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Retrofit Case studies

Wayne Edgeloe
Edgeloe Engineering

WSUD Retrofitting and Principles of Stormwater Management

Protect Natural Systems

Convey in natural systems or systems that mimic natural drainage processes

Retain (use and infiltrate) stormwater at source

Protect the built environment from flooding and water logging

Protect Water Quality

Provide liveable communities

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WSUD Retrofitting- Design for event scales

Street Level

1 in 1 year ARI

Water Quality and Quantity Management

- Retain or detain stormwater at source
- Maintain pre-development flows
- Improve water quality
- Reduce degree of imperviousness
- Control pollutants at source
- Protect ecological values

1 in 5 year ARI

Drainage Serviceability

- Minor flow conveyance including detention/retention
- Maintain serviceability of roads

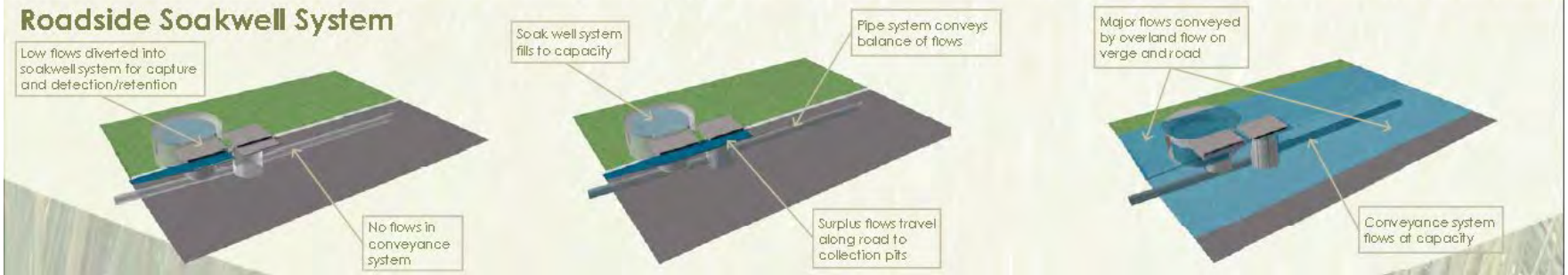
1 in 100 year ARI

Flood Management

- Major flow conveyance
- Protection of people and property

Roadside Bioretention Garden

Roadside Soakwell System



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WSUD Retrofitting- Design for event scales

Get the 100 year right first then the rest follows

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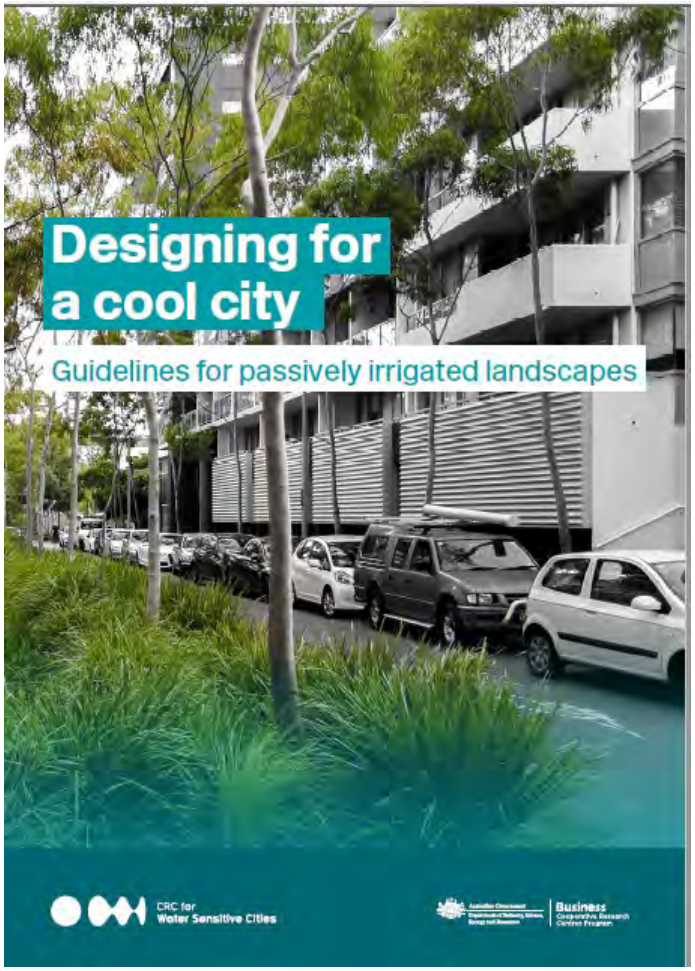
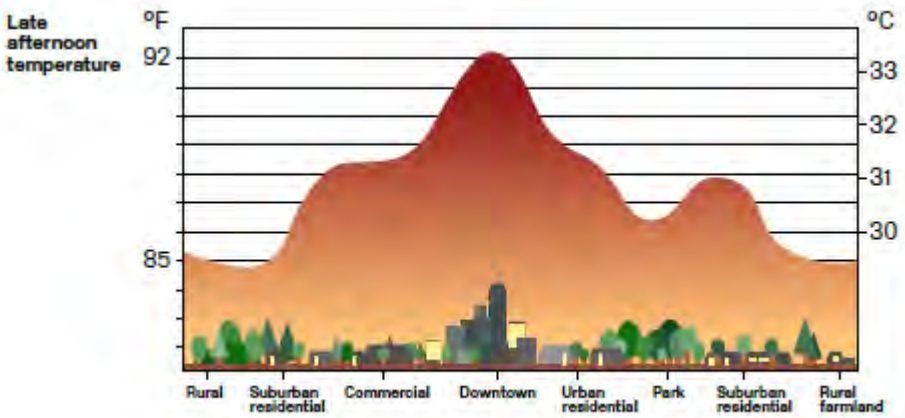
WSUD Retrofitting- Urban cooling





Urban Heat Island effect

https://watersensitivecities.org.au/wp-content/uploads/2020/04/200427_V13_CRC-DesigningForACoolCity.pdf

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Benefits of passively irrigated systems

The combination of vegetation and water in the city landscape using passive irrigation provides many benefits. These benefits are shown in Figure 8.

Figure 8 — Benefits of passively irrigated systems in the city landscape

Trees with adeqate soil volume and soil moisture have:

- 13 to 50 years increased lifespan[3]
- Doubled growth rate[2], canopy can be 8–10 times larger
- reduced cost from pavement uplift and root intrusion[7]
- remove 60 to 70 times more air pollution[15]

Large trees result in:

- up to 20°C reduction in surface temperatures[4]
- lower odds of heart disease, hypertension and diabetes[12]
- 5–15% increase in property values[6]
- economic value of up to $207,000[10]

Increased urban greening results in:

- lower odds of diabetes[13]
- reduced stormwater and pollutants entering waterways
- reduced surface temperature and air temperatures[5]
- 1 hectare of trees can provide 19 people's oxygen consumption per year[11]
- Increased green space, vegetation and water in greenfield developments can result in $142 million worth of health benefits[14]

Street trees can:

- save 95 kWh in energy per tree per year[8]
- increase local business income by 20%[9]

1. Grey et al. 2018
2. Hitchmough 1994
3. Skiera & Moll 1992
4. CRCWSC 2019
5. Coutts et al. 2016; Klok et al. 2012
6. Pandit et al. 2013
7. Boer & Browne 2017; E2Designlab
8. McPherson 2005
9. Burden 2006
10. City of Melbourne; The valuation in the City of Melbourne
11. Nowak et al. 2007
12. Astell-Burt & Feng 2019 (Odds of incident heart disease (odds ratio 0·78), hypertension (0·83) and diabetes (0·69) were lower among people with ≥ 30% tree canopy, compared to 0–9% tree canopy).
13. Astell-Burt & Feng 2019 (Total green space ≥30% compared to 0–4% was associated with lower odds of prevalent diabetes (0·72).
14. Frontier Economics 2019
15. McPherson et al, 1994

https://watersensitivecities.org.au/wp-content/uploads/2020/04/200427_V13_CRC-DesigningForACoolCity.pdf

