

LIVING BROOKLYN: INDUSTRIAL REMEDIATION THROUGH WATER

AN INTEGRATED WATER CYCLE MANAGEMENT (IWCM) STRATEGY TO REDUCE WATER AND AIR POLLUTION FROM THE BROOKLYN INDUSTRIAL PRECINCT

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ABSTRACT

The Brooklyn Industrial Precinct (BIP) is a major industrial and business hub located in Melbourne's inner west.

The BIP and adjacent areas downwind suffer the highest levels of air pollution in greater Melbourne, measured as levels of particulate matter 10 micrometers or less in diameter (PM10). This has created long-standing tension between business, Government and community stakeholders. In 2012 Brimbank City Council adopted the 'Brooklyn Evolution Strategy' to improve business, environmental and health outcomes in the precinct. This led to the preparation of 'Living Brooklyn', an Integrated Water Cycle Management (IWCM) that explored how water could be used as a catalyst to bring stakeholders and remediate the precinct.

The strategy also pursued enhanced liveability and business prosperity through place-making projects that create a sense of pride in the precinct and establish greener and cooler environments and areas for respite. To deliver this, ongoing and careful management of stakeholder engagement across the private and public realm was essential.

This paper outlines the process of collaboration and technical investigation undertaken to arrive at the preferred approach to support BIP's transition to greater health and prosperity.

INTRODUCTION

Land Use

The Brooklyn Industrial Precinct (BIP) consists of 330ha of industrially zoned land in Melbourne's west (Figure 1). For over 150 years, the precinct has played a crucial role in supporting Melbourne's urban development and waste management. The site was originally used to quarry basalt (bluestone), which was used to construct many of Melbourne's valued landmarks, buildings and laneways.

Most of the land within the BIP is privately owned. Quarrying activities ceased in the 1950s and were replaced by landfilling (Meinhardt, 2012). Landfilling has also slowed or ceased over recent years, however, the presence of material recycling and composting industries ensures that the precinct remains an important hub for waste management. The precinct also houses a complex mix of abattoirs, tallow producers, container yards, vacant and contaminated sites (most notably the former Huntsman Chemicals site), warehousing logistics and several small businesses including light industrial, retail and manufacturing (Meinhardt, 2012).

This limits the impact that Local and State Government organisations can have on the ground and heightens the need for consultation as a means to effect change.



Figure 1. The BIP and surrounds (Meinhardt, 2012, p9).

Site Significance

The BIP forms part of the Western Industrial Node; it is a hub of state significance that plays an important economic and employment role in Melbourne's west (Sustainability Victoria, 2015). The area is strategically located close to Melbourne's CBD, the Port of Melbourne, airports and important road corridors.

Given the rapid growth predicted for Melbourne, the BIP is well placed to improve future economic development and liveability in the west through the provision of employment and commercial services (Meinhardt, 2012).

Despite its current value and future potential, BIP's image is connected

to the negative impacts associated with the waste management industry. In particular, the precinct is grappling with issues related to dust, odour, land contamination and noise.

Many of the traditional and outdated modes of operation adopted by businesses within the precinct contribute to amenity and air quality issues that impact the precinct and its neighbouring residential population.

In light of these challenges, it is apparent that significant and ubiquitous change is required to ensure the longevity and prosperity of the precinct. The alternative is to move these industries elsewhere and lose the economic, social and environmental advantages of the location.

Recent Action

In light of its challenges and potential, Brimbank City Council (BCC) has prioritised the BIP for revitalisation. In October 2012, Council adopted the 'Brooklyn Evolution Strategy' with a vision that:

"Over the next 20 years BIP will evolve into a key employment node for Melbourne's West, a destination of choice for new 'clean and green' investment and development" (Meinhardt, 2012).

Council is delivering the Brooklyn Evolution Strategy by creating a positive climate for business to thrive through the promotion of new investment and improved infrastructure. Specifically, in 2013 the strategy helped secure \$405,320 through the Living Victoria Fund to prepare 'Living Brooklyn', an Integrated Water Cycle Management (IWCN) Strategy for the BIP.

The Living Brooklyn Strategy, the subject of this paper, focused on utilising urban design and water management principles to deliver improved air quality, liveability, urban greenery, biodiversity, safety, urban design, health and social equity.

The project brought together a team of experts from BCC, Victoria University, E2Designlab, City West Water, Melbourne Water and others.

BASELINE DATA

Living Brooklyn involved scientific and economic analysis of baseline conditions within the BIP (E2Designlab, 2015 and Jones and Ooi, 2014). A snapshot of the most pertinent information is provided in the following sections.

Air Quality

The BIP has long suffered from poor air quality (Figure 2) and in 2015 Brooklyn continued to have the highest levels of air pollution (measured as PM10 dust) in Melbourne. Historically, these impacts have been managed and controlled with dust management plans that prioritise the use of potable water (drinking water) to wet down or control the dust. This has established a strong connection between the precinct's air quality, water cycle and overall health.

