for example, maintaining environmental water flows at pre-development levels, and not increasing nutrient levels as a result of development, among others. A second critical component of the Environmental Planning LPP is provisions relating to using alternative water sources for watering public open spaces. Notably, the City supports water conservation and re-use schemes especially for watering community/public facilities, open spaces and households.

The City of Swan also maintains some design guidelines and specifications that are relevant to water management at Brabham.

Cooperative Research Centre for Water Sensitive Cities

Level 1, 8 Scenic Boulevard
Monash University
Clayton VIC 3800

info@crcwsc.org.au

www.watersensitivecities.org.au