# USING BIOPHILIC DESIGN TO INTEGRATE WATER SENSITIVE DESIGN WITH LAND DEVELOPMENT

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**ABSTRACT**

The concept of biophilic design is to integrate specific elements of nature within the urban form. These elements are linked to the evolutionary preferences that humans have for key aspects of nature, such as connection to water, healthy vegetation and open spaces. As stormwater management moves towards achieving better water sensitive outcomes, it also generates opportunities to further enhance other aspects of our future urban spaces. Biophilic design can help inform how stormwater is managed in an integrated manner, and how it can be visually presented to develop attractive urban spaces within residential and commercial areas. In doing so, we can achieve significant outcomes across the sustainability pillars of economics, social outcomes and environmental benefits.

This paper focuses on how we achieve good design outcomes within our urban forms by using biophilic design principles to integrate WSD within the overall land development and urban design processes. It looks at how the elements can be integrated with the current engineering and planning requirements of urban developments. It also focuses on how the local climate and cultural preferences need to be carefully considered as part of the process. Two examples from Western Australia will be presented that show biophilic design adding value to strata developments, streetscapes, commercial areas, community facilities and public spaces.

Significant research has been undertaken showing improved outcomes for residents and the overall community through the integration of biophilic design within urban spaces. The local characteristics and regulatory processes, along with cultural preferences, also need to be considered for biophilic design to be workable.

**KEYWORDS**

**Stormwater Management, Water Sensitive Design, Biophilic Design, Bioretention, Wetlands**

**PRESENTER PROFILE**

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Brendan has over 15 years of experience in the development industry with a focus on water and environmental management. He has extensive experience in designing tailored WSUD solutions for residential, industrial and commercial developments.

He has complemented this work by leading project teams working with State Government, Local Government and Natural Resource Management groups to develop design solutions and WSUD policy. Furthermore, he has produced Water Management Plans for a range of developments across Western Australia.

Brendan Oversby was also the lead author for the Vegetation Guidelines for Stormwater Biofilters in the South-west of Western Australia, produced the figures for the Department of Water and Environmental Regulation's latest Decision process for Stormwater Management WA, as well as writing a number of guidelines and a book on riparian revegetation.

# 1 INTRODUCTION

As New Zealand's population continues to grow, and the state of our freshwater resources (and wider environment) becomes a topic of intense public and political debate, the pressures on water industry professionals to deliver water sensitive urban spaces have become higher than ever before. Auckland Council's Guideline Document for Water Sensitive Design (WSD) of Stormwater (GD04) recognises the significant crossover between WSD and urban design, and encourages the fostering of inter-disciplinary, integrated design processes in urban design.

The following two case studies are used to show how the Biophilic Design has been used in Western Australia to achieve outcomes for both water management and the wider sustainability aspects we're seeking in New Zealand. These outcomes relate to the social elements framed within human needs and the well improved functionality of the local environment.

