LANDSCAPE AS INFRASTRUCTURE ?

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Declaration

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; and, any editorial work, paid or unpaid, carried out by a third party is acknowledged.

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LANDSCAPE AS INFRASTRUCTURE ?

How landscape can precede housing development and set the parameters for its location, density and relationship to the Maribyrnong River.

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Along the Maribyrnong River development is currently the focus of attention. Can this be switched to a landscape which provides a unique environment for the residents as well as preceding the development of the houses?

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I WAS FASCINATED BY THESE SYSTEMS AND THE WEB OF INTERCONNECTING TUNNELS, GATEHOUSES, RESERVOIRS, AND ABANDONED PLACES COVERING (OR COVERED BY) SEVERAL HUNDRED SQUARE MILES OF LAND. I KNEW THEIR BASICS FROM READING HISTORIES AND GUIDEBOOKS, AND SPENDING TIME IN THE LIBRARY AND IN THE DEP ARCHIVES. I STUDIED ROAD AND TOPOGRAPHIC MAPS FOR HINTS ABOUT WHERE PARTS OF THE SYSTEM WERE LOCATED. SOON I CAME TO THINK OF THE SYSTEM AS AN UNDERGROUND ORGANISM, LIKE THE GIANT FUNGUS NOW REGARDED AS THE LARGEST LIVING THING ON EARTH.

STANLEY GREENBURG, 2003.

Preface

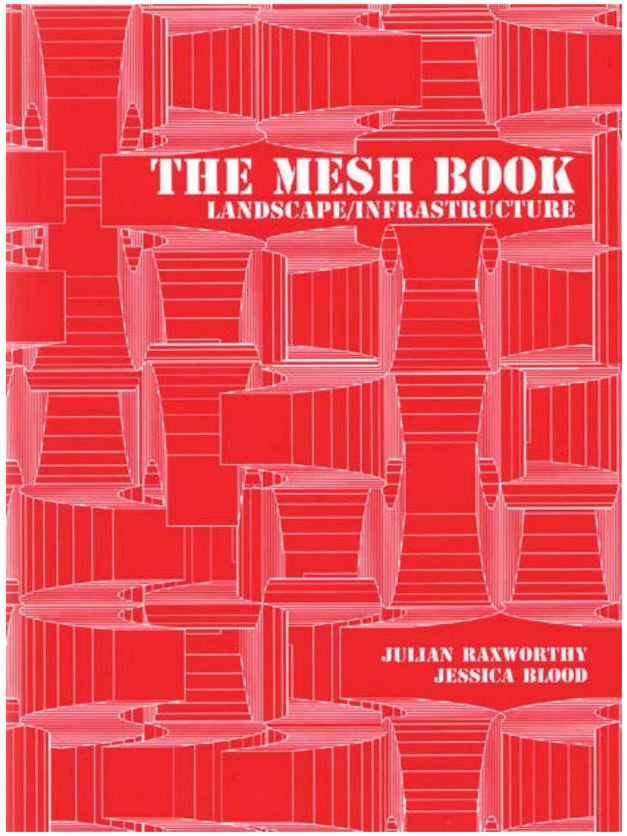
During my undergraduate studies at RMIT I was involved in the organisation of the MESH conference which brought over 500 students, academics and professionals from around the globe to discuss the concept of 'infrastructure as landscape'.[1] This theme was the umbrella under which participants were invited to speak and argue on scale, visible public infrastructures, the operation of the landscape, and non-visible systems such as political, cultural and social networks.

Together with Julian Raxworthy I collated, edited, researched and wrote on the topics to produce The Mesh Book: Landscape/ Infrastructure – a collection of case studies, essays and portfolios, which not only captured the conference deliverables but also reflected on the theme and its relevance within the profession.[2]

The title of The Mesh Book privileges neither infrastructure nor landscape as there was a significant shift in thinking from the conference phrase 'infrastructure as landscape' which emphasised the object qualities of infrastructure, to the research phrase 'landscape as infrastructure' which emphasised the dynamic operation of landscape. This research took the latter direction as it offered more potential for understanding and working with landscape as a system, through which one could understand how housing development may play a part within the operation of landscape, not simply an object that sits on its surface.

The book was launched in 2004 and I had begun what was to be a three year Masters degree at RMIT.

The Mesh Book sets up a theoretical position on 'landscape as infrastructure' but lacks critical discussion about working with the landscape as an infrastructural system. The book is open-ended because no clear definitions were reached and there was no direction as to how one might act infrastructurally through the design process. A conclusion could not be reached because writing about infrastructure is, it seems, like writing about the background: it is always there, but the closer you get to it, the more background there is behind it. Like the background, infrastructure is a relational term and is not supposed to be privileged.[3]



Cover of *The Mesh Book*.

Series of intersections along Texas Route 360, taken from the U.S. Geological Survey Urban Areas series.
Brian Hayes, 2005.

Introduction

This research is an investigation into the phrase ‘landscape as infrastructure’ and questions the influence of this notion in the design of new housing developments along the Maribyrnong River, Melbourne. The phrase lends itself to a systems based agenda because the word ‘infrastructure’ implies that it performs some kind of function. It is through this functioning that we can understand the way landscape acts as a stage for activities to occur, not just background.

The main question within the research is how landscape can precede housing development and set the parameters for its location, density, and relationship to the river. Associated sub questions within the research include:

– How do you define landscape if you consider it as an infrastructure?
– How can one work across a range of scales simultaneously?
– If landscape is a fluctuating dynamic system, how can one capture it or use site as a generator for design?

By creating an infrastructural landscape we can prepare the ground for future change and additional housing. One of the key requirements for a landscape to be considered infrastructural is that it produces an output; in this case treated water. Being infrastructural, however, is also about multiuse and as such the landscape will have many secondary outcomes such as unique recreational opportunities, improved flora and fauna reserves and dynamic landscapes. The focus of this research is the production of water and its relationship to housing.

Noise walls, Hallam Bypass, Melbourne. Designed by Kirsten Thompson Architects.

Water production is one of the fundamental infrastructures for any region, where traditionally all types of systems share the common ability to capture, store and transport water. This research considers not only the object qualities of a water system (the container, pipes and so on) but the quality of the water itself and its ability to perform as an infrastructure and influence landform and topography.
By opening up the definition of water infrastructure to include new qualities it also offers landscape architects the opportunity to question the role of Water Sensitive Urban Design within new environments and assess the viability of water policy documents.

If landscape is considered the medium of infrastructure and housing development a part of that medium it will play a fundamental role in the structure and function of the site, rather than simply an additional layer that sits on its surface. When considering the structure of an urban landscape it is important to recognise that there are many surfaces and levels of ‘ground’ that add to the function of the site. Topography is typically considered as the uppermost layer in the form of the earth’s surface, but topographic information does not apply to the built form of buildings and man-made infrastructures. This research considers the impact of understanding landscape not as a single layer which provides a surface for objects to be placed but the form that it can take if you consider the multiple layers of systems and the inclusion of built form within those systems.

For many years landscape architects and designers have been talking about the potential of infrastructure and landscape in

Powerlines, Dubai, United Arab Emirates.

providing new design methodologies and spatial typologies.
In 1984 JB Jackson suggested:

> ...that we will eventually formulate a new definition of landscape: a composition of man-made or man-modified spaces to serve as infrastructure or background for our collective existence; and if background seems inappropriately modest we should remember that in our modern use of the word it means that which underscores not only our identity and presence, but also our history.[4]

The discourse this research focused on has centered on the need for a closer integration of infrastructure within urban cities and developments and yet no-one has really tackled the notion that the landscape is an infrastructure in itself, a composition of many systems. The potential for new methods and typologies is limited if infrastructure is defined only through its spatial qualities as the discourse focuses on the static nature of objects without opening it up to the notion of being infrastructural.

The problem of considering infrastructure in relationship to the landscape is that discussions revolve around the object or how the system sits within the landscape, not about the system itself.[5] There is a lack of discussion on the qualities of infrastructure systems: how they function, the dynamics of flow, interactions with other systems, reactions to forces internally and externally to the system and how these qualities could be embraced within landscape design.

This research shifts the definitions of infrastructure and landscape to include process of flow and how the landscape may

Radio telescope array in New Mexico. Image by Sue Anne Ware.

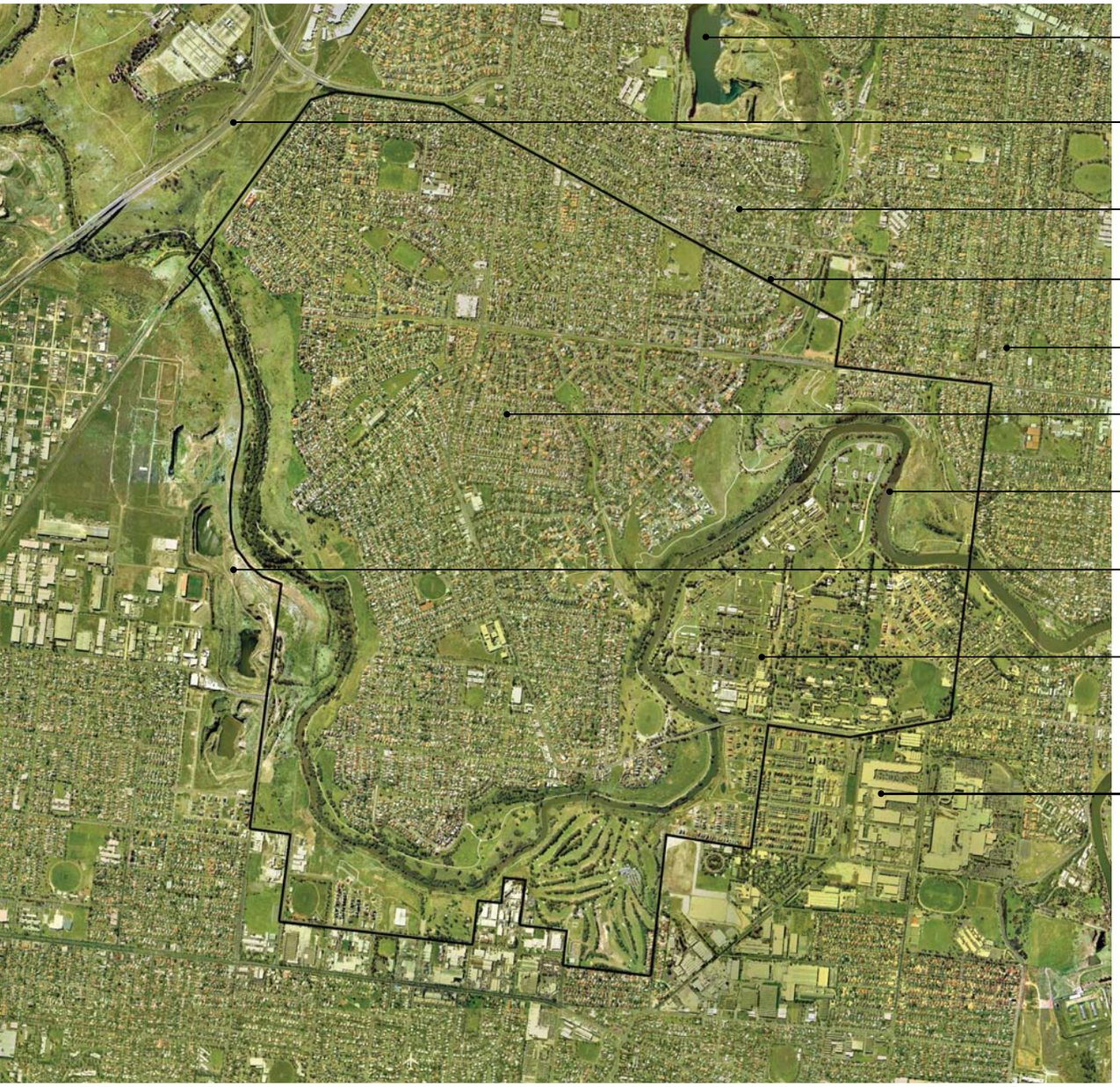
act as an infrastructure not just background to the object. If we consider infrastructure as a verb rather than an object can the landscape become an agency for change?[6]

To establish a framework for this discourse the research has been filtered through seven principals, originally developed by Stan Allen as a series of propositions for infrastructure. These principals question issues of force, process, typology, scale, invisible form, structure, function and change and visible form and set up a mechanism enabling me to challenge the notion of landscape as infrastructure. If the landscape is infrastructure then Allen's principals will also apply for the design of housing developments.

This testing led to four overriding themes which summarise the key ideas and methodologies for designing with landscape as infrastructure. The themes 'Catalyst', 'Time', 'Cause and Effect' and 'Experience' are tested on four different sites along the Maribyrnong River responding to different site conditions and the influence of geology and topography. The four sites have been named to reflect the primary function they perform within the overall strategy.

This Appropriate Visual Record (AVR) is aimed at tackling the understanding of landscape as an infrastructure and how landscape can influence development and its viability.

Understand the site



Aerial view of the site, taken before the River Valley Development commenced.

Topography has a large impact on the use of the land adjacent to the rivers edge. As the river approaches Port Phillip Bay there is a greater level of recreation and amenity at the rivers edge.

As the topography gets steeper there is less public use and amenities. There is much less interaction with the river itself.

The existing suburbs are quite isolated from the system of the river.

Site

Understanding site in relation to current development codes, Maribyrnong and the Melbourne 2030 Framework

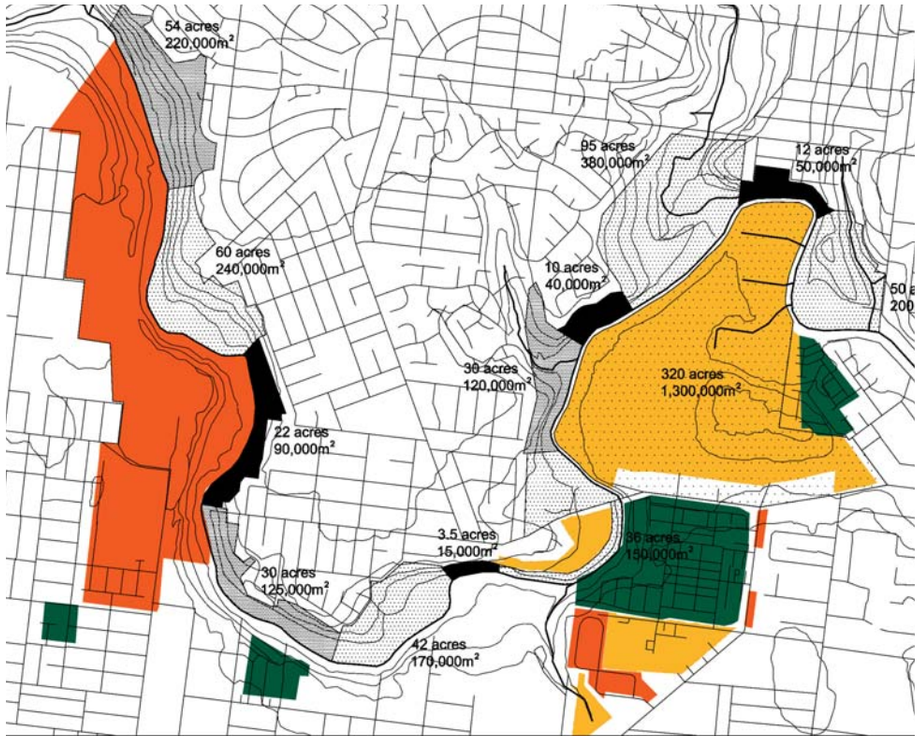
The Maribyrnong River is located west of Melbourne's Central Business District forming in the suburb of Keilor North and discharging into Port Phillip Bay after joining the Yarra River near its mouth. This research focused on an eight kilometer section of the river from the Department of Defense Explosives Factory to the Western Ring Road where the existing suburbs have a large setback from the river due to the steep topography and where there are several sites flagged for future development as part of the Melbourne 2030 Strategic Framework.

This framework speculates that Melbourne's population will grow by one million people before the year 2030. Within this framework the Maribyrnong Planning Scheme states that by 2011 the number of dwellings in the Maribyrnong area will 'increase by about 7,000 offering a wider range of housing choice at a wider range of prices'.[7] During this period the Maribyrnong River will continue to change rapidly from its past industry orientation to a high quality mix of housing, open space, cultural, leisure and recreational activity, arts activity and employment and tourism nodes. It will begin to rival the Yarra River as a regional recreation and tourist focus.[8]

This project was based on an initial hunch that the test sites – although not flagged for development within the 2030 framework – will one day become prime real estate due to their proximity to the water and access to Melbourne's CBD.

This research has used the 2030 framework to understand how the population is changing within the Maribyrnong area and the impact of the proposed developments. This research does not critically examine the framework or associated planning policies but offers a way in which the landscape, with careful consideration, may inform and change the way development occurs within existing urban areas, without relying on written policies which are susceptible to shifting government agendas.

This research asked the question of whether it was possible to accommodate all 7,000 dwellings along the river within the test site without losing existing open space. If housing development and open space can be incorporated into the one system it will challenge the notion of 'open space' by taking on many new forms and definitions, creating potential for new methods of appropriation and use.[9]



Topographic density plan and Melbourne 2030
Division of the site into three topographic zones relative to the site (shallow, medium and steep) and areas flagged for development under the Melbourne 2030 Framework (red is supply for 1-5 years, yellow is supply for 6+ years, and green represents completed developments).

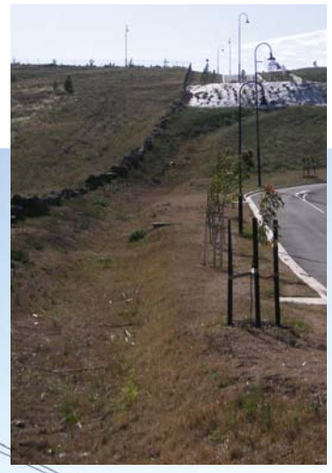
AS DEMAND FOR WATERFRONT LOCATIONS AND THE ATTRACTION OF WESTERN MELBOURNE AS A LOCATION FOR NEW RESIDENTIAL DEVELOPMENT HAS INCREASED...COUNCILS FACE SIGNIFICANT PRESSURES IN CONSIDERING THE EFFECT OF THESE RIVERSIDE DEVELOPMENTS.

IT IS ANTICIPATED THAT THE REDEVELOPMENT OF MAJOR SITES FOR RESIDENTIAL AND COMMERCIAL USES IN AREAS ADJACENT TO AND WITH ACCESS TO THE MARIBYRNONG RIVER WILL RESULT IN ADDITIONAL VISITORS SEEKING TO USE THE RIVER VALLEY FOR RECREATION AND TOURISM ACTIVITIES.

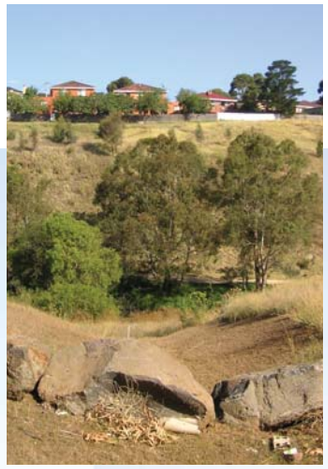
MARIBYRNONG RIVER VALLEY PROJECT VISION AND PLANNING GUIDELINES.

Recognise the value of WSUD

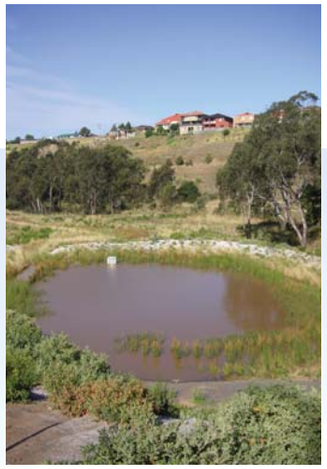
A critique of the River Valley Development based on the principals outlined in the Urban Stormwater: Best Practice Environmental Management Guidelines, 2006



Grass swale does not appear to take run-off from the road.



Rocks act as an inadequate gross pollutant trap for the swale before discharge.



Water retardation is minimal compared to the size of the development.

Revegetation is very minimal, however measures have been taken to protect the trees and minimise erosion.

Soil stockpiles should be at least 10m from the river and have a surrounding silt fence or drainage system.

Stage 3 of the development.

Grass swale.

Advanced eucalypt trees will need to be removed for construction of houses.

Direct views from the existing suburb.

Due to steepness of the main road most of the stormwater drains directly into the river causing bad erosion and an increase in sediment loads.

Stage 2 of the development.

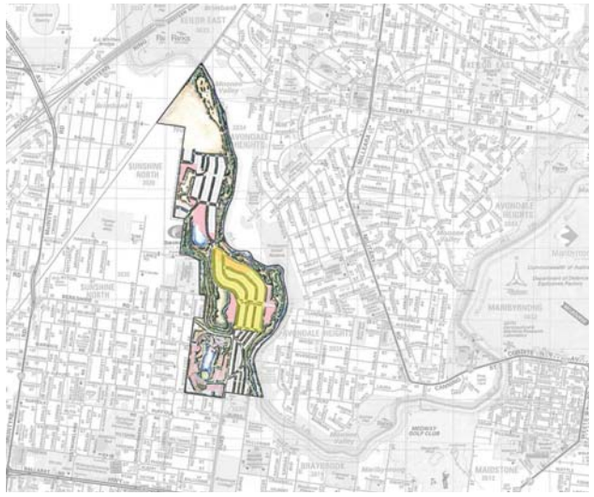
Site

Understanding the potential for water in urban environments
Water Sensitive Urban Design (WSUD) practices

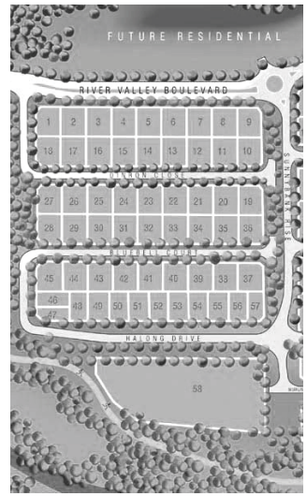
According to the Melbourne 2030 plan all new developments are encouraged to instigate the principals of WSUD which gives landscape architects the opportunity to re-look at the way housing and water can work together within the urban landscape.

Many existing suburbs around Melbourne are very isolated from the infrastructure that supplies them with potable water or the systems that dispose it. This lack of integration causes a disconnection from the water source, a problem which is especially pertinent in times of drought. Our only connections to the water sources around Melbourne are updates on the weekly news and billboards such as at Richmond train station on Punt Road which has a digital display of the current percentage of capacity in the reservoirs. This research offers a new type of development that has a much stronger interaction between the housing and the systems of water supply and re-use. The landscape will become the agent for change and through its operation to produce clean water will replace the notion of the sign by becoming a fundamental part of the residents lives. Each of the research scenarios along the river offer the residents different relationships to the water – The catchment offers opportunity to engage with the discharge and treatment of grey water; the drain combines housing with an extensive wetland system; the conduit engages directly with the river; and the sink responds to a range of situations.

The River Valley Development in Sunshine North is a housing development currently under construction on the south side of the river adjacent to this research site. It appears that very few WSUD principals are being employed here despite this development occurring under the 2030 Framework. Which is perhaps a reflection on the lack of understanding of the impact that development has on landscape or that there is no clear way of approaching WSUD principals and its too easy to get away with a bare minimum approach.



River Valley Development location and advertised masterplan. The highlighted zone is the first stage of development that is currently waiting for the 'homesites' to be sold.



'Homesite' plan with lot numbers (from the River Valley Development website).

WSUD EMBRACES A RANGE OF MEASURES DESIGNED TO AVOID, OR AT LEAST MINIMISE, THE ENVIRONMENTAL IMPACTS OF URBANISATION. WSUD RECOGNISES ALL WATER STREAMS IN THE URBAN WATER CYCLE AS A RESOURCE. RAINWATER (COLLECTED FROM THE ROOF); STORMWATER (COLLECTED FROM ALL IMPERVIOUS RUN-OFF); POTABLE MAINS WATER (DRINKING WATER); GREYWATER (WATER FROM THE BATHROOM TAPS, SHOWER, LAUNDRY AND KITCHEN); AND BLACKWATER (TOILET) CAN ALL BE VALUABLE SOURCES OF WATER.

WATER SENSITIVE URBAN DESIGN GUIDELINES, CITY OF MELBOURNE.

Landscape as infrastructure encourages the integration of all systems and the current development acts in isolation from the existing site conditions. Because of this it is contributing to the unhealthy nature of the river while it remains in limbo waiting for the plots to be sold and houses built.
The objectives of this research is to create a development that works with the principals of water from the beginning, to understand how it may drive the design and layout of the housing and create an integrated system. An alternate approach to the current methods of practice in the River Valley development, which will respond to the potential of the site..

Blurring the boundary between recreation and transport infrastructures, Amsterdam.

Blurring the boundary between drain and road infrastructures, Cremorne Street, Melbourne.

Develop an understanding of site detail and existing conditions

1

2

3

4

1-3
Desire lines indicate a lack of path networks and inadequate recreational opportunities within the site.

4
The area between the existing suburbs and river has become common ground for the residents. Here a resident has extended their garden space beyond his fence line and planted trees and placed furniture.

5-7
Limited existing infrastructure elements including basic seating, pedestrian bridges and drains.

8-10
Existing housing types within the suburb of Avondale Heights. Large two storey houses dominate the area. Most streets have large setbacks and nature strips, ideal for the inclusion of WSUD principals.

11-13
Existing boundaries and entrance points into the site are often disregarded, are of a poor quality or do not connect with other path networks.

5

6

7

8

9

10

11

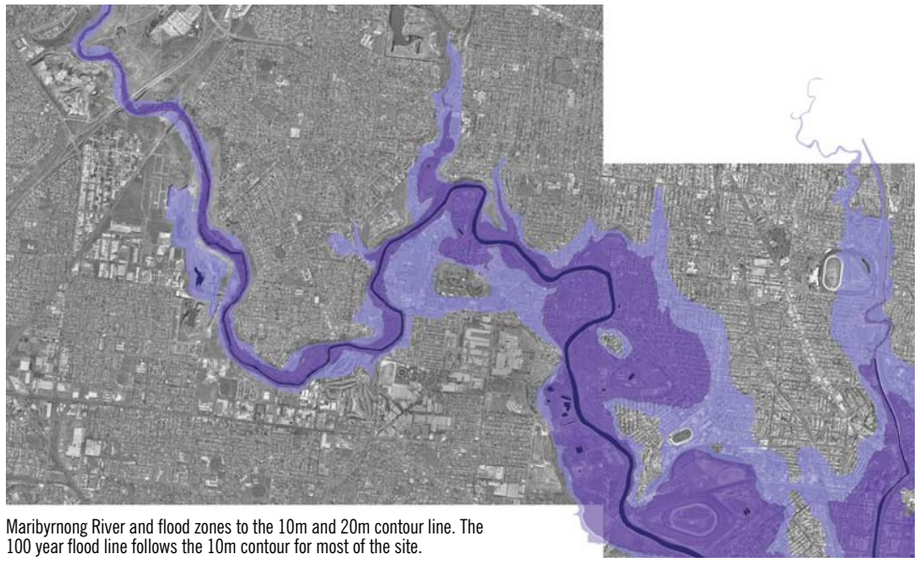
12

13

Site
Development of the river

The Maribyrnong River was chosen for the final design test because of the opportunity to investigate a dynamic natural infrastructure and its relationship to existing topography and new housing. The sites offer an amplified view of the systems of topography and highlight the many forces which connect and run through the site and surrounding suburbs.

Water became the focus of the research because it has a fundamental relationship to topography and surface condition. Current developments are often placed as a layer over the earth's surface and no consideration is given to the way these systems can influence each other. The River Valley Development is one such area where the developers have applied a layer of asphalt roads and concrete drains on top of the existing surface to develop lot size and plot numbers, enabling would be buyers to choose their plot on site prior to building their homes.



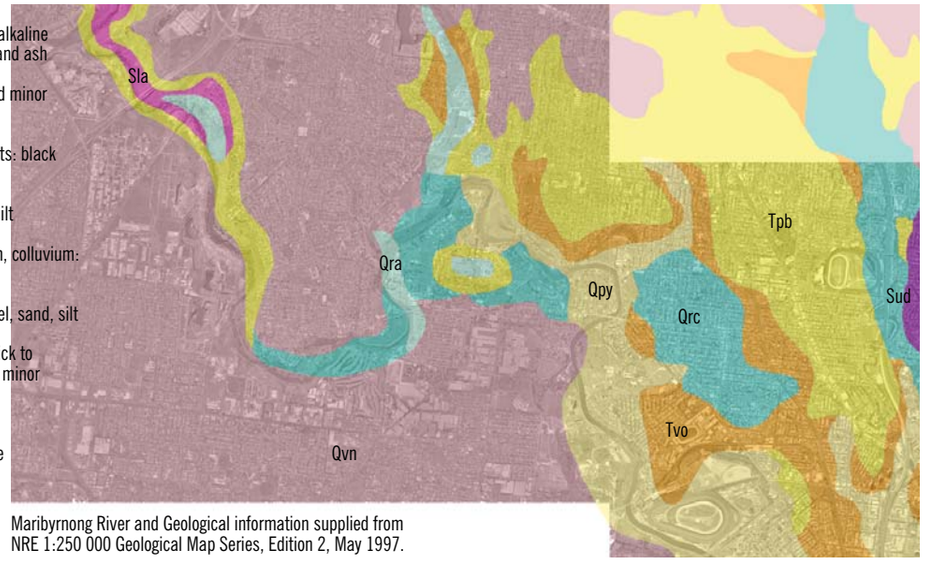
Maribyrnong River and flood zones to the 10m and 20m contour line. The 100 year flood line follows the 10m contour for most of the site.

This in effect freezes the topographic condition underneath and does not allow for flexibility or adjustments, creating greater risk of disturbance to the structures on its surface.

The River Valley Development does not appear to offer a large variety of houses or open space and is based on one plot size which caters for the average suburban family. This development, despite selling itself as a 'river' development, does not actively engage with the river itself, a phenomena which is consistent with existing developments within the Avondale Heights area. If the Maribyrnong River is indeed going to one day rival the Yarra River, development needs to engage more closely with its ecological, aesthetic and recreational values.
This research pushes the relationship between recreational and residential spaces by integrating both landscape and infrastructure into the one urban system, creating an environment where boundaries are blurred and there is no clear definition of either system. Blurring the boundaries of landscape and infrastructure creates an overlap of function where two or more systems can operate within the same space.

In this hybrid landscape all types of space are valuable because they are considered usable parts of the system, not leftover spaces which are typically associated with the construction of above ground infrastructure objects.

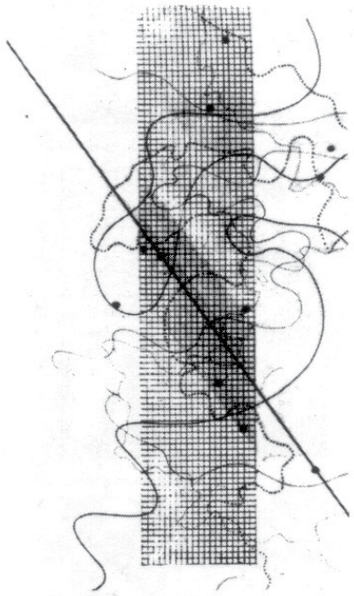
Qvn
Extrusive: tholeiitic to alkaline basalts, minor scoria and ash
Tvo
Extrusive: tholeiitic and minor alkaline basalts
Qpy
Paludal: lagoon deposits: black silt, clay
Tpb
Fluvial: gravel, sand, silt
Qrc
Fluvial: 'gully' alluvium, colluvium: gravel, sand, silt
Qra
Fluvial: alluvium, gravel, sand, silt
Sla
Marine: Sandstone, thick to thin bedded, siltstone, minor conglomerate
Sud
Marine: Siltstone, thin-bedded sandstone



Maribyrnong River and Geological information supplied from NRE 1:250 000 Geological Map Series, Edition 2, May 1997.

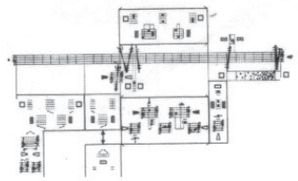
1A	1B	1C	1D	SURFACE
	2B	2C	2D	SERVICE
3A	3B	3C	3D	ORGANIZATION
4A	4B	4C	4D	STRUCTURE
5A	5B	5C	5D	REPETITION
6A	6B	6C	6D	ANTICIPATION

2A
SERVICE
PATHWAYS



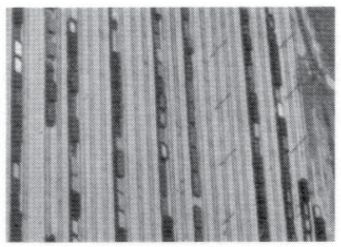
JOHN CAGE'S SCORE FOR FONTANA MIX

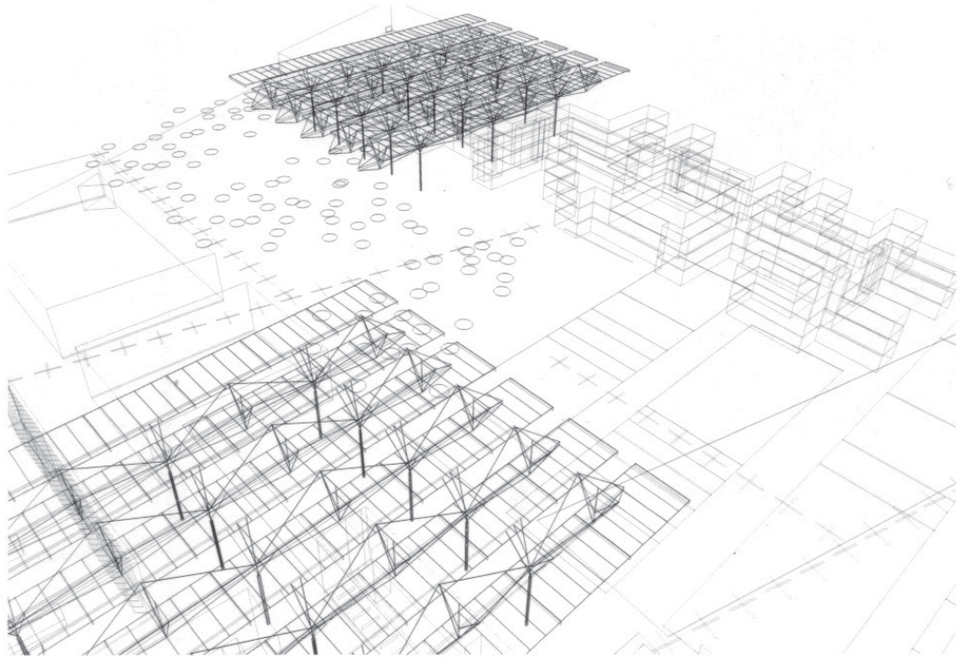
NOTATIONS:
Traditional representations presume stable objects and fixed subjects. But the contemporary city is not reducible to an artifact. The city is a place where visible and invisible streams of information, capital and subjects, interact in complex formations. They form a dispersed fireld, a network of flows. In order to describe or to intervene in this new field we need representational techniques that engage time and change, shifting scales, mobile points of view and multiple programs. In order to map this complexity, some measure of control may have to be relinquished. To open architectural representation to the score, the map, the diagram and the script could establish a basis for exchange with other disciplines such as film, music and performance. The score allows for the simultaneous presentation and interplay of information in diverse scales, on shifting coordinates and even of differing linguistic codes. The script allows the designer to engage program, event and time on specifically architectural terms. New maps and diagrams might begin to suggest new ways of working with the complex dynamics of the contemporary city.



SCORE FOR STOCKHAUSEN'S ZYKLUS

network circuitry: the degree to which circuit loops in a network are present.
network complexity: the combination of network connectivity and circuitry.
network connectivity: the degree to which all nodes in a system are linked by corridors.





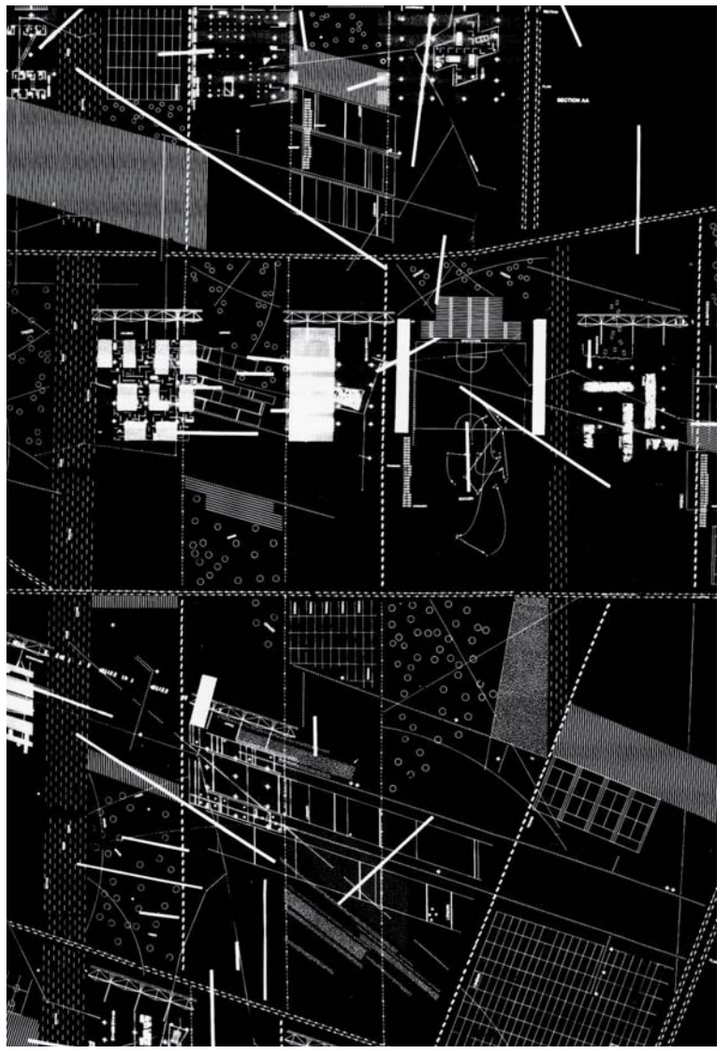
AERIAL VIEW

2. Infrastructural work recognizes the collective nature of the city, and allows for the participation of multiple authors. Infrastructures give direction to future work in the city not by the establishment of rules or codes (top-down), but by fixing points of service, access and structure (bottom-up). Infrastructure creates a directional field, where different architects and designers can contribute, but it sets technical and instrumental limits to their work. Infrastructure itself works strategically, but it encourages tactical improvisation.

Page from the *User's Manual* developed by Stan Allen to describe the infrastructural approach to the design for the Logistical Activities Zone Competition in Barcelona, 1996.

INFRASTRUCTURAL URBANISM OFFERS A NEW MODEL FOR PRACTICE AND A RENEWED SENSE OF ARCHITECTURES POTENTIAL TO STRUCTURE THE FUTURE OF THE CITY. INFRASTRUCTURAL URBANISM UNDERSTANDS ARCHITECTURE AS A MATERIAL PRACTICE – AS AN ACTIVITY THAT WORKS IN AND AMONG THE WORLD OF THINGS, AND NOT EXCLUSIVELY WITH MEANING AND IMAGE.

STAN ALLEN, 1999.



Montage of Scenarios: the work of Stan Allen on the Logistical Activities Zone Competition in Barcelona, 1996.

To develop this landscape as an infrastructural system that includes all aspects of urban living, and more specifically 7,000 dwellings, water production and a closer engagement with the river, seven key principals have been tested to push the notion of landscape as infrastructure.

Architect Stan Allen wrote seven propositions for infrastructure to describe it as a useful design term, beyond its practical application, and to examine the potentials of infrastructural urbanism. He tested these propositions on a design for the Logistical Activities Zone Competition in Barcelona.

[Their] design strategy consisted of setting down the traces of an architectural infrastructure that would allow flexible development while maintaining unified identity: a directed field within which the future life of the site could unfold; an architectural means to impose minimal although precise limits on future construction.[10]

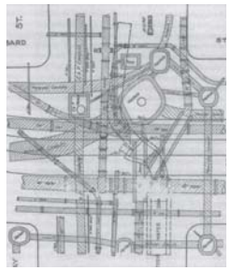
The design was developed through a User's Manual which complied each of the key ideas of surface, movement, program, patch typologies and infrastructure. Although this manual, and the competition, were driven by architectural design the same ideas are important when considering the design of landscapes and urban environments.

If landscape is indeed an infrastructure and the word 'infrastructure' is substituted for 'landscape' will the same propositions apply for the design of an urban environment?

Allen's propositions have acted as a vehicle for this research to construct a series of themes that emphasise the landscape.
The next section of this AVR is based on the pages from the original User's Manual where Allen's original proposition sits in the top left corner on each page. The only difference applied here is the substitution of the work 'infrastructure' for 'landscape' to switch the emphasis. The remainder of each page is then broken down into key images and diagrams from design exercises carried out as part of this research and my own analysis.
Each principal acts as an isolated moment within the AVR however, through the development of the final themes it became apparent that many principals overlap and influence each other when understanding the test sites.

Allen's propositions not only offer an understanding of infrastructure as a design tool but established a strategic way to approach site from a different angle – thinking beyond the analysis techniques that are traditionally used.

Principals



1
Underground pipes and conduits at the junction of Gay and Lombard Streets in Baltimore, Maryland, 1908. (Graham & Marvin, 2001, p39).

2
Maintenance work in the streets of Borneo Sporenburg, Amsterdam.

3
Aerial view of the Western Treatment Plant, Werribee, Melbourne. (Melbourne Water Corporation).

Multiple layers of 'ground' that make up the field of landscape systems within the site along the Maribyrnong River.

TO THE ENVIRONMENTALIST THE TOPOGRAPHY AND VEGETATION HAVE VISIBILITY; TO THE STUDENT OF ARCHITECTURE IT WILL BE THE BUILDINGS; ALL THE REST IS MERELY BACKGROUND, AND ALL OBJECTS IN THAT BACKGROUND SEEM TO MERGE INTO A KIND OF INVISIBILITY.

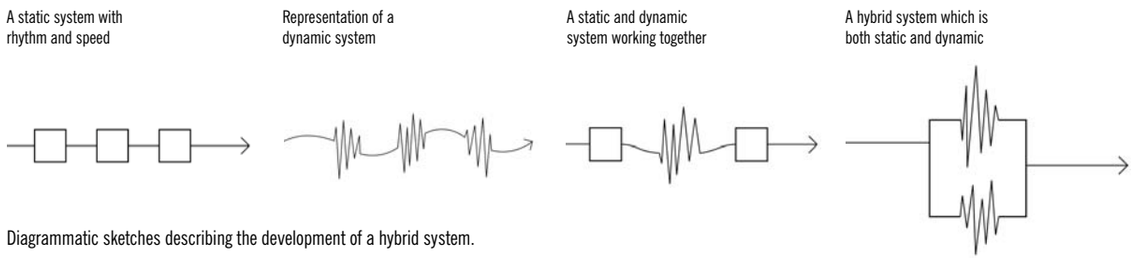
JB JACKSON, 1984.

Infrastructure needs to shift from something that simply accommodates the flow of a material or object with the expectation of a smooth transition between one or many points. They are traditionally systems of service that provide the foundation for urban living and carry the basic necessities to our homes and places of work. These systems are often placed underground for protection and to maximise usable space on the surface, but can also be spatially dominant above ground in the form of powerlines and roads.

Landscape in an urban context becomes the field which accommodates these systems of service but also accommodates buildings, utilities, neighborhoods, open space and natural habitats.[11] To consider everything that makes up this landscape awakens me to its functioning and begins to privilege the movement and operation of these systems.

The term 'infrastructure' has enabled designers to re-think the way we understand the word 'landscape' and its relationship to the urban environment. The words, when used in isolation, can have numerous meanings depending upon the context in which they are being used. This is problematic when trying to understand the usefulness of the words for design and the discipline of landscape architecture.

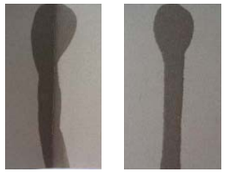
This research focused on the phrase 'landscape as infrastructure' to unravel the relationship of the words as a concept and to understand the fundamental principals behind their use in design and operation of the landscape.

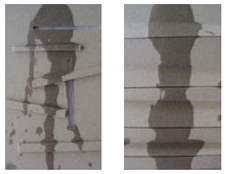


Diagrammatic sketches describing the development of a hybrid system.

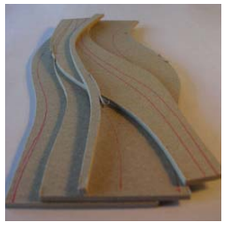
Landscape works not so much to propose specific buildings on given sites, but to construct the site itself. Landscape prepares the ground for future building and creates the conditions for future events. Its primary modes of operation are: the division, allocation, and construction of surfaces; the provision of services to support future programs; and the establishment of networks for movement, communication, and exchange. Landscape's medium is geography.

Principals of river morphology, the effect on topography and housing development.

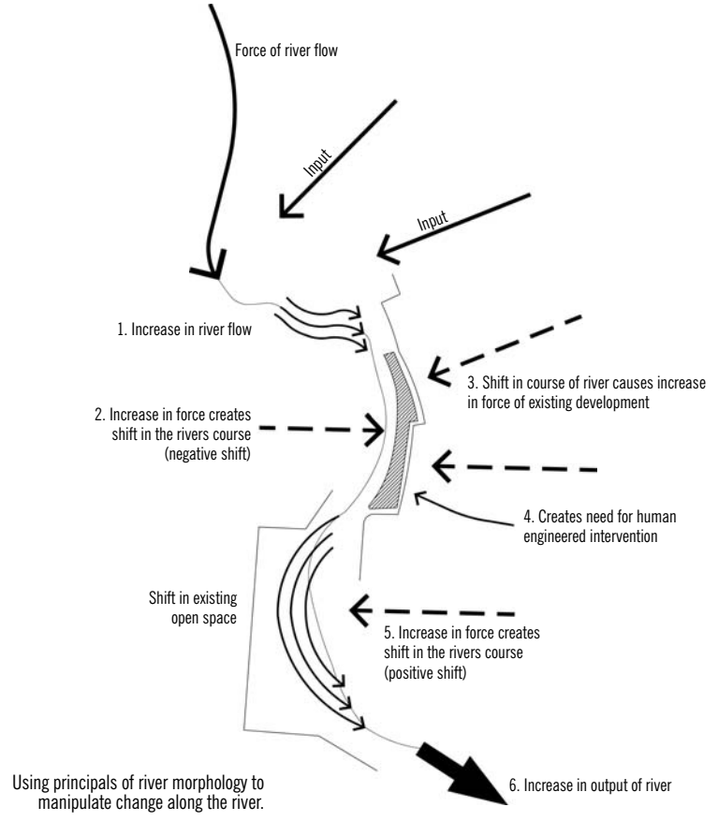




The effect of water on different surface models.



Understanding topography as built form.



Using principals of river morphology to manipulate change along the river.

01
Prepare the Ground

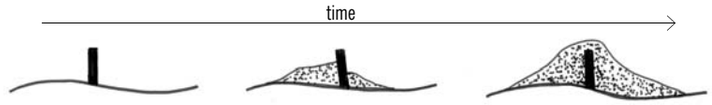
Preparing the ground investigates the form of the land and the forces that shape it – for topography these forces are primarily geological and hydrological.

Gary Strang believes that 'the potential [that] infrastructure systems have for performing the additional function of shaping architectural and urban form is largely unrealised'.[12] But to consider the river as the primary infrastructure within the site one can start to understand how this system could be manipulated through the use of river morphology principals in order to create change.

The initial strategy for the site was to take advantage of the dynamic nature of the river and by increasing its volume and flow it would shift creating two main topographic outcomes between the river and the existing housing. In zones of erosion the topographic outcome would be steeper and more suited to dense high rise residences. In zones of deposition flatter areas would be produced creating an area more appropriate for low density housing or recreation spaces, or a hybrid landscape.

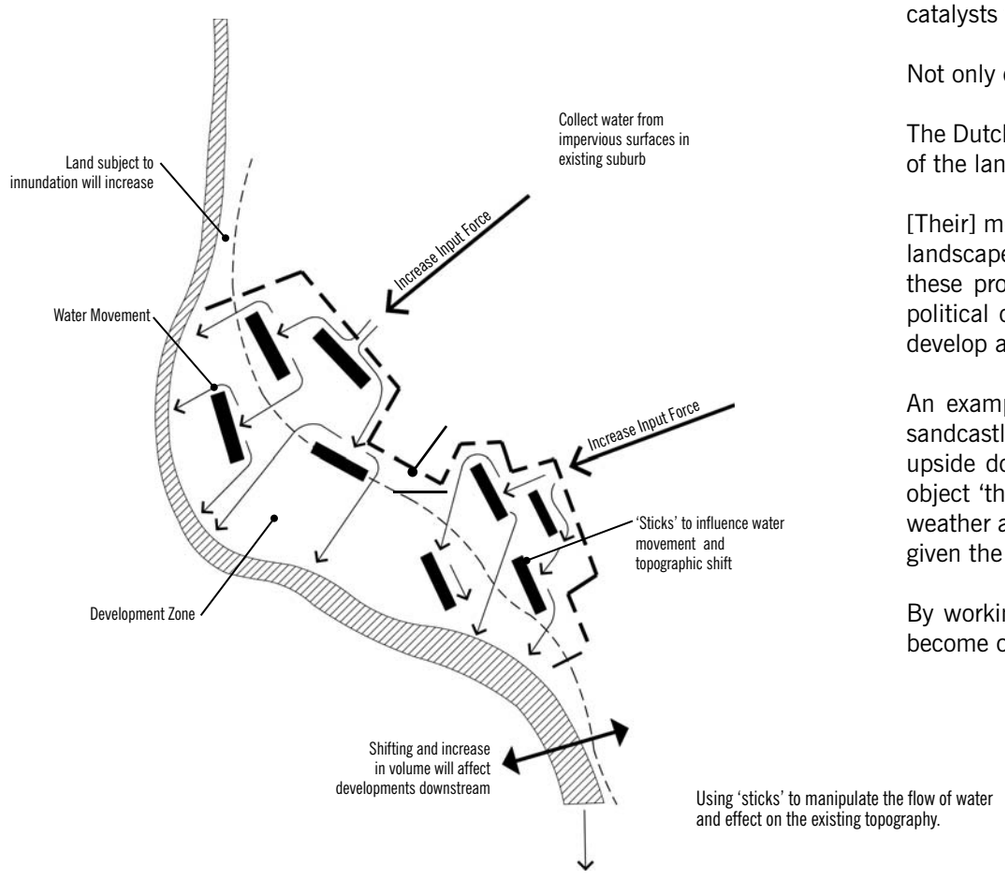
The importance of form in the organisation of space has been critically examined throughout the discourse of landscape urbanism where architects and landscape architects have looked to infrastructure as a mechanism for new design methods and programs. Charles Waldheim understood landscape urbanism as an 'interstitial design discipline, operating in the spaces between buildings, infrastructural systems, and natural ecologies'.[13] Using this definition landscape becomes a discipline which encourages working with the dynamic qualities of the landscape and the principals associated with infrastructural systems and networks – understanding that 'landscape' no longer refers to a patterning of the earth's surface but a complex mix of processes. James Corner suggests that 'the promise of landscape urbanism is the development of a space-time ecology that treats all forces and agents working in the urban field and considers them as continuous networks of inter-relationships.'[14]

Landscapes are flexible and anticipatory. They work with time and are open to change. By specifying what must be fixed and what is subject to change, they can be precise and indeterminate at the same time. They work through management and cultivation, changing slowly to adjust to shifting conditions. They do not progress toward a predetermined state (as with master planning strategies), but are always evolving within a loose envelope of constraints.



Creation of a sand dune using the principals of process design and a 'stick'.

A VISTA landscape forming over time (Collages by VISTA, from *The Mesh Book).*



Using 'sticks' to manipulate the flow of water and effect on the existing topography.

02
Be precise and indeterminate

Man-made infrastructures are built for very precise operations where the speed and volume of flow determines the size and shape of the structure that carries it. This creates interdependency within the overall structure of the system where one component can not operate without the other and where each component will determine the level to which the other can function.

Landscapes on the other hand are very indeterminate as their function is much less definable or controlled. By understanding the medium of landscape precise decisions and moments can act as catalysts to create change in its form.

Not only do flows create structure, but structure determines flow.[15]

The Dutch landscape architecture firm VISTA uses this approach when considering the potential form of the landscape. Roel van Gerwen describes the firm's approach of 'process design' where:

[Their] main goal is to use the right 'sticks' in order to activate, unravel and manipulate the dormant landscape-forming processes that are hidden within the rural and urban landscape. [They] refer to these processes as 'steering processes', which may be of a hydrological, ecological, economical, political or other nature, but will always have a common capability to transform, manipulate and develop a landscape.[16]

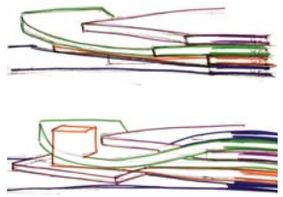
An example van Gerwen uses to describe the operation of these 'sticks' is the act of making a sandcastle. Option one is to use a pre-molded, standard plastic bucket, fill it with sand and tip it upside down. In most cases the resulting sandcastle will be the same. Option two is to place an object 'the stick' into the sand, let the steering processes (in this case the force of the wind, sand, weather and the object) create a mound over time. The result in this case will be different every time given the conditions of the forces – a very precise act which has a very indeterminate outcome.

By working with both precision and indeterminacy at the same time landscape and infrastructure become one system reacting and changing to a variety of forces.

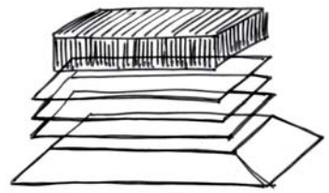
Landscape work recognises the collective nature of the city and allows for the participation of multiple authors. Landscapes give direction to future work in the city not by the establishment of rules or codes (top-down), but by fixing points of service, access, and structure (bottom-up). Landscape creates a directed field where different architects and designers can contribute, but it sets technical and instrumental limits to their work. Landscape itself works strategically, but it encourages tactical improvisation. Landscape work moves away from self referentiality and individual expression toward collective enunciation.

Beautiful coexistence:
Craigieburn Bypass, Melbourne.

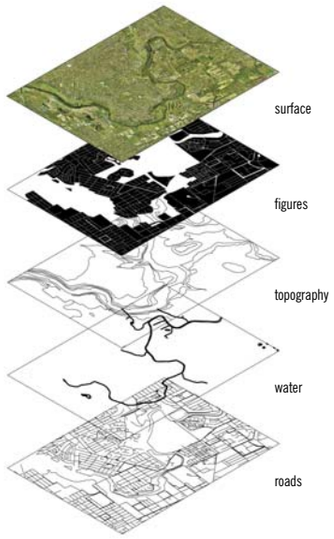
Fiscal infrastructure:
Bolte Bridge, Docklands, Melbourne.



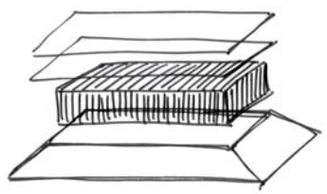
Understanding the role of usable space when the systems begin to overlap and blur.



In current development practices housing is the top most layer.



Representing the shift in relationship between housing, topography and water through a manipulation of the axonometric layers.



Incorporating the object as a part of the system and altering the hierarchy of layers.

03
Create a directed field

Kathy Poole in her paper 'Six-and-a-half Degrees of Infrastructure' offers a series of infrastructure typologies that address 'landscape as infrastructure' and how they could direct and influence the design of spaces.[17] Two of the most influential degrees for this research are 'beautiful coexistence' and 'fiscal infrastructure' which are described below.

'Beautiful coexistence with municipal infrastructure' refers to utilitarian infrastructures (bridges, dams, aqueducts etc) and how they coexist with their context, often playing an important role within the aesthetic of a town or place by providing an iconic landmark and direction. This focuses on object based design and refers to principal 07 – specific architectural elements.

'Fiscal infrastructures' have the ability to generate economic development or to be catalytic, acting as stimuli for other projects, directing the designer to consider if an object can be sustainable or cause change. It is therefore important to understand not only the political, cultural and social context – invisible forces – in which these objects sit but how they will affect neighboring sites, other developments and planning regulations. The Bolte Bridge which spans the Yarra River in Melbourne's Docklands is an example of a fiscal infrastructure. The Government made a deliberate decision to construct a bridge that would not allow large ships to pass under it, condemning the existing port facilities unusable and thus opening the area up for residential and commercial properties. Although I am sure that all planning regulations and standards were followed in the design and construction of the bridge, this one design decision has been catalytic in the changes to the Docklands area.

When considering the form of infrastructure it is important to understand not only its relationship and context but also the immediate effect on or above the surface that it touches. Spaces associated with infrastructure are often labeled the 'leftover' spaces that seem to have escaped budget or timing consideration. These spaces however become the most critical aspect for understanding the way these objects are experienced if you are not part of the direct flow associated with the system. The consequence of this understanding is that there is no such thing as 'leftover' space – it is all usable.

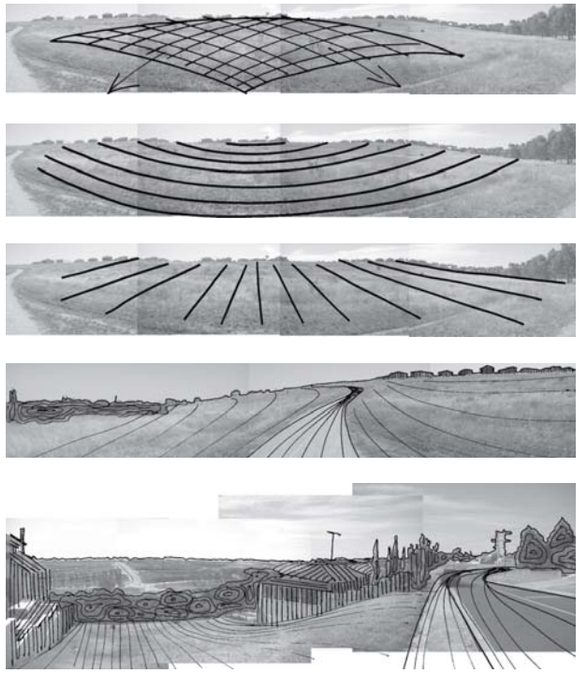
If we then consider all space as usable, the notion of the directed field is very important when considering the role of the masterplan within housing development. For this research strategic plans of operation are developed which describe the stages of development, directing the contribution of other designers by allocating areas of operation. Masterplans typically become redundant the moment they are implemented, and as such are not a useful tool to describe and represent an operating environment. By using strategic plans the strategies can shift according to the behavior of the system and its inputs and outputs, creating a more dynamic solution.

Landscapes accommodate local contingency while maintaining overall continuity. In the design of highways, bridges, canals, or aqueducts, for example, an extensive catalog of strategies exist to accommodate irregularities in the terrain (doglegs, viaducts, cloverleaves, switchbacks, etc.), which are creatively employed to accommodate existing conditions while maintaining functional continuity. Nevertheless, landscape's default condition is regularity – in the desert, the highway runs straight. Landscapes are above all pragmatic. Because it operates instrumentally, landscape design is indifferent to formal debates. Invested neither in (ideal) regularity nor in (disjunctive) irregularity, the designer is free employ whatever works given any particular condition.

Melway zoom, understanding the limits of representation.

Parc Andre Citroen – formal green, Paris.

Parc Andre Citroen – themed garden, Paris.



Understanding and experiencing topography at a 1:1 scale.

04
Accommodate local contingency and maintain overall continuity

To accommodate local contingency while maintaining overall continuity, design becomes a question of scale. When considering a landscape which extends across many kilometers it is important to consider not only the effect of design at a large scale, but also zooming out to its context and zooming in to the detail and the 1:1 experience. To work infrastructurally is to work at multiple simultaneous scales and to understand that there is always ongoing adjustments when manipulating the way the urban landscape operates.

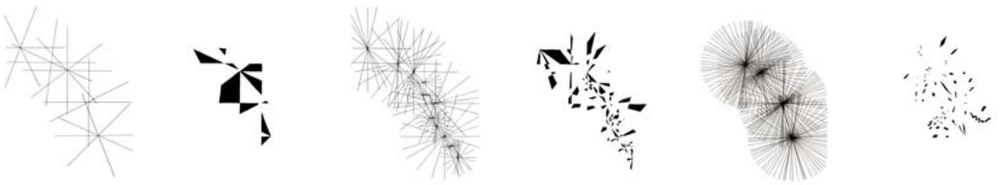
The landscape drives the scale that one needs to work at and unlike techniques that set the parameters prior to the commencement of the design, through working with landscape as an infrastructure one must consider the entire system (not just the boundaries set by the client or budget constraints) in order to understand the effects a localised design can have across other scales. The 'butterfly effect' is a very broad example of understanding how one small action can have ongoing repercussions.[18]

Understanding the scale of landscape and how we experience it is essential when determining its use. Parc Andre Citroen in Paris, France is a landscape which works at two very different scales. The large formal green caters for a number of people simultaneously and has a very public feel as the space is bordered by paths and buildings which provide key viewing points over the green. As more people occupy the green it appears to get larger because it can accommodate a number of people and maintain a sense of personal space. As a contradiction to this one must descend into the themed gardens which create very private spaces. If alone in these spaces you suddenly feel crowded if one other person enters the space.

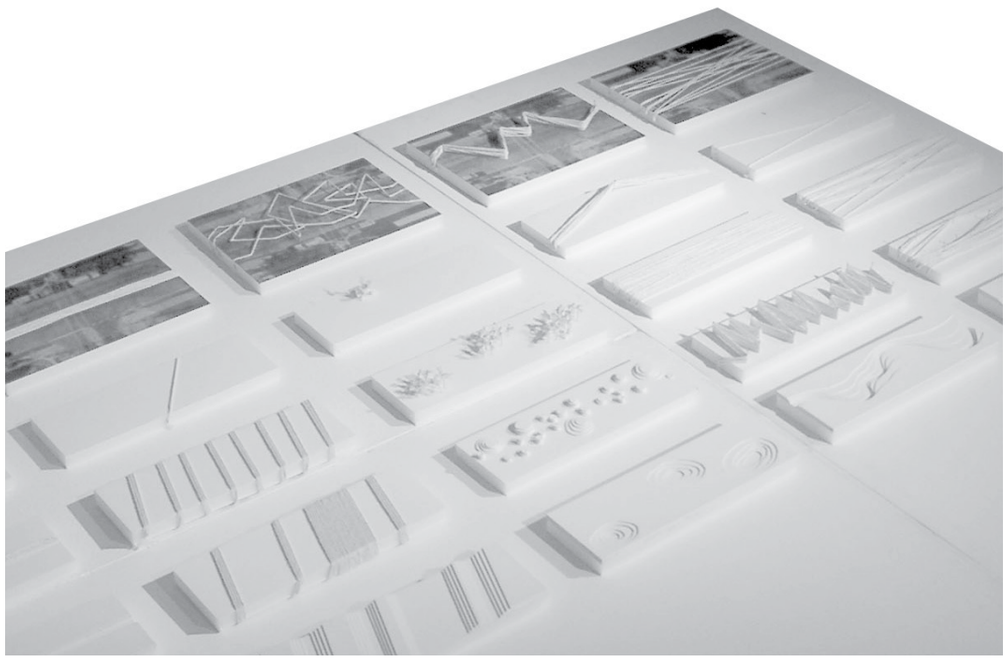
Although this example relates to the design of parks and gardens and how we experience scale, the ratio of buildings to open space is very important which considering the layout and function of an urban development and in understanding the scale of operation. Each development zone along the Maribyrnong site has a different ratio determined by the relationship between the topography and housing.

Alex Wall argues that if the goal of designing the urban surface is to increase capacity then the primary strategy is to extend continuity while diversifying the range of activities.[19] He likens this approach to that of agricultural practice and the dynamic nature of changing crops and land management techniques. It is interesting that Strang also drew similarities between new methods of design in landscape architecture and agriculture, claiming 'we should be more like farmers, who depend upon the architecture of natural systems for their livelihood'.[20] To consider the urban landscape as a production zone for water creates an urban landscape where the residents can participate in the treatment of their own water and have a much closer relationship to the system and thus respect for the quality and use of water as well as the landscape in which it sits.

Although static in and of themselves, landscapes organise and manage complex systems of flow, movement, and exchange. Not only do they provide a network of pathways, they also work through systems of locks, gates, and valves – a series of checks that control and regulate flow. It is therefore a mistake to think that landscapes can in a utopian way enable new freedoms, that there is a possibility of a net gain through new networks. What seems crucial is the degree of play designed into the system, slots left unoccupied, space left free for unanticipated development. This also opens the question of the formal description of landscape systems: landscapes tend to be hierarchical and tree-like. However, there are effects of scale (a capillary effect when the elements get very numerous and very small) and effects of synergy (when systems overlap and interchange), both of which tend to produce field conditions that disrupt the overall tendency of landscape systems to organise themselves in linear fashion.



Understanding the scale of space – as you increase the number of lines (linear system) the scale of space decreases and multiplies.



An investigation into different flows through linear space, understanding the influence of the pin (force) and string (surface).

05
Organise and manage complex systems of flow

When considering the complex nature of flow within the landscape it is important to consider the invisible form of many systems.

Invisible form describes those systems which are unseen because they are physically buried or hidden from view and those systems which do not have physical boundaries such as political systems (often distinguished only as a line on a map), cultural systems (the movement and gathering of people through the landscape), and invisible systems such as wireless networks, flight paths and boat channels.

Invisible systems are just as important as visible ones and contribute greatly to the organisation and type of surfaces above, around or below them. We live in a world preoccupied with information and as such our lives are governed by constantly updating technologies. Robert Thayer argues that this constantly changing style is a dangerous path to go down because as these systems forever increase in size and volume they will influence more and more of our public and private spaces.[21]

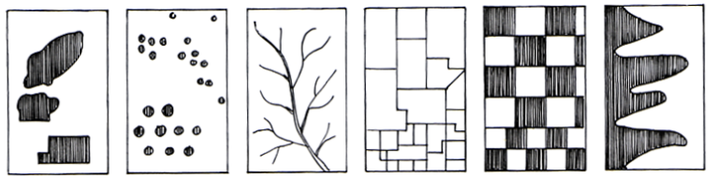
Thayer questions whether or not our infrastructure systems should be concealed or exposed and how far our environmental guilt can go to conceal large infrastructure systems.[22] Rather than applying a layer of 'art' to these systems we should go beyond the aesthetic value (or non-value) and treat them as dynamic flows which can help to understand the function of the urban landscape and influence our experience of space.

This research does not address the engineering aspects of infrastructure systems – the detailed design of the system itself, pipe dimensions, flow rates etc – but the principals of their design are important when considering the landscape as the system of operation where the variables are much less definable and constantly shifting.

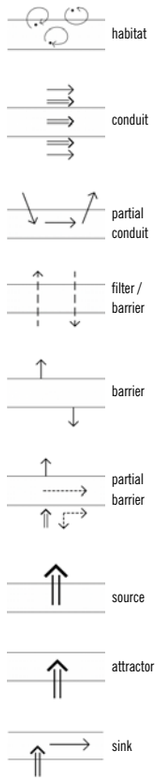
A system of infrastructure is inclusive of both the pipe and water where the two are both dependant on each other in determination of flow, speed and efficiency. Interdependency is a critical issue in infrastructure reliability and a natural part of infrastructure design and operation.[23] Systems are not built in isolation and are often interconnected due to function or spatial configurations and availability. This interconnection often relies on a redundancy within the system allowing for disturbances and interruptions. Redundancy, a traditional engineering principal, 'in design and construction is generally considered indispensable and invaluable for structural integrity and soundness…redundancies among infrastructure provide functional flexibility and trade-offs among and between the systems.'[24]

Landscape systems work like artificial ecologies. They manage the flows of energy and resources on a site, and they direct the density and distribution of a habitat. They create the conditions necessary to respond to incremental adjustments in resource availability, and modify the status of inhabitation in response to changing environmental conditions.

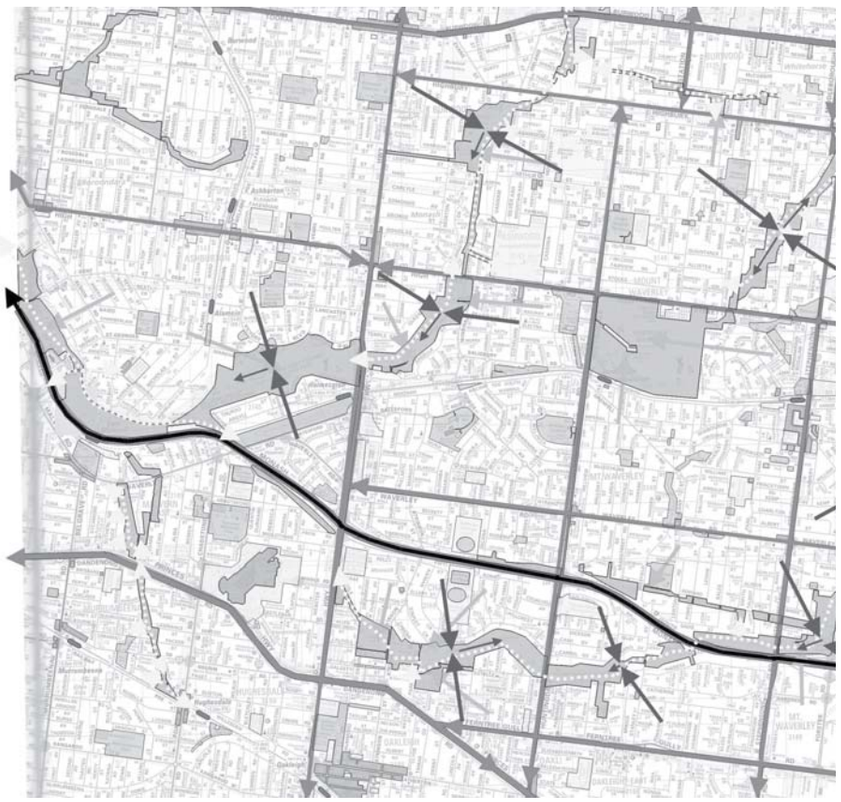
Cover image from *Underneath New York*, Harry Granick, 1947.



Six landscape types based on predominant patterns, Forman, 1995.



Functions of a corridor. Adapted from Forman, 1995.



Understanding an urban system through principals of landscape ecology.

06
Understand the role of ecology

Infrastructure is becoming much more natural in function: no longer are infrastructures simply large objects that sit in the landscape but systems that 'are so complicated they have begun to take of some qualities of nature itself'.[25] Strang uses this analogy to describe the work of Harry Granick who portrays New York's infrastructure as the hidden structure that makes urban culture possible. He talks about the city as if it were a human nervous system, the vital organs which provide it with heat, water, light and air, opening up the definition of an infrastructural system to include ideas of live systems that can shift and react much like nature itself does.[26] Granick first published this work in 1947, which is important when considering the development of the discourse. The most recently published work from James Corner addresses the same concept of infrastructure systems becoming ecological.

Apparently incoherent or complex conditions that one might initially mistake as random or chaotic can, in fact, be shown to be highly structured entities that comprise a particular set of geometrical and spatial orders. In this sense, cities and infrastructures are just as 'ecological' as forests and rivers.[27]

The consequence of this shift in definition is that infrastructure also becomes susceptible to threats of random catastrophe, something described by ecologists as a 'feedback loop'.[28] Strang touches on the consequences of engineers who believe they can achieve the total management of nature and the problems of assuming that over-engineering is the best solution.[29] In these types of cases it is always nature which wins and in recent times the world has seen the affects that these natural disasters have had in Thailand, Japan and the United States.

Thinking about infrastructures as ecological entities is a shift in definition however; it is not useful for design and focuses the discourse toward the object not the system. The definition of ecology is however still useful when considering the way a landscape operates: 'ecology is generally