Potable Water, Trade Waste And Wastewater

Approximately 1,500 ML/year of potable water is consumed within the precinct. Use is highly concentrated. A relatively small number of businesses account for most of the use (e.g. manufacturers and abattoirs). Anecdotal accounts suggest that water use for dust suppression within the precinct is significant. Most potable water used in the precinct is discharged as trade waste (1,150 ML/year) with a smaller volume (~50 ML/year) discharged as wastewater (Figure 3).

Waterways and Stormwater

The BIP is located within the Werribee River catchment. Most stormwater generated within the precinct discharges

into Kororoit Creek... A smaller proportion of runoff enters Stony Creek to the east. Both waterways are in poor condition and are significantly impacted by catchment urbanisation. The volume of runoff is approximately double what would occur naturally, and most of this runoff is discharged without being treated or used.

Stormwater quality in the BIP is expected to be highly variable. With such diverse land use and influencing factors a broad spectrum of pollutants will be generated and transported into the stormwater system.

The nutrient, heavy metal and hydrocarbon impacts are likely to be similar to surrounding industrial areas, with the precinct being one of a number of contributing areas.

Kororoit Creek is currently impacted by high levels of heavy metals, with EPA monitoring indicating frequent exceedances of heavy metal trigger levels downstream of the precinct at Racecourse Road Ford, Altona (Site ID: WBKOR0278).

Sediment discharges from large areas of disturbed soils are considered to be the most significant pollutant impact from the BIP. The precinct contains large landfill and material recycling areas with unconsolidated surfaces and unsealed roads that experience significant truck traffic. These areas behave similarly to construction sites, with the potential to generate large volumes of sediment.

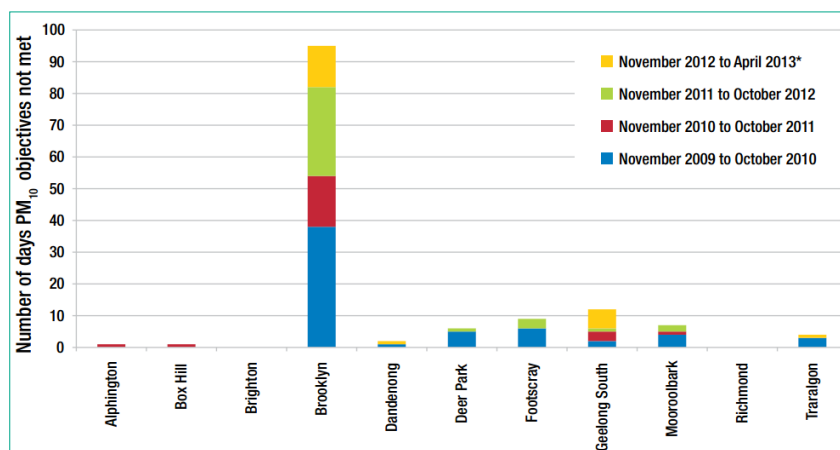


Figure 2. Number of days PM10 objectives not met, Victorian air-quality monitoring stations (*only six months of monitoring data available for 2012–2013, from November to April.) (CESV, 2013, p57)

GOVERNANCE MODEL AND PRINCIPLES

BCC was the authority responsible for delivering Living Brooklyn, with overview provided by DELWP and other project partners who, together, formed the core technical team (Figure 4).

The Living Brooklyn model of governance prioritised equitable participation, ownership and access to the project. The following five principles, based on the United Nations Principles for Good Governance (Graham *et al.*, 2003), were embraced:

Legitimacy of voice: All of the people who engaged with, or influenced, the water cycle were invited to participate in the project. Different project interests were mediated to reach a broad consensus on the project direction, goals and strategies to achieve IWCM.

Direction: Participants worked together to develop a strategic vision that would continue to support long-term collaboration. Time spent building knowledge of the complex historical, cultural and social factors influencing outcomes contributed to ownership and understanding of IWCM benefits.

Performance: Engagement with a range of stakeholders from the start of the project ensured that responsiveness to project implementation outcomes would be more likely to succeed at the later stages of the project.

Accountability: Working collaboratively allowed a diverse stakeholder group to identify and commit to outcomes and actions throughout the project. Outcomes were seen as achievable, practical and based on current best practice. Transparency was achieved through this process, increasing information flows and delivering shared responsibility.

Fairness: All people engaged in Living Brooklyn displayed a commitment to the principle of equity and agreement to people's right to have their health and wellbeing needs met. This is reflected in the Vision and Objectives outlined in the following sections.