A stylized view of this can be seen in Figure 1

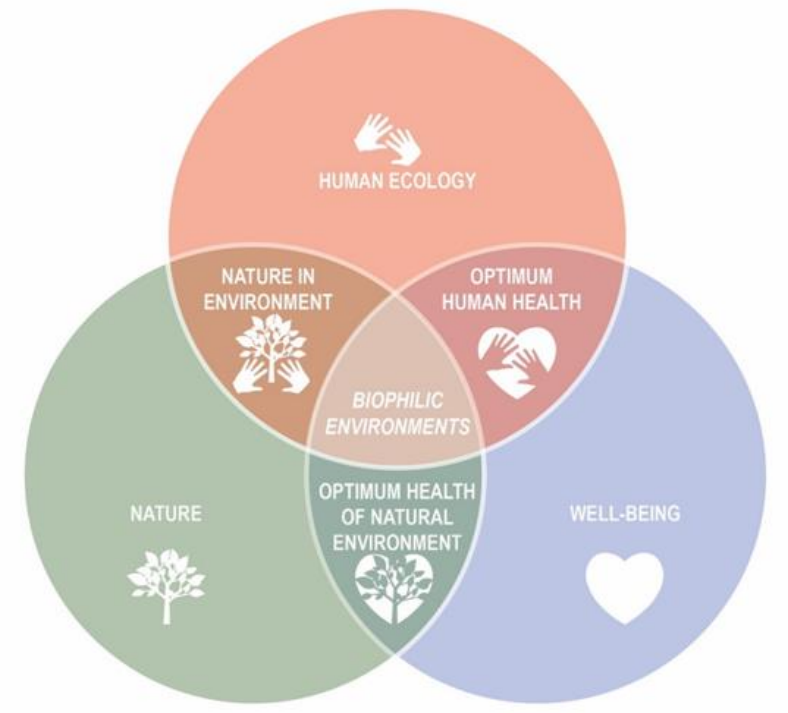


*Figure 1. Interrelationship of Biophilic Design*

# 2 CASE STUDY - CAPE RISE WATER MANAGEMENT AND LANDSCAPING

This first case study aims to show how water management and landscaping can utilise biophilic design to achieve an improved outcome for the environment and community. The project is located in an area where developers are encouraged by regulatory authorities and their processes to focus their efforts to incorporate key elements of nature into their urban spaces.

Developing a residential estate upstream of the town of Dunsborough, Western Australia, presented the opportunity to reduce existing flood risks to the existing township. Through detailed water modelling a series of large basins, stacked along the valley, was determined as a suitable engineering solution. These basins were sized to accommodate exiting deficiencies in the capacity of the downstream networks, up to and including the 1%AEP event. The effect of the basins allows a 1%AEP flow rate to be attenuated to that of a 20%AEP, to meet the capacity of the downstream infrastructure.


*Figure 2 - Original engineering concept to manage flooding*

The issue however, was that this series of 'dams' was both unsightly in terms of its position with a residential development, and offered little ecological value.

Alternative options were therefore investigated to see if this engineered solution could be enhanced using biophilic principles, turning the flood protection requirement into a wider communal, and ecological asset for the development. The following is a few of the aspects considered.

## 2.1 VISUAL CONNECTION TO WATER AND LOCAL SENSE OF PLACE

As water is central to the human psyche, it was deemed logical to encourage the public to interact with the water, including visually, audibly and physically. The basins, roads and footpath networks were designed so that water can be seen and heard at multiple points.

Furthermore, achieving an outcome of an ecologically functioning landscape that also matched human preferences was seen as critical. To achieve this, maintaining sight lines over much of the space, with particular points of interest was developed. This included using locally native plants to produce a low cover of plants under feature native trees. This was complemented with areas away from main paths and houses, set aside for dense shrub planting, providing interests and critical variation in the landscape. The placement of the plants was also designed to allow for water quality treatment and fauna habitat, while creating an interesting landscape that can be viewed from both the main road into the development, and resident houses/local streets. This offered residents with regular interactions with nature, as they go about their daily lives.

This connection was also taken further through a pathway network that offered easy walking and cycling options around the landscaped areas. The pathway was designed to include nodes that invited people to explore the spaces further. These pathways lead to look out points, as well as places people can actually leave the path and interact directly with water.

## 2.2 FIRE RESPONSE

Given the high bushfire risk generally associated with developments in Western Australia, all works needed to consider and address associated risks. Low fire risk zones were developed, which included low native groundcovers interspersed with landscaped stone mulches. These have been designed with organic curves to reflect natural systems and also include feature rocks from locally available material, providing a local sense of place and structure.

Careful placement of these mulch areas provided for informal pathways directly from residents houses to the formal path network. This area of stone mulch and low plants also allowed for view lines to be maintained for residents, providing passive surveillance to minimise risks of crime, while also providing people with a visual link to nature.

## 2.3 WATER QUALITY IMPROVEMENT

A combination of bioretention systems, as well as overflow wetlands were used to provide water quality improvements. The wetlands included a small low flow channel to allow for the upstream catchment water to move through without significant ponding and associated mosquito management risks. This upstream water is relatively clean in nature as the upper catchment along the stream is heavily vegetated around the banks, and the current low intensive farming practices do not contribute high levels of nutrients. For this reason the current low ecological flows are allowed to drain through a vegetated low flow channel. This low flow channel also provides a flowing water feature throughout a majority of the year. Sight lines along this low flow channel are maintained at key viewing points, so that the residents can be connected to flowing water on a daily basis. During larger events, the water spills into the surrounding wetlands for treatment and detention.