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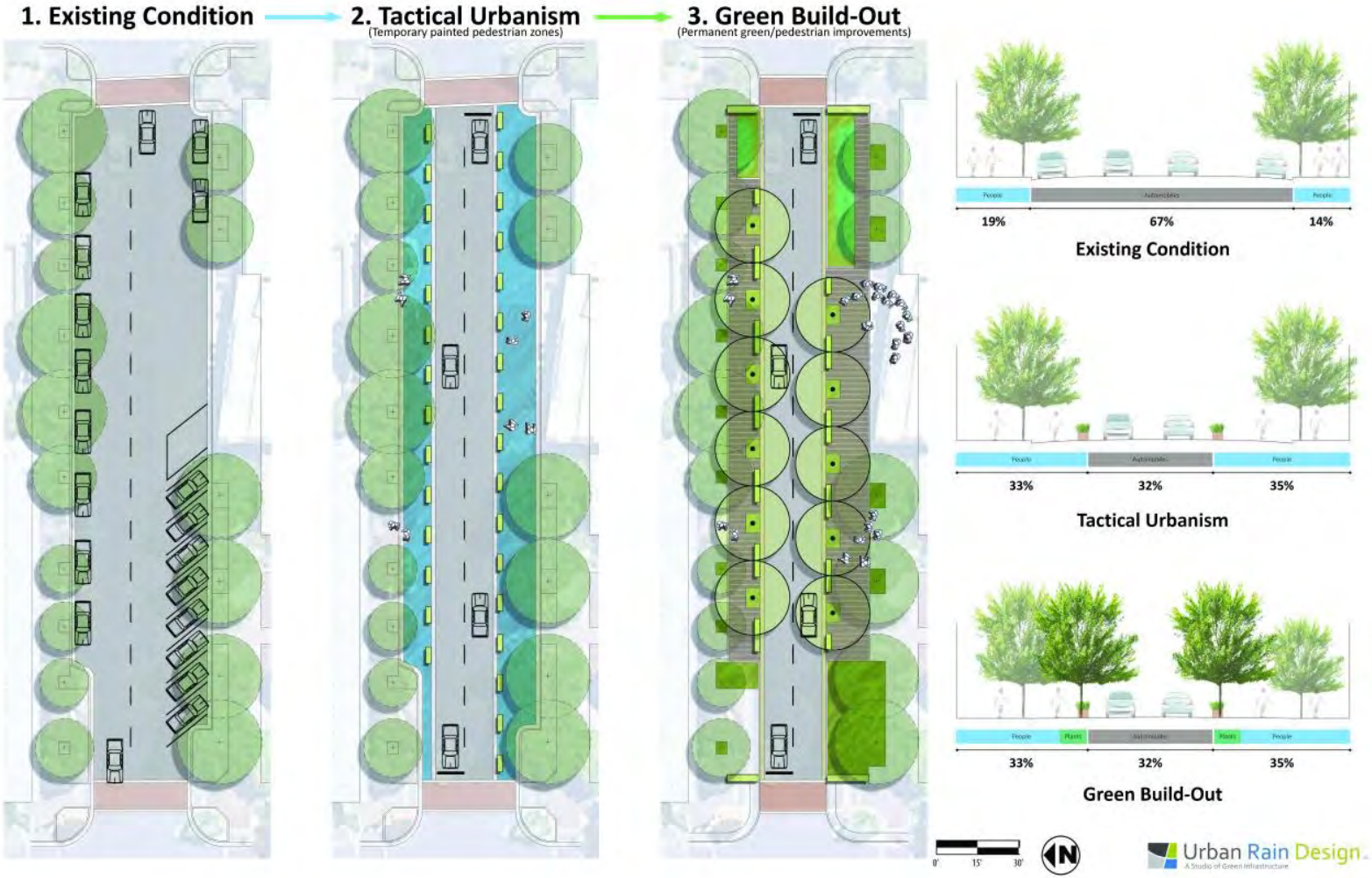
WSUD Retrofitting – Urban Greening



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Sump Retrofit – Bortolo Reserve, City of Mandurah

- Sump intersected the groundwater all year
- Issues with algal blooms and mosquitoes
- High boundary fence, permanent water and unsuitable bank grades also provided a drowning risk
- City of Mandurah annual sump retrofit program = $150,000/yr
- Sump Maintenance
  - fence repairs = $60,000/yr
  - general maintenance = $80,000/yr
- Retrofit program devised using money that would have normally been spent on sump maintenance
- Stored 1 year event underground
- 10+ year event above ground

Sump Retrofit – Bortolo Reserve, City of Mandurah

- Stormtech storage modules used
- Underground storage - 1 year ARI events
- Landscape swale - 10 year ARI events
- Larger events over-top into reserve- always check 1:100 is adequate
- Total cost of project = $100,000
- Sump maintenance costs are now park maintenance costs

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Sump Retrofit – Bortolo Reserve, City of Mandurah

BEFORE

AFTER

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Sump Retrofit – Bortolo Reserve, City of Mandurah

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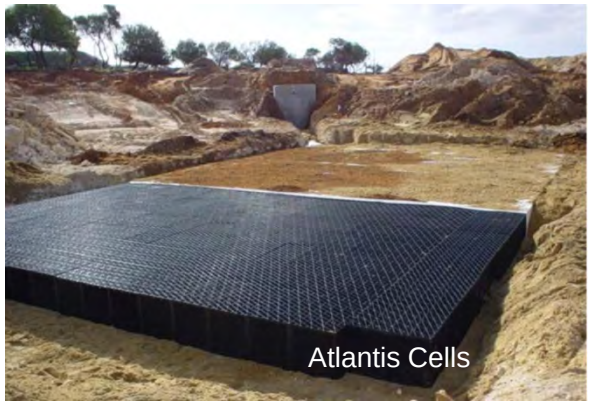
Sump Retrofits – variety of products available



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Baldivis shopping centre failure- Things can go wrong

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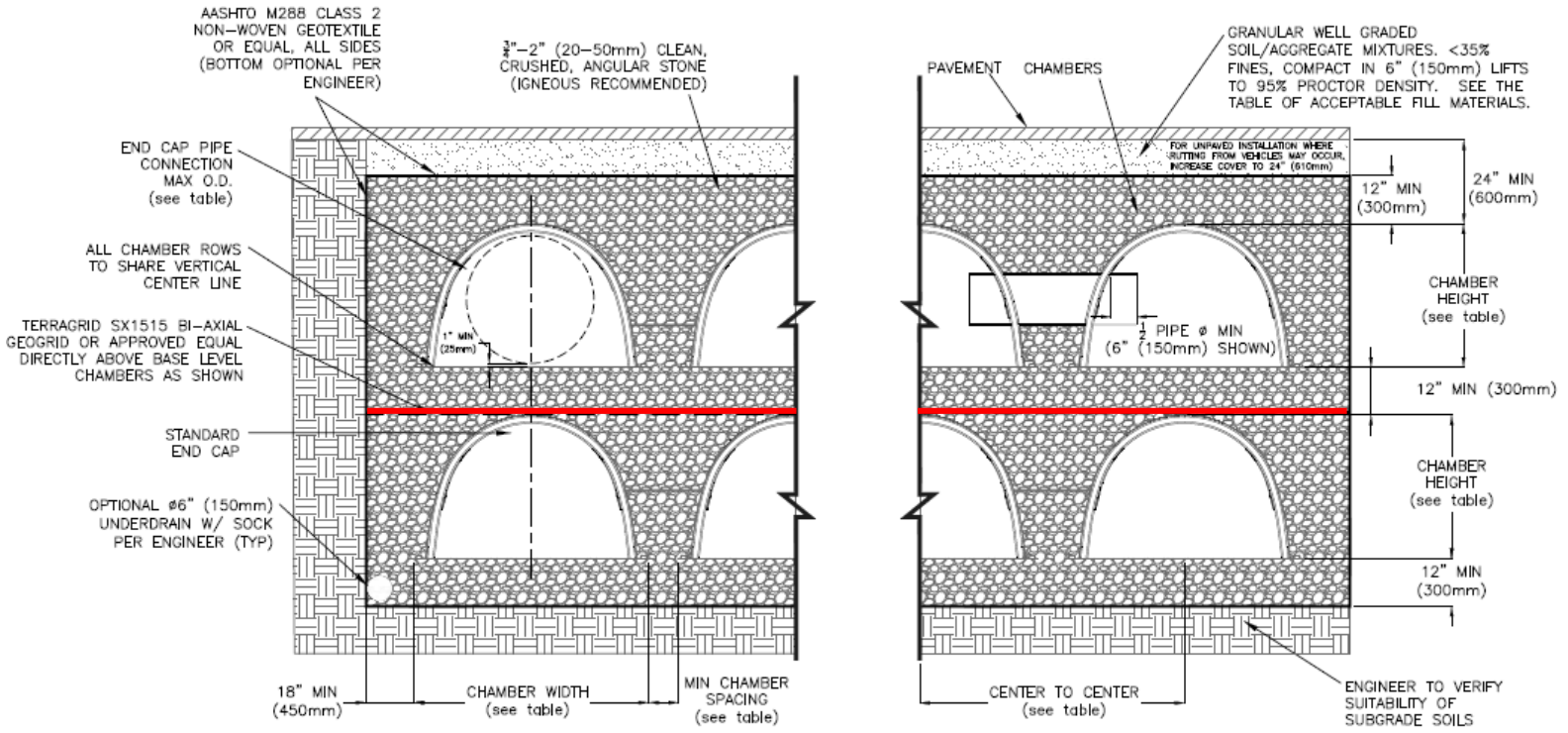
Baldivis shopping centre failure- Things can go wrong