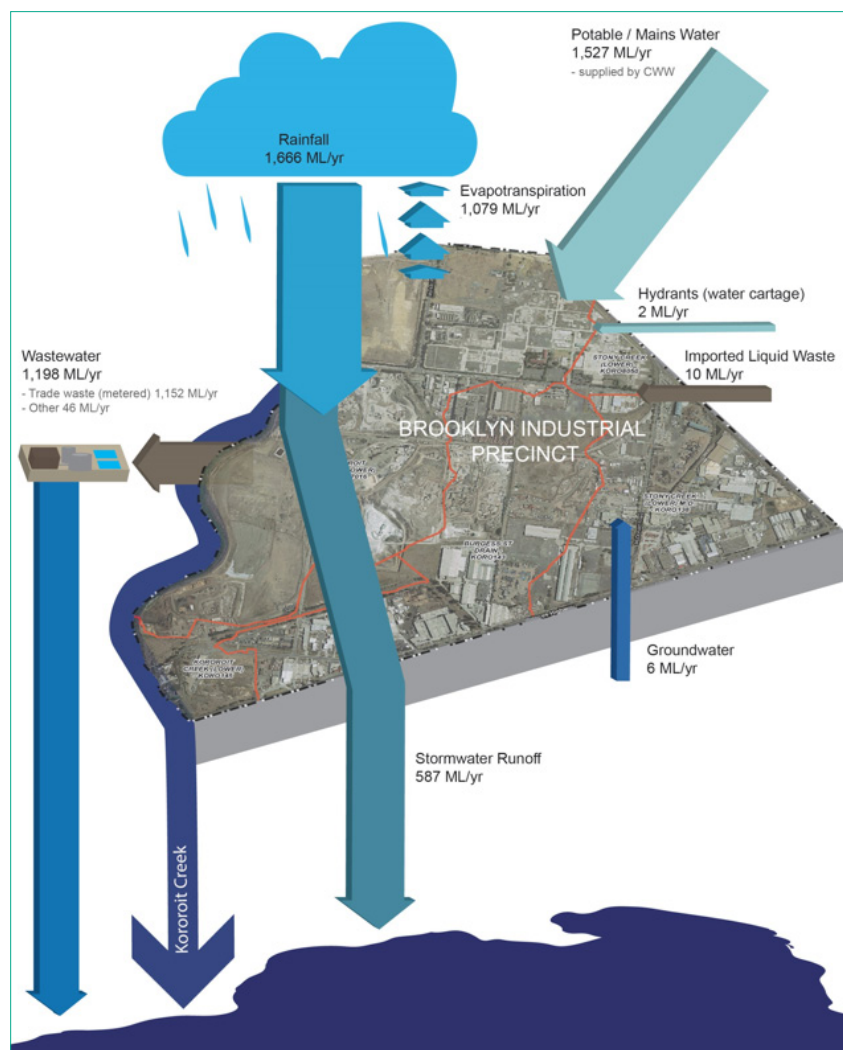


Figure 3. The BIP water balance (BCC, 2015).

COLLABORATION AND STRATEGY DEVELOPMENT

Living Brooklyn was developed over three phases:

- (1) Relationship building and data collection;
- (2) Consensus building; and
- (3) IWCM Development.

These stages are presented in Figure 5 and discussed in turn below.

Relationship Building And Data Collection

IWCM depends on people working together in the pursuit of healthy and economically prosperous communities. As such, Phase 1 focused on engaging

with stakeholders that use, influence or are affected by aspects of the water cycle. These included:

- Representatives from Local Government departments in all of the key areas that influence or impact the water cycle, air quality, community health and wellbeing, strategic planning, urban planning, urban place making, BIP's economy and the environment.
- Water authority and water retail staff responsible for managing the water cycle and caring for customers who depend on it.
- State Government agencies, including representatives with funding or influence over aspects of the BIP, the people who work there, the sectors they represent and the environment they influence.