Stormwater of the developed areas firstly enters the bioretention systems where it receives treatment for most annual storm events (approximately a 63%AEP event). The infiltrated water and runoff during larger storm events overflow into the wetland chain, for further retention and treatment.

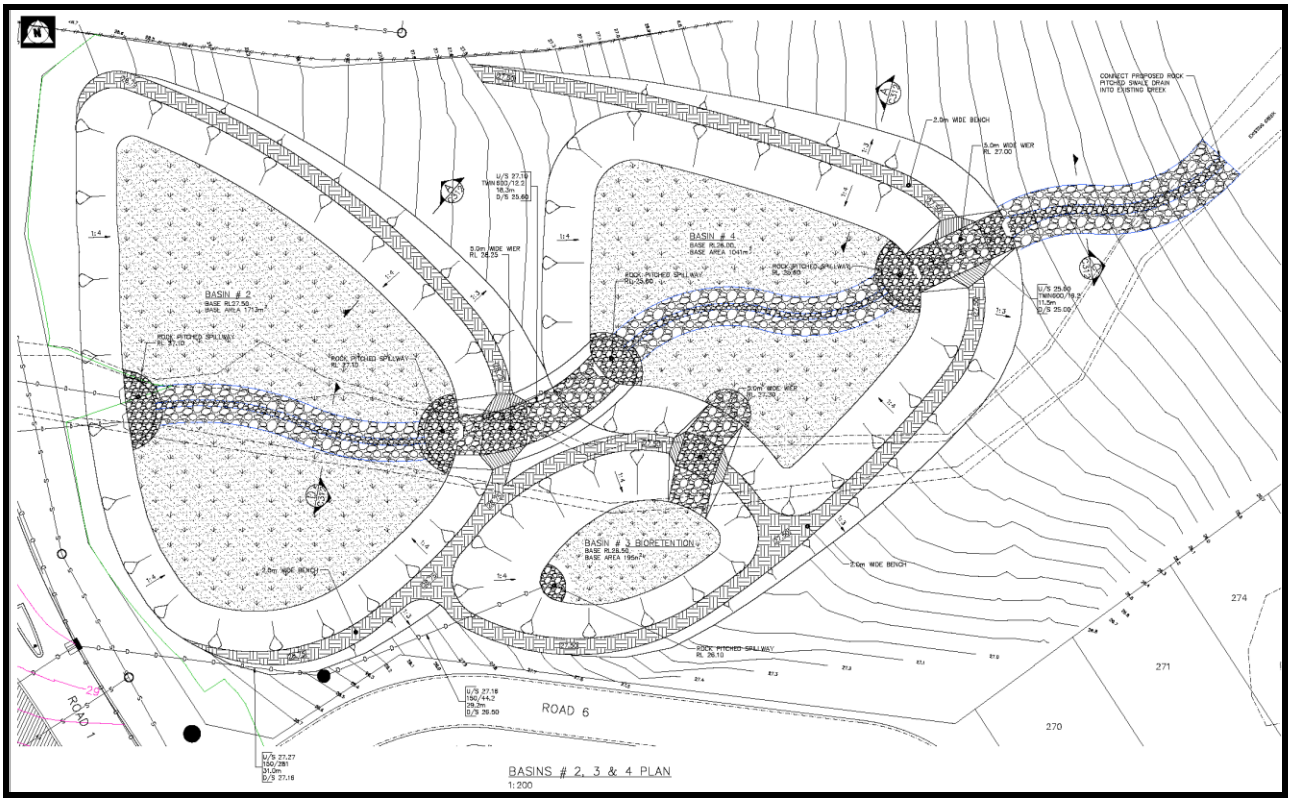


*Figure 3 - Detailed engineering drawings starting to incorporate Biophilic design*