Baldivis shopping centre failure- Things can go wrong

Original installation using stacked systems

Baldivis shopping centre failure- Things can go wrong



Is suspected incorrect separation layer but no formal reports released on the failure

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Baldivis shopping centre failure

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Baldivis shopping centre failure

Baldivis Now
18 hrs ·

Soakwells or a new underground affordable accommodation?

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Stephen Street upgrade, Bunbury

- Bioretention gardens incorporated in streetscape upgrade to improve water quality in Leschenault Inlet

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Stephen Street upgrade, Bunbury

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Stephen Street upgrade, Bunbury

Gardens initially filled to surface

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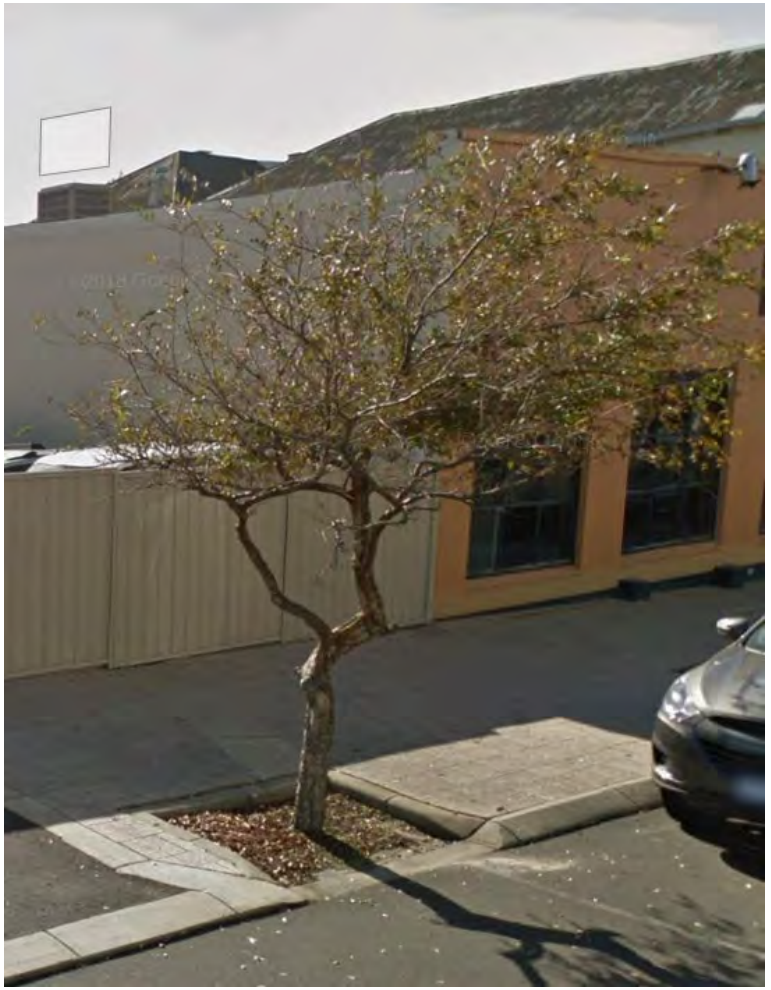
Stephen Street upgrade, Bunbury

Later settled to create space for bioretention storage

Elliot Street upgrade, Bunbury

Overfilled and have not settled



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Elliot Street upgrade, Bunbury

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Queen Street upgrade, Busselton

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Queen Street upgrade, Busselton

Retained native trees and used natural species

Queen Street upgrade, Busselton

Healthy growth is indicator of system performing well

Queen Street upgrade, Busselton

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Strelly Street- Busselton

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Town of Kwinana
Parkfield Lake, Bertram

- Problem: high nutrient load in groundwater to lake and elevated groundwater levels
- Solution: remove contact of lake with groundwater system, add bioretention treatment for surface flows
- Required extensive community consultations and numerous options

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Parkfield Lake, Bertram

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Parkfield Lake, Bertram

Issues

- Fauna Habitat
- Fire fighting resource
- Adjoining property values
- Poor water quality
- Fauna and human health issues
- Poor quality groundwater fast tracked to Peel Main Drain
- Park walkway inundated
- Algae management expensive
- Groundwater difficult to treat effectively.
- Stormwater & direct runoff contaminated.
- Limited usage options within park
- Road duplication.
- New drainage requirements

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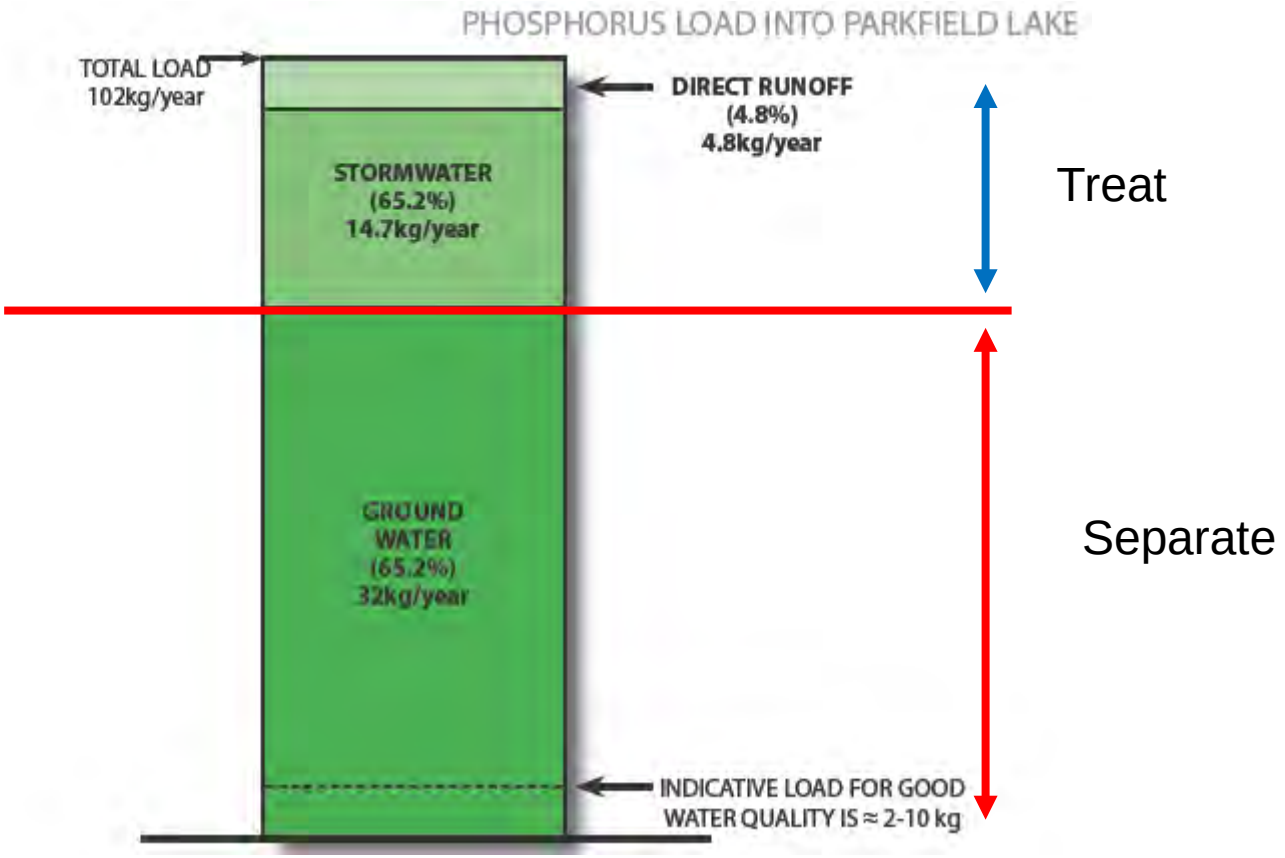