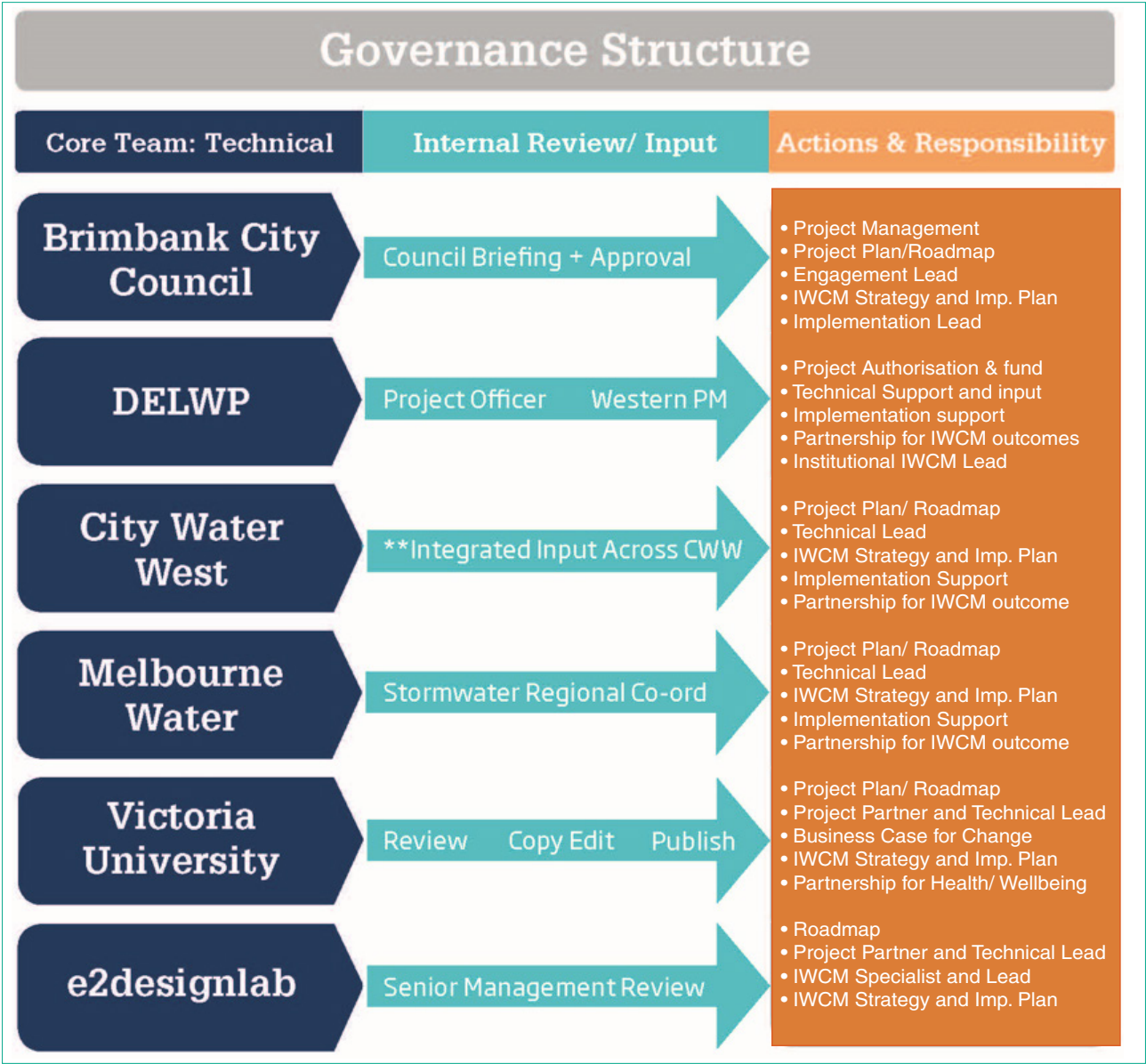


Figure 4. Governance model (BCC, 2015).

- Institutions and progressive organisations working in the same space or with shared project aspirations around health, liveability, productivity, sustainability, economic growth etc.
- Businesses located in Brooklyn were all invited to the project. Over 30 businesses actively participated in the project over two years. Several participated in discrete Working Groups and provided valuable insight from a business perspective.

The project stakeholders, including the contributors mentioned, were engaged early on in the project and

formed into four teams to facilitate greater collaboration (Figure 6).

The Technical Working Group consisted of staff from City West Water, Victoria University, E2Designlab and Brimbank City Council. Together, these parties worked on the Living Brooklyn Submission and continued to meet over the course of the project to steer and undertake the background work and final IWCM Strategy.

The Technical Team consisted of several highly skilled professionals including engineers, economists, urban designers, sociologists, scientists and strategic planners.

The Business Leadership Team comprised key businesses within the BIP. Business representatives came together to review material before it was tabled in public forums.

This contributed to building trust between Government and business. It also ensured that valuable intelligence from businesses was considered and incorporated where relevant. The Council Leadership Team included officers from Strategic Planning, Statutory Planning, Urban Design, Engineering, Community Planning and Development, Environmental Health, Compliance and Enforcement, Environment and Economic Development.

A collaborative approach was adopted within BCC to anchor the project. All departments that influenced outcomes in the BIP were brought together to discuss a unified approach to change. This included departments responsible for aspects of the urban water cycle, departments supporting the transition of BIP into a productive, healthy, job-generating node, and department members who had been working in Brooklyn on a range of remediation projects over many years. Existing knowledge of the area and connections to key stakeholders who influenced change in the area was vital. Extending the net to include key project participants beyond those who influenced the water cycle allowed indirect issues to be dealt with through the dialogue on water.

The Leadership Team included all participants in the project. Within many of the businesses and Government organisations a key person took on the role of ‘champion’.

This supported a range of ideas and values into the project. The contribution of stakeholders not directly engaged via the other three working groups was facilitated through easy access to BCC’s Living Brooklyn project manager. Several stakeholders also attended one or more of the project’s workshops.

The implementation of the four working groups helped to successfully engage people from a broad section of society. The input of key participants contributed a wealth of knowledge, expertise and time that directly influenced the strategies development.

In addition to engagement, Phase 1 involved scientific and economic analysis. Baseline IWC, economic, dust and health assessments were prepared to better understand the challenges and opportunities in BIP.

The IWC Baseline Report created a snapshot of water management in the BIP (E2Designlab, 2015).

The inflow and outflow of potable water, wastewater, stormwater and groundwater resources were captured in the precinct’s water balance. The planning and policy context for water management was explored and a preliminary estimate of the costs of water use and discharge within the precinct was prepared.

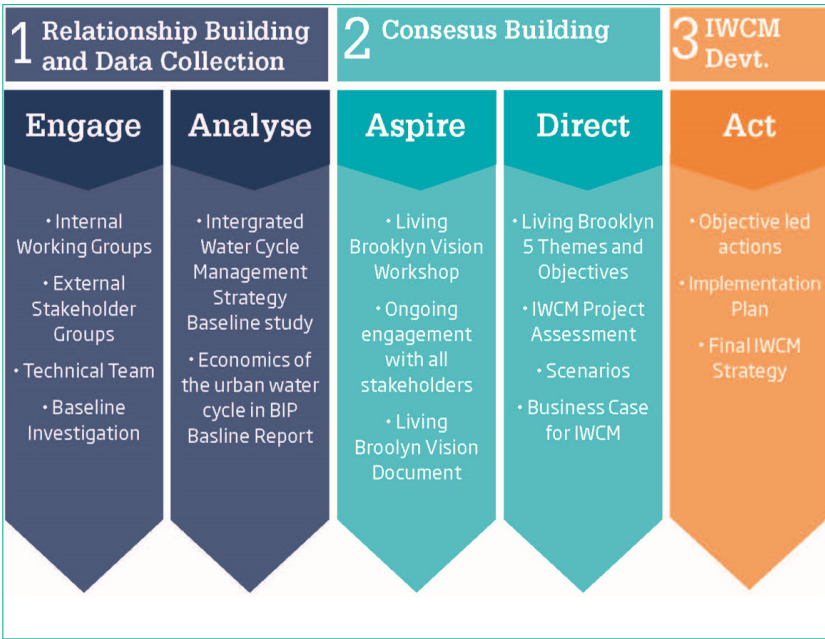


Figure 5. Living Brooklyn strategy development (BCC, 2014).

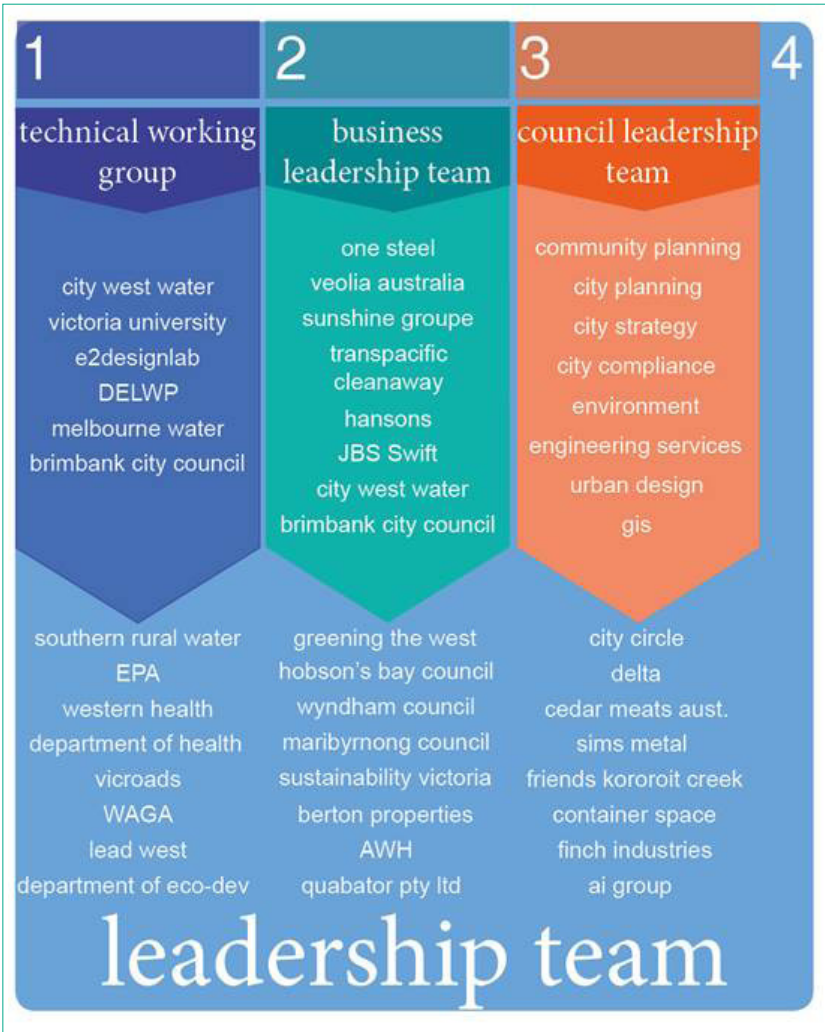


Figure 6. Collaboration snapshot (BCC, 2014).

Local and international precedents for the implementation of water-sensitive urban design (WSUD) and integrated water cycle management within industrial areas were identified and summarised. This provided a succinct and realistic overview of potential opportunities, technologies and approaches that could be applied within the precinct.

The baseline economic, dust and health study used EPA air quality monitoring data to tease out the relationship between dust particles from the site and the health of residents to the south and east of the site (Jones and Ooi, 2014). Average dust pollution figures were then applied to a World Health Organisation air pollution and health model to estimate health (asthma) and mortality among the population affected, taking into account their ages and health status.

The welfare costs of air pollution were estimated based on:

- (1) willingness to pay to have clean air; and
- (2) levels of happiness, both related to air pollution by differencing household income between clean air and polluted locations.

Direct health care costs were also estimated. Past (20 years) and future (30 years) costs were estimated to assess the historical burden and to create a business-as-usual baseline from which to calculate the benefits of pollution reduction.

Traffic and air quality measurements were used to show that PM10 emissions in the BIP are driven by traffic movements. This led to the conclusion that PM10 pollution is largely a catchment and water-based issue because of the role of the hydrological cycle in sediment production, transport and dust suppression through watering. Based on the findings, a four-step 'best practice' sediment management cycle for limiting visible dust and PM10 particles was proposed.

This management cycle is premised on the notion that it is much more efficient to reduce sediment supply in the long run than it is to temporarily suppress a constant supply.

The key to doing that is through whole-of-life-cycle management of sediment

and water, with vegetation playing a key role in pollutant interception. The findings from each baseline investigation were drawn on throughout the remainder of the Living Brooklyn project.

They helped guide stakeholder discussions, were used to develop solutions and were drawn on as a foundation for further scientific and economic analysis.

Consensus Building

Once the initial relationship-building and data collection had been completed, efforts turned towards creating a vision for the project.

During the consensus-building phase of the project, agency and 'visioning' workshops were held along with one-on-one meetings, technical discussions, positioning sessions and community engagement.

This input framed and informed the project, while establishing technical rigour to identify and assess IWCM projects suitable for the precinct.

The Living Brooklyn Vision Workshop (Figure 7) was held in 2014, with stakeholders from private industry, local members of parliament, State and Local Government representatives, water retailers, universities and other related organisations. The purpose of the workshop was to bring the stakeholders together to discuss a new outlook across business, Government and community for the benefit of all.

Stakeholders who attended the workshop openly shared their experiences. This exchange deepened

attendees' knowledge of the broad array of issues that influence outcomes in BIP and the complexity of transitioning towards new systems such as IWCM. At the close of the workshop participants were asked, "What could Brooklyn Industrial Precinct be in 2034?". Responses were used to develop a shared vision for the future of Brooklyn. The resulting vision is to develop a:

"World Class Industrial Eco-Park that is the pride of place for the people working and living in Brooklyn." (BCC, 2015)

This vision is supported by key objectives in the Brooklyn Evolution, and the statement 'World Class Industrial Eco-Park' was chosen as it establishes an exciting benchmark for future business in Brooklyn. The principles around 'eco-park' are strongly connected to efficiency and health, which were key themes discussed over the course of the Vision Workshop. The second component of the vision relates to the synergistic relationship between the people who live and work at BIP and are equally affected by the collective actions of business in Brooklyn.

Five themes were also developed to guide actions in furtherance of the Living Brooklyn vision (Figure 8). The themes reflect the values of business, Government and community in the Brooklyn area. They were developed in collaboration with stakeholders during workshops, technical meetings and other sessions. Under each theme sits a range of goals and objectives that focused efforts throughout the Living Brooklyn project (BCC, 2014).



Figure 7. The Living Brooklyn Vision Workshop (BCC, 2015).

Build Knowledge and Form Connections:

This theme relates to building stronger relationships and connections across the BIP and between the stakeholders who influence outcomes at Brooklyn.

Improved networking to promote sharing of knowledge and expertise is considered to be necessary for BIP to transition to IWCM. Significant opportunities can be realised within the precinct through a co-ordinated and collaborative approach to IWCM.

Government, private industry and water retailers each have a valuable role to play in the change process.

- **Goal 1:** Increase industry's capacity to transition towards IWCM successfully.
- **Goal 2:** Support industry, Government and community to work collaboratively to achieve the goals sought through Living Brooklyn.

Lead Prosperity: Innovation and leadership are important attributes of IWCM at BIP.

Investment of time and willingness to work collaboratively to improve the health, wellbeing and prosperity at BIP is the first step. Prosperity will come from industry and Government working towards the same goals and having a shared vision for BIP.

- **Goal 1:** Deliver an IWCM project onsite in BIP as a priority that embeds the goals outlined in this document.
- **Goal 2:** Pursue innovation through all facets of BIP's transition.

Value Water: This theme prompts an investigation of all aspects of the existing water cycle and opportunities to improve the water management



Figure 8. Living Brooklyn themes (BCC, 2014).

within the precinct by supporting and complementing existing strategies and projects, seeding new projects and initiatives and increasing collaboration:

- **Goal 1:** Water resources to be used on a 'fit-for-purpose' basis in an effective and efficient manner.
- **Goal 2:** Effectively manage the impacts of BIP on Kororoit Creek and Stony Creek.

Enhance Liveability: Protecting and improving the health and wellbeing of workers and residents is central to BIP's transition to IWCM. Liveability in the context of BIP relates to ensuring that strategies and projects prioritise people's health and happiness. Living Brooklyn will use the lens of IWCM to evaluate the best methods to improve the health and wellbeing of the workers and residents affected by its actions:

- **Goal 1:** Establish a sense of place from the characteristics of water: connectedness, health, liveability, identity.
- **Goal 2:** BIP will contain quality open space supported by appropriate landscaping and plant species prosperity.
- **Goal 3:** Air quality in BIP will support a healthy, vibrant community.

Celebrate Success: Through monitoring and recording our progress both individually and collaboratively, BIP businesses, Government and community can revel in the improvements that are achieved. To clear a pathway to achieve a healthy Brooklyn, achievements must be captured and celebrated:

- **Goal 1:** Celebrate the actions that lead to the achievement of BIP vision and goals.
- **Goal 2:** Improve business effectiveness.

Once the vision and associated objectives had been devised, the technical team worked together with stakeholders to identify potential IWCM projects and develop future directions for development of the precinct. Industry and community leaders were invited to provide input and shape the types of project identified in the strategy, as well as their mode of implementation.

The outcomes of the extensive consultation process were used to develop a long list of IWCM options for the precinct, which consisted of both public and private realm actions. Site-specific IWCM options were then prioritised using a rapid assessment framework (RAF) that considered financial costs, economic benefits, quantifiable outcomes and stakeholder preferences. Assessment outcomes were then discussed during follow-up workshops. These findings were incorporated into the RAF and used to identify a final list of preferred options and approaches for inclusion with the strategy (Table 1).

A business case for IWCM was also prepared during this phase of Living Brooklyn. This analysis focused on the costs/benefits of air pollution removal over a 30-year period.

Table 1. Summary of RAF outcomes (BCC, 2015).

Project	Score	Priority
Perimeter greening – swales and tree-lined	20	High
On-site stormwater detention and use	19	High
Perimeter greening – swales only	17	Medium
Rainwater tanks	15	Medium
Rain gardens	13	Medium
Green roofs	8	Low

Introducing 'best practice' on the site to all roads, including sealing Jones and Bunting Roads, was estimated to reduce PM10 production to 138 tonnes per year (by ~55%). The direct health cost benefits of these improvements would be \$1.5 million per year with a range of \$1.4 to \$2.4 million per year. The community welfare benefits would be \$8.6 million per year with a range of \$7.2 to \$15.9 million per year.

Total benefit would be \$10 million with a range of \$8.6 to \$18.3 million per year. This analysis also included a discussion of where the risks emanate from and who owns them, who would receive the benefits of IWCM, who is responsible for implementing those measures and who pays (BCC, 2015).

IWCM Development

With a vision established and priority projects identified, the focus of Living Brooklyn turned to the final phase of IWCM Development. Delivery of the most viable projects and further capacity building was set in motion with the creation of an Implementation Plan endorsed by key stakeholders. The Implementation Plan focused on targeting the existing policies supporting IWCM and bolstering the planning framework to facilitate new capacity building opportunities within Council. The Implementation Plan's objectives are to incorporate a range of 'soft' and 'hard' IWCM projects and strategies. The objectives were detailed into actions, with partners identified to undertake the key actions.

Three project stages were devised to guide high-level stakeholder action and project implementation of the IWCM projects identified during phase 2 of the project. These consisted of:

- Stage 1: 2015–2017 (3 years)
- Stage 2: 2018–2024 (7 years)
- Stage 3: 2025–2034 (10 years)

Project assessment and prioritisation outcomes were used to determine which projects should be implemented in each stage. Other considerations included the practicality and likelihood of various inclusions with the strategy (Table 1). Most of the opportunities are complementary and the greatest challenge is determining the priority and timing of when they should be actioned.

Where multiple choices exist to achieve similar outcomes, the opportunities providing the greatest benefits for least cost were chosen.

OUTCOMES

To date, strategy outcomes flowing from the Brooklyn Evolution and Living Brooklyn include the resurfacing of Jones and Bunting Roads and action by a number of businesses to improve site water and dust management practices. Work is also progressing on planning scheme amendments and the creation of a Gateway Site that may include a stormwater treatment wetland. Other outcomes are summarised below:

Partnerships

- Regular meetings across Local and State Governments to discuss BIP have been established.
- The Brooklyn Industrial Precinct Committee and Brooklyn Community Reference Group have been formed.

Planning

- BCC has proposed new planning provisions via C177 to improve future development outcomes in relation to build form, environmental sustainability, access and movement and landscape design.
- Opportunities for significant planting along the BIP Kororoit Creek interface are being investigated as part of Greening the West, a one-million-tree project.

Projects

- BCC secured \$2m from State Government to seal Jones and Bunting Roads including swales and landscaping; these works were completed in 2015.
- BCC secured \$20k from Melbourne Water to investigate an improved entrance landscape at the Geelong Road entrance to the precinct.
- BCC has completed over 200 compliance inspections to improve operational practices and improve urban landscape to mitigate dust and improve the precinct's image.

Publicity

- Living Brooklyn was featured as a case study in the Green Infrastructure Economic Framework (Victoria Institute of Strategic Economic Studies, 2015).

- The BIP was featured at the Australian Industrial Ecology Conference in November 2014 and the Clean Air Society of Australia and New Zealand Conference in September 2015.

- BCC has produced a prospectus to promote BIP and created a newsletter that has gone digital as an e-bulletin.
- A feature article was published in the *Sunday Age*, December 7, 2014.
- Briefings and seminars have been provided to industry and Government partners, BCC and the EPA.

The project also highlights the challenges of translating IWCM strategy into IWCM implementation.

Investment in capacity building within the organisations charged with assessing and enforcing planning applications is essential. Without a focus on capacity building, particularly from the ground up (e.g. statutory planners) in local council, embedding IWCM is difficult to achieve. This is particularly important as early career planners are often at the front line of IWCM implementation. Equipped with the right policy, training and management these officers can have a significant influence on IWCM uptake. Cultivating a 'culture' of IWCM is essential. This depends on strong support from management personnel. By providing key actors with adequate capacity and appropriate management, the implementation of IWCM can be supported from the bottom up and the top down.

The project also identified the following learnings and shortcomings:

- Incorporating intangible benefits into traditional economic frameworks remains a challenge. More research and application is required to strengthen approaches that consider broader costs and benefits to represent the full gamut of community and environmental impacts.
- The allocation of costs and benefits associated with the impacts of industrial practices such as those at the BIP are inequitable. The division of Government activities, both within and across Local, State and Federal jurisdictions, fails to facilitate the cost sharing that is

required to address these impacts. Cost sharing can also be hindered by traditional business practices that limit knowledge sharing and stifle goodwill.

- Industrial precincts are comprised almost entirely of privately owned land. Consequently, purchasing land to remedy environmental and social issues is unlikely to be feasible. This increases the need for long-term planning and collaboration with landowners to drive change.
- Air and water pollution within industrial precincts is diverse and diffuse. The varied nature of land use limits the potential for generic solutions. Careful investigation is required to uncover the mechanisms for the creation and spread of pollution in order to tailor solutions to the cause. This requires a specialist inquiry with higher costs.

CONCLUSION

Living Brooklyn demonstrated that IWCM serves as an ideal method to support BIP's ongoing transition to health and prosperity. IWCM was of particular value due to its ability to deliver multiple benefits via the management of impacts caused by pollution, out-of-date industrial practices, health hazards and business inefficiencies.

In terms of collaboration, water was a driving force that brought together a complex and diverse stakeholder group to work collaboratively on strategies to revitalise the precinct. The strong desire for all members of the water cycle to work together to achieve IWCM was an essential ingredient that supported the delivery of greater social equity, health, green space, biodiversity and improved urban design. Finally, in order to capitalise fully on the strategy into the future a mixture of bottom-up and top-down implementation consisting of capacity building, supportive management and strong collaboration, will be essential.

This paper was presented at the 2016 YWP Conference in Sydney.

ACKNOWLEDGEMENTS

The Authors wish to thank Brimbank City Council, Brooklyn Residents Action Group, City West Water, Department of

Environment, Land, Water and Planning (incorporating the former Department of Environment, Planning and Infrastructure and the Office of Living Victoria), E2Designlab, EPA for data provision and background information, Melbourne Water, and participating businesses operating in the BIP, including One Steel, Veolia, Sunshine Groupe, Transpacific Cleanaway, Hansons and JBS Swift, and Victoria University.

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Tashia Dixon has over 15 years' experience in social planning, urban design and sustainability management, and has engaged with a range of projects across Australia and in Asia. Her passion lies in sustainable place-making to deliver safe, healthy and beautiful environments for all members of the community to enjoy.



Dale Brown is an expert in the modelling and design of water-sensitive urban design (WSUD) systems. Dale applies his expertise in WSUD and integrated water management to deliver innovative solutions for managing urban water. These range from stormwater reuse for households to integrated designs for simultaneous mitigation of flooding, management of hydrology for environmental protection, stormwater treatment and stormwater reuse to improve landscape and recreational amenity.

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