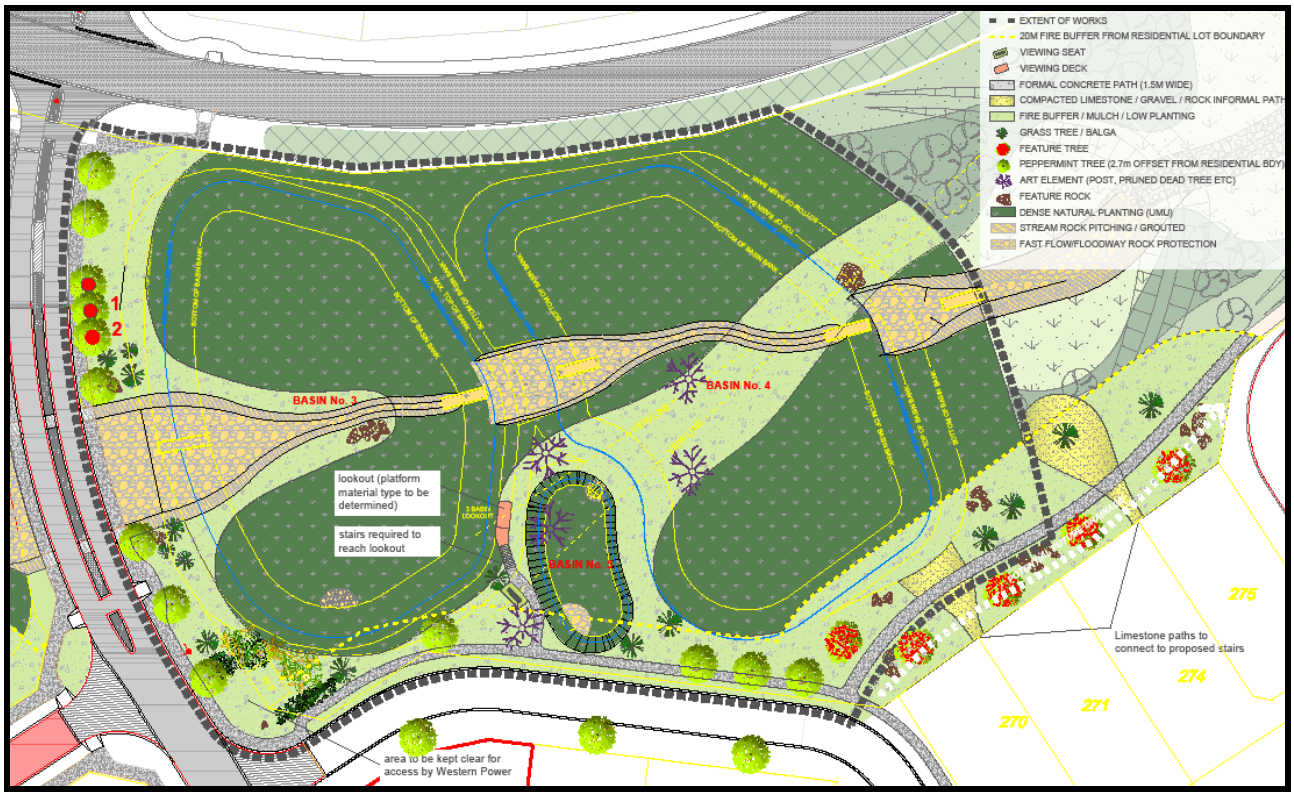


*Figure 4 - Landscaping concept highlighting bioretention systems and wetland creation with basic basin footprint*

*Figure 5 - View of basins as seen from entry road, showing low flow channel through wetland*

*Figure 6 - Visualisation of path network along top of wetlands.*

# 3 CASE STUDY - WILLETON STRATA DEVELOPMENT- INCORPORATION OF DESIGN IN NARROW STREETS

This second case study focuses on high density development. Traditional Western Australian densely built environments are by their very nature removed from the natural systems in which we evolved. They therefore represent a real opportunity for tailored biophilic design to enhance the lifestyle of residents.