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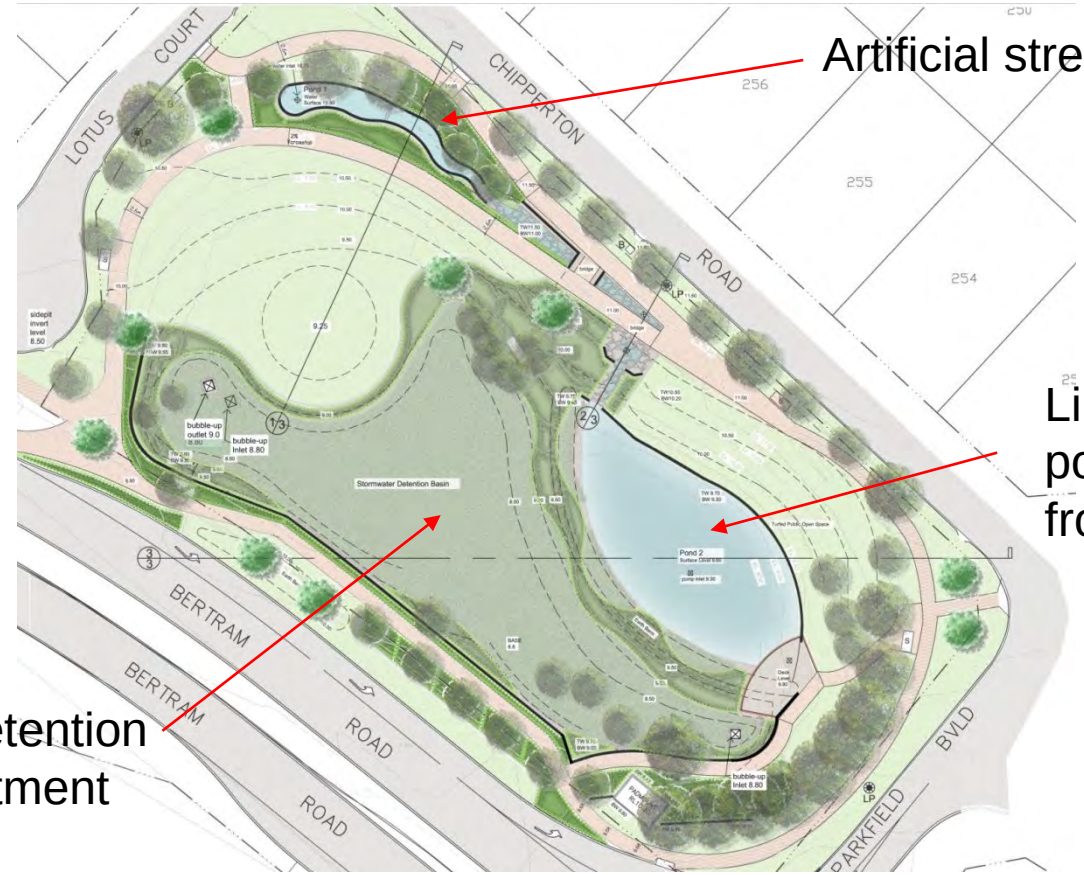
Parkfield Lake, Bertram

Design Criteria

- Visually appealing- Public acceptance
- Improvement in water quality (fauna and human heath issues)
- Usable space within park.
- Able to store stormwater for all events up to 1:10 ARI (to meet new drainage requirements)
- Remove maintenance issues
- Remove health and safety issues

Retain water body and connection to water for residents

Parkfield Lake, Bertram



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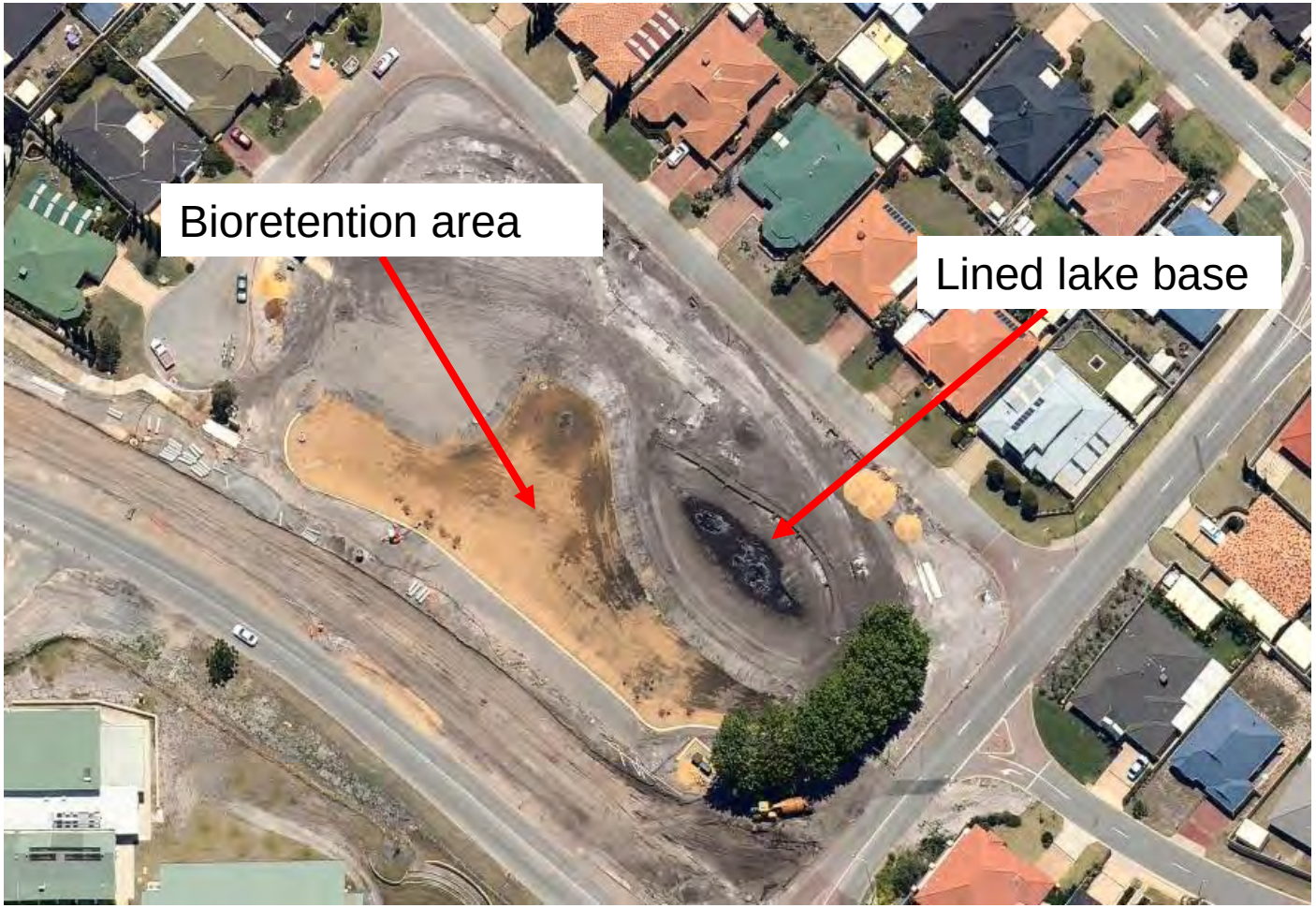

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Parkfield Lake, Bertram +3 yrs

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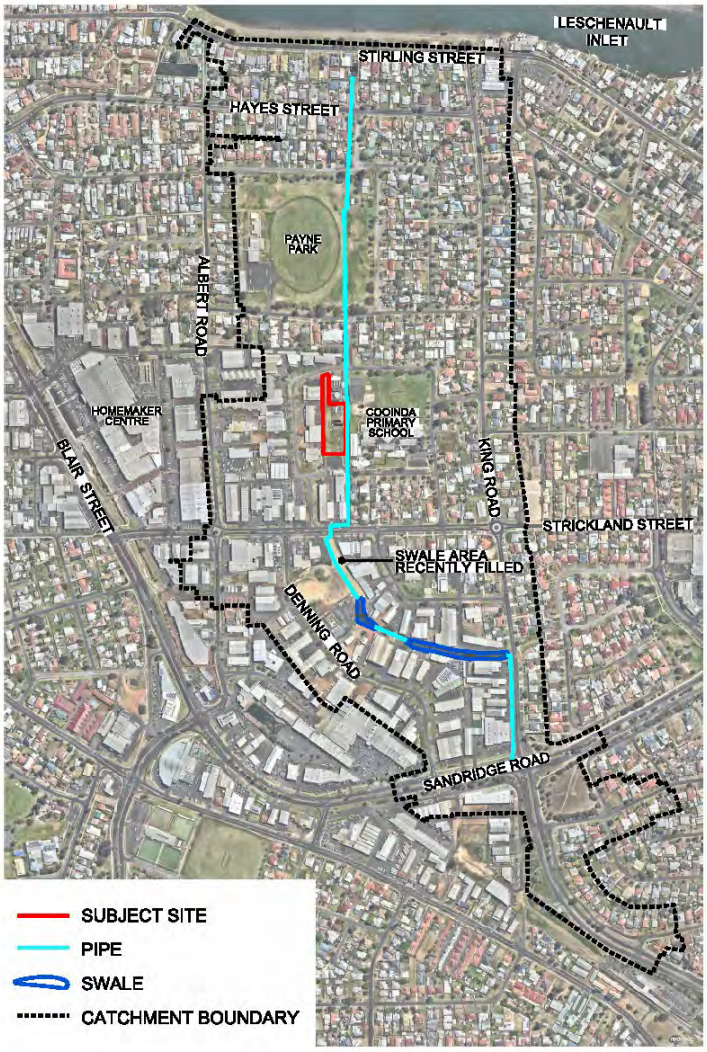
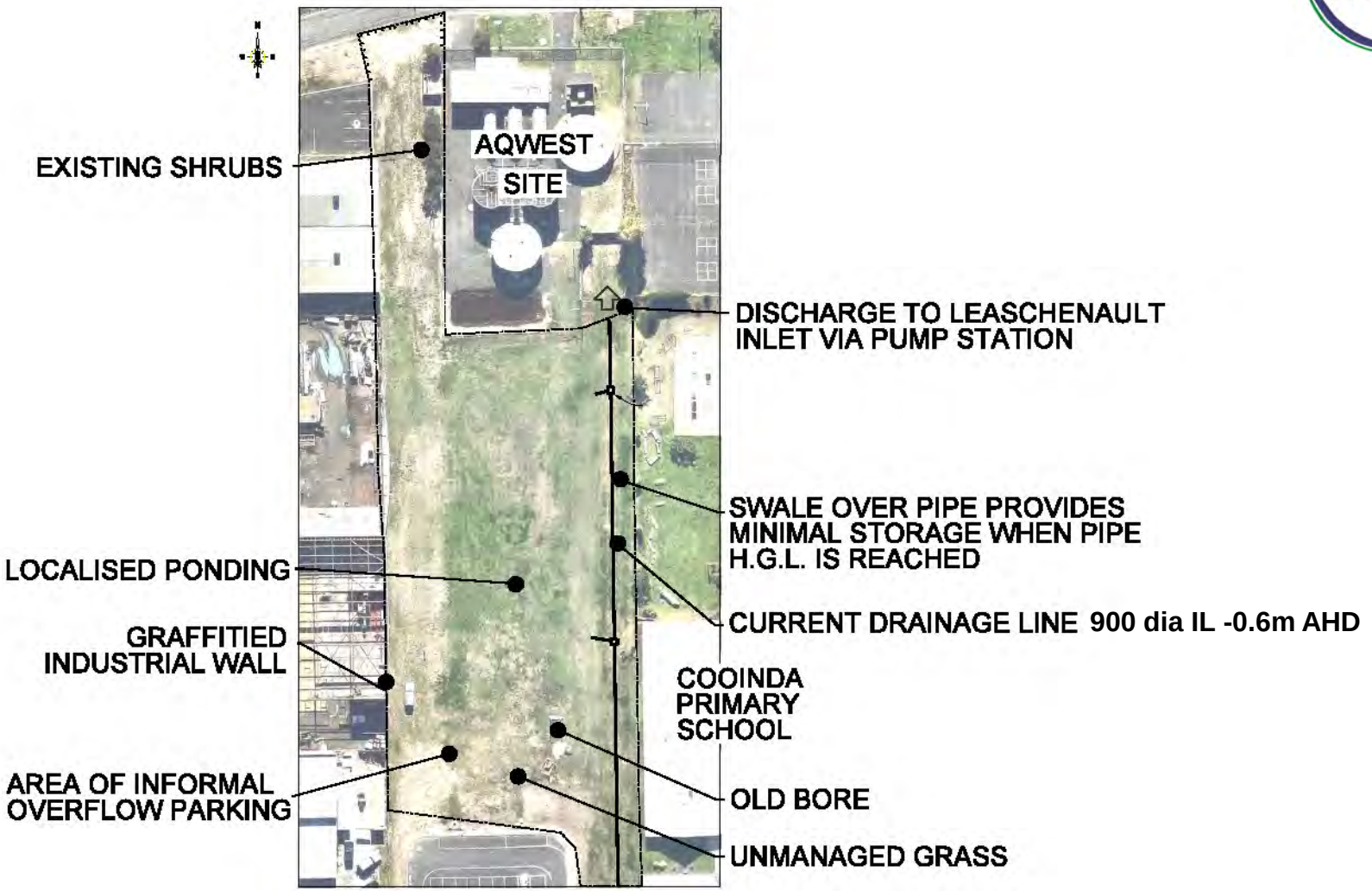
Brockman Park Bunbury

- Adjacent to Cooinda Primary school
- Within Creek Street Catchment
- Piped main drainage network that is below sea level and then discharges via Pumpstation into adjacent Leschenault Inlet
- Upstream there was a large swale for conveyance that was filled for commercial development and City of Bunbury wanted to replace storage capacity within Brockman Park



Brockman Park – Original site



Brockman Park Bunbury- before

Brockman Park Bunbury

Design requirements

- Need 1500m^3 of storage – based on modelling by City . Replaces storage taken by upstream filling of swale for development.
- Water Quality improvement
- Be accessible to the public and enhance the current site
- Provide educational opportunities for adjoining Cooinda Primary School.

Oversby Consulting

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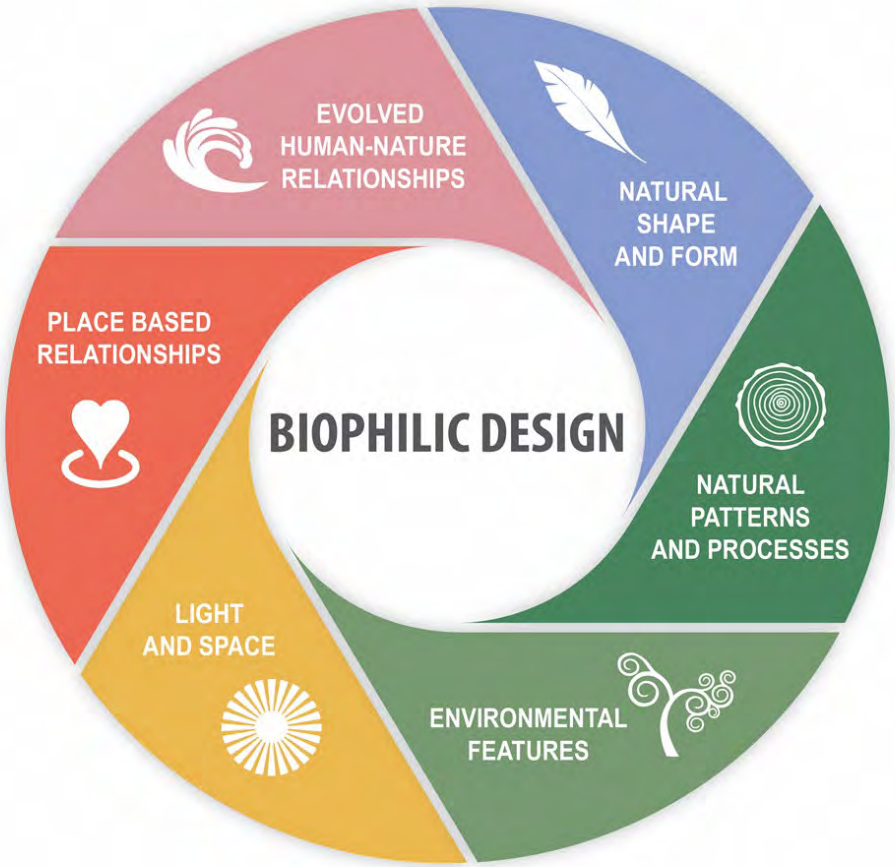
Brockman Park Bunbury