A traditional strata development in Perth, Western Australia was reviewed using biophilic design. The idea was to determine how the development could be improved, to produce a

product valued by consumers at the point of sale, and to provide residents with a long-term improved lifestyle. The development as originally designed to consist of 12m wide roads, continual 2 storey dwellings, 8m frontage lots, of which 6m was taken up by garages. How this would look using traditional detailing can be seen in Figure 7.


*Figure 7 - Strata development as originally designed*

Without changing the lot size or road layouts, a review was undertaken to enhance the development using biophilic design. The aspects outlined below were considered and included to ultimately achieve the design outcome seen in Figure 8.


*Figure 8 - Strata development after Biophilic design elements incorporated*

## 3.1 TRAFFIC CALMING

The original straight roads created a situation for fast moving traffic, with its associated risks to pedestrians and backing cars. Rather than traditional traffic calming options such as speed humps and narrowing bollards, small sections of the road pavement were curved, within the straight road reserve. At the entrance point to the curve low boulders were used to create a visual cue to slow down. This was then complemented with low vegetation and trees. With the combination of the wider verges at each point of the curve and the planted trees, the long straight roads were broken visually, meaning that views down the street was one of vegetation rather than continual asphalt. Organic art pieces can also be used to further enhance the traffic calming areas. A concept of this can be seen in Figure 8. These areas also provided space for stormwater treatment.

## 3.2 STORMWATER MANAGEMENT

The development site was constrained from a stormwater point of view due to limited capacity within the downstream infrastructure. The original concept was underground storage within the road reserve. To reduce the amount of expensive underground storage, and improve water quality outcomes and aesthetics, micro bioretention gardens were designed. Trees within the bioretention gardens provided shade and structure, while the low sedges and rushes provided aesthetics and water quality improvements. Driving sight lines were retained above the low plants and below the tree canopy, for safety and to allow for long vistas.

The bioretention gardens were carefully positioned to allow easy access of cars into garages. The vegetation was also placed outside the front door and associated glass paneling. This allowed for a green vista from within the house, while also providing a sense of privacy. The bioretention gardens also allowed residents to be connected to the water cycle and gain an appreciation of the need to manage water. Furthermore, a portion of the vegetation's irrigation requirements were satisfied by stormwater, greatly reducing the need for external sources of irrigation water.

## 3.3 COOLING

In the original design, the majority of the development was hard surfaces, including building rooves, footpaths and road paving. By incorporating biophilic design, the urban heat island effect was significantly reduced. The trees also provided significant visual appeal. The shaded streets are also more inviting for pedestrians and cyclists, helping to encourage outdoor movement during warmer weather.

## 3.4 NOISE ATTENUATION

The development included a noise wall along its southern boundary. Alongside the wall was an internal perimeter road and overflow parking. This wall was seen as an opportunity to provide visual interest for residents. This consisted of vine/climbing plants along much of the wall. A narrow garden was used to support these climbers, with low ground covers also included. The use of vines/climbers was seen as an effective way to achieve a green wall in Western Australia's dry climate. Traditional green walls, with the plants actually growing on the wall tend to struggle over dry hot periods. Having plants rooted in the ground helped overcome part of this issue, as their root systems can be significantly increased.

As there is a line of overflow parking provided along the wall, the garden was widened at regular intervals to accommodate bioretention gardens with trees. This provided more opportunity to increase the amount of vegetation and water quality improvements within the development.

Other internal roads that met the perimeter road created long view lines to the wall. To provide visual interest, organic inspired feature art pieces were located on the wall, which could be viewed by people travelling down these connecting roads. These complemented the planting alongside, and assisted with creating a local sense of place.

The green wall provided an attractive vista for residents compared to a standard plain mass wall, as well helping habitat creation, cooling and runoff quality improvements.

# 4 CONCLUSION

The use of biophilic design provides opportunities for integrating WSD with wider land development processes and considerations, and enhance the livability of the communities created. Careful consideration is required so that the design process works with the regulatory framework and local conditions while also understanding the evolutionary preferences of people. When done well, the spaces can provide multiple benefits to residents, while also achieving outcomes for the local natural and created environments such as increased habitat, water quality improvement and reducing effects associated with extreme weather events such as heat and rain.