Design Outcomes

- Provides slightly in excess of required 1500m^3 storage.
- Location of storage in catchment provides better catchment flood management
- Wetland base with extended flow paths and depths provides ability for water quality treatment

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Brockman Park Bunbury

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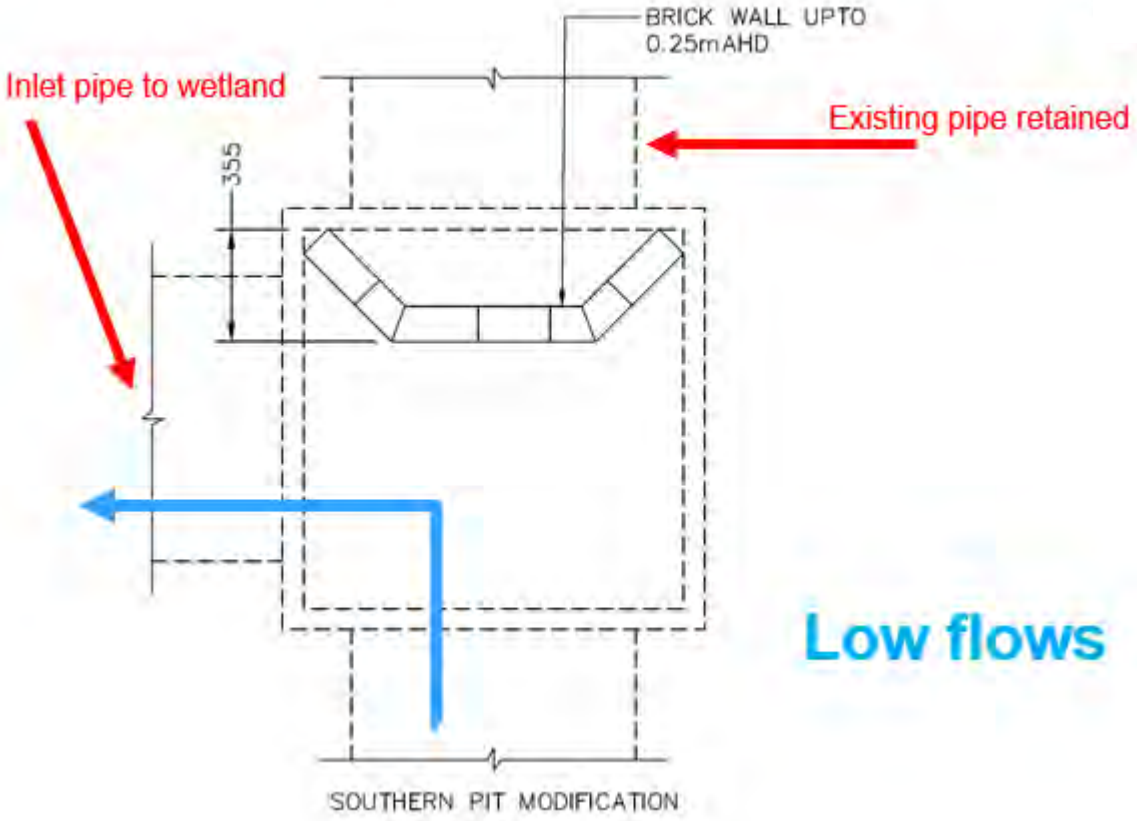

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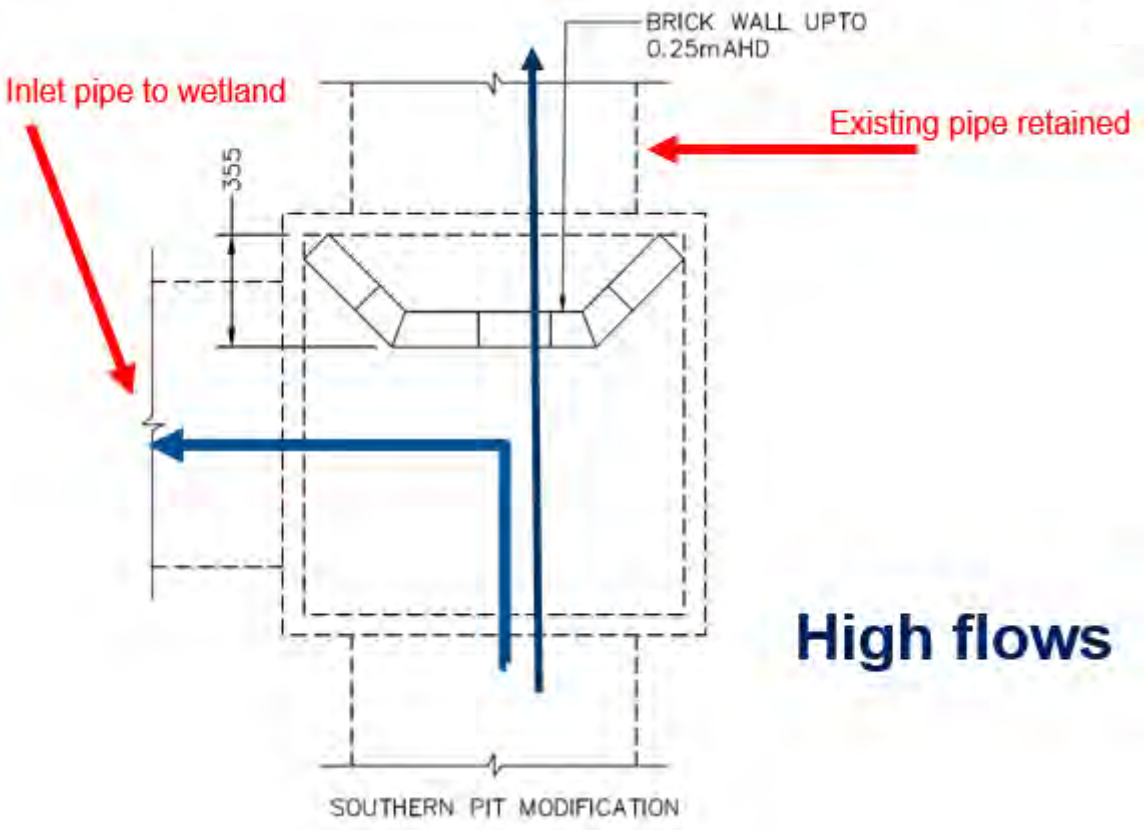

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Brockman Park Planting Plan

- Each zoned planted with appropriate species
- Locally native species used within basin and are also the predominate species in the surrounding park
- Clear areas remain to facilitate access and clear sightlines along school fence
- Shade trees throughout the park
- 2 grass interaction zones, one near school for student access and one near carpark
- Pathway link through western edge

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Brockman Park Bunbury

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Other Design Outcomes

- Step down areas to provide safe points for interaction
- Mounds incorporated to minimise off site disposal
- Educational opportunities for adjoining Cooinda Primary School.
- Wall mural.
- Attractive park for public

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Brockman Park Bunbury

BUDGET

- Total budget approximately $250K
- Funds sourced from:
  - Regional Estuaries Initiative (DWER) - $120K
  - Water Corporation - $40K
  - City of Bunbury - $165K

Brockman Park Bunbury

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Brockman Park Bunbury

Darling Street, Melbourne

- Stormwater Harvesting Project in City of Melbourne
- Design and Construct Project by Australian Ecosystems and Biofilta
- Innovative System used in trial

Darling Street, Melbourne

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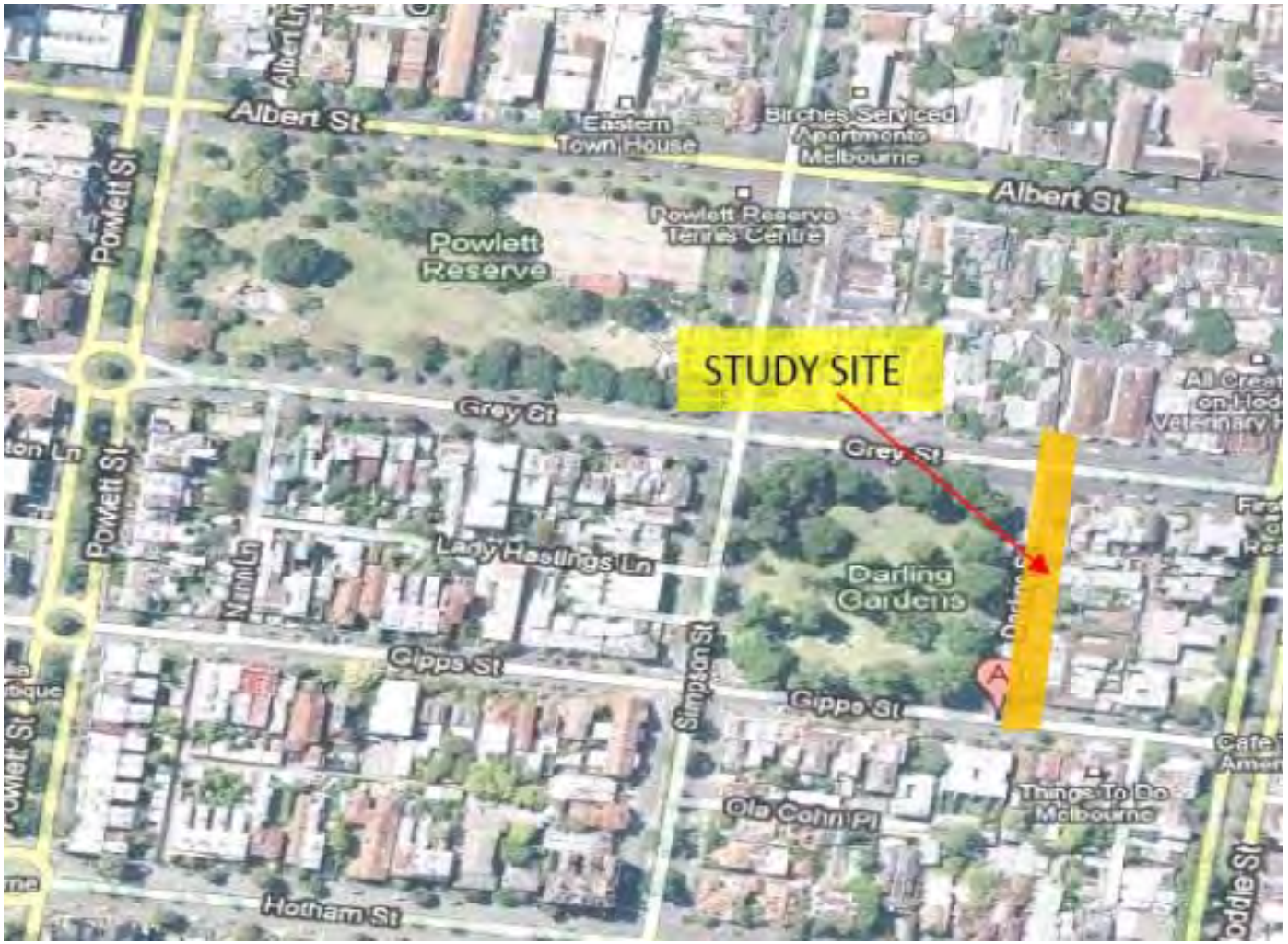

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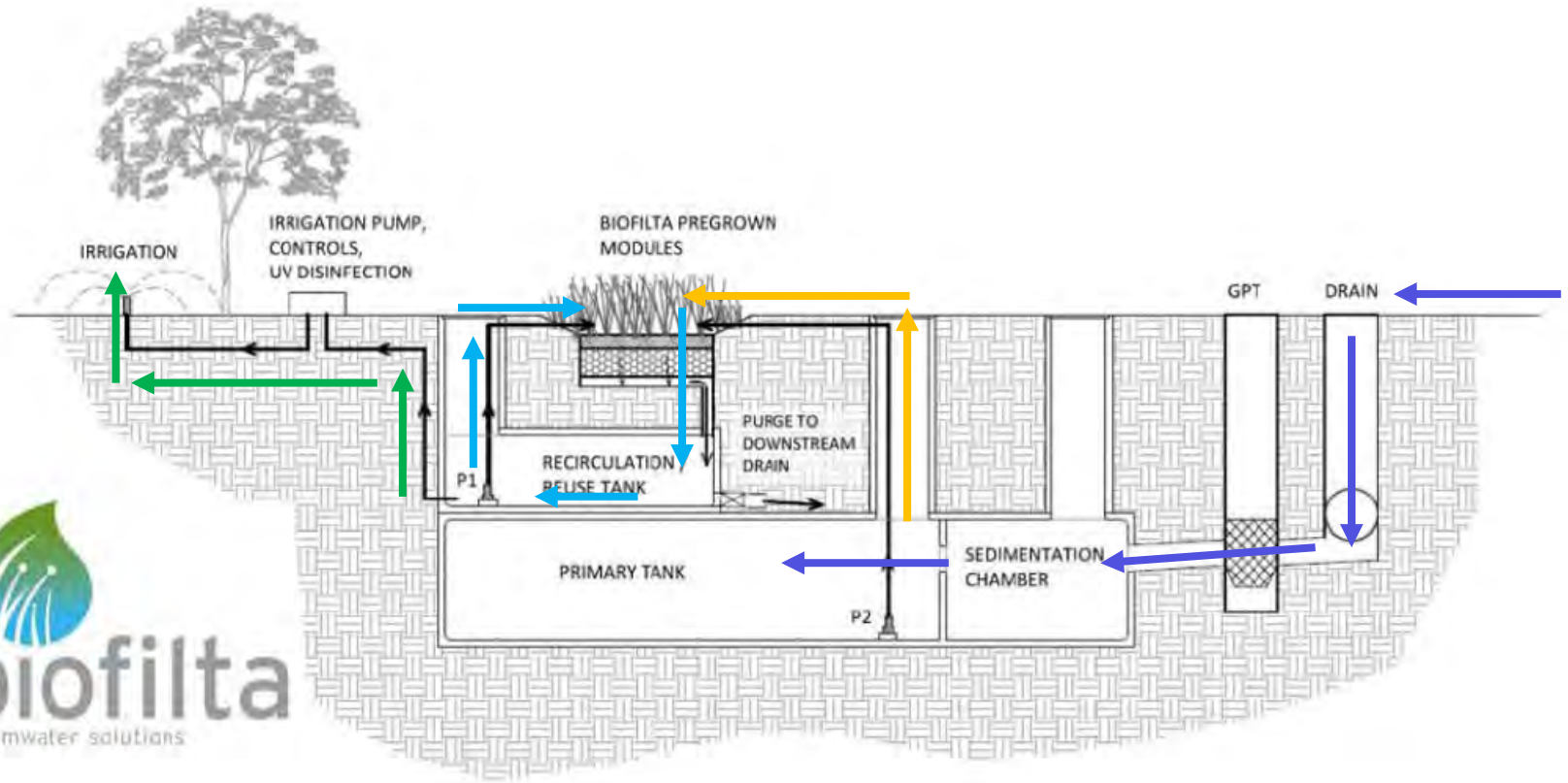

BIOFILTA STORMWATER (PATENT PENDING) HARVESTING SYSTEM SCHEMATIC
N.T.S.

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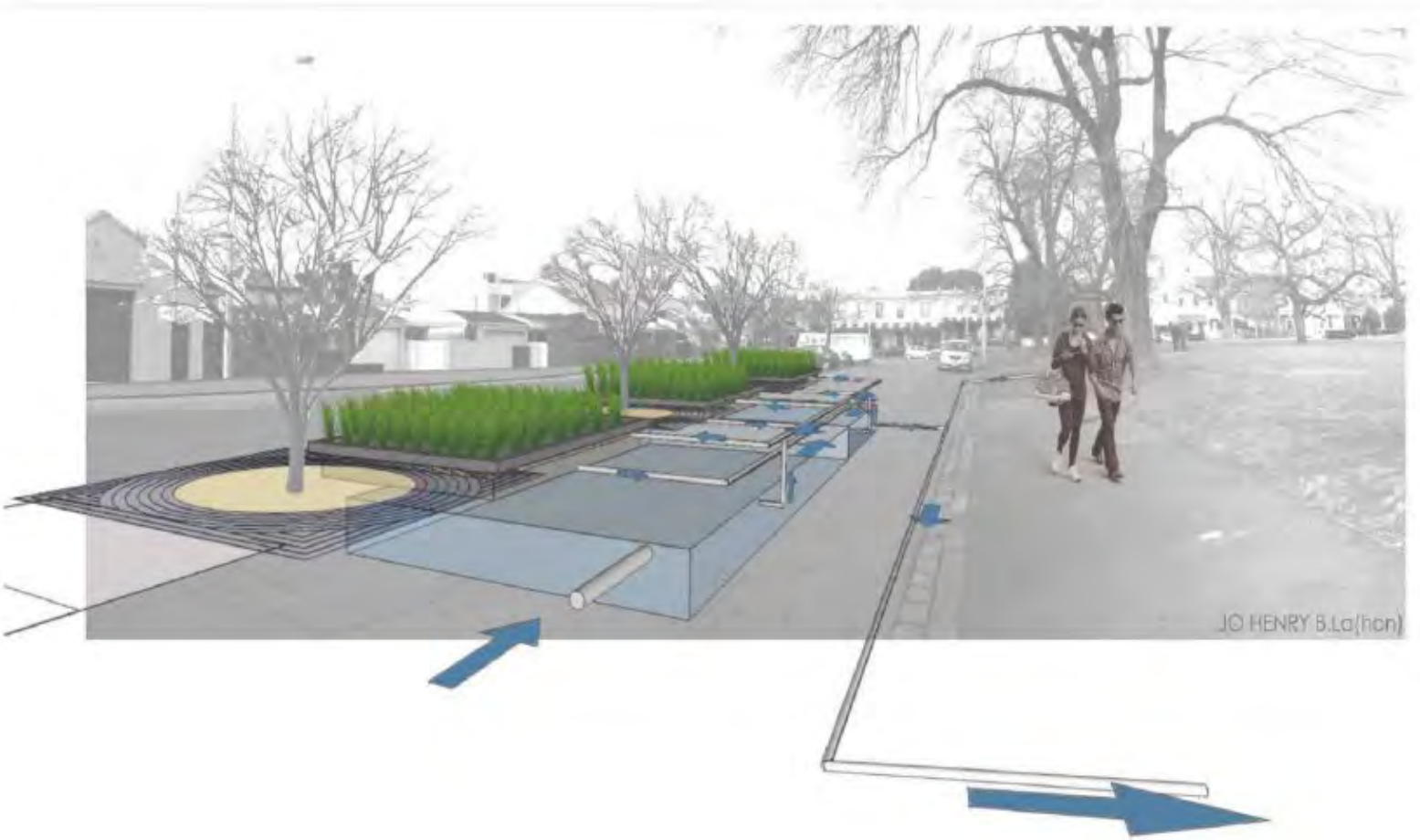

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Darling Street, Melbourne

Before

During

After

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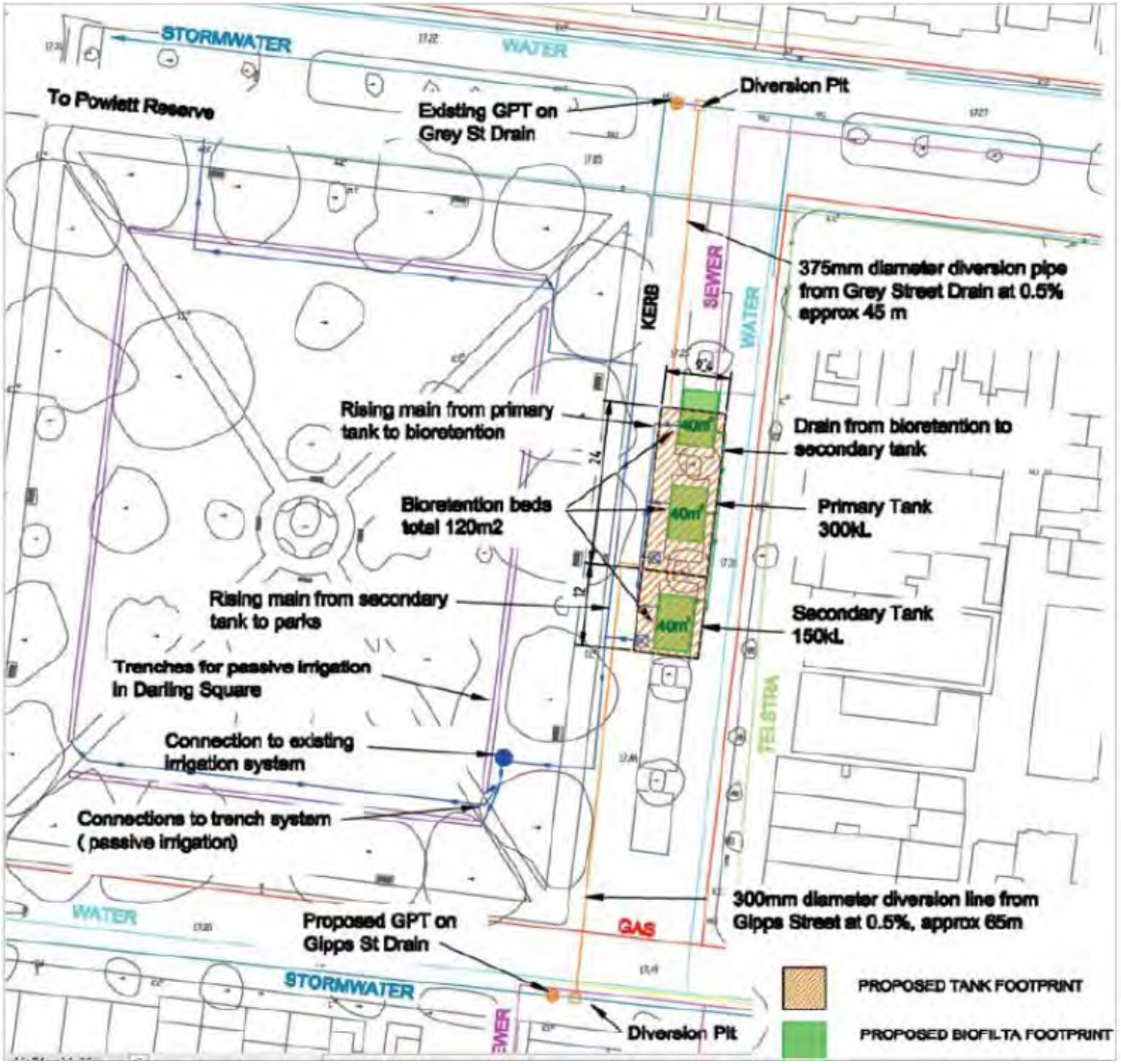
Darling Street, Melbourne



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Darling Street, Melbourne

- Reuse on adjacent reserves and treated medians
- 21.3 ML/yr reuse at $1.93/kL
- Potable currently $2.01/kL and rising to $2.50/kL in 2012
- Total system cost approx $1m

Mexico City Vertical Gardens

Mexico City Vertical Gardens

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Bosco Verticale - Milan

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Bosco Verticale - Milan

Bosco Verticale - Milan

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Department of Water
WATER CORPORATION
WALGA
SWAN RIVER TRUST
EDGELOE Engineering

Multiple solutions possible

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Just be creative and use imagination

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Innovate and learn from others

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Consider safety and amenity

Consider the various scales that WSUD can be applied to

EDGELOE
Engineering

Thank you for your time
Questions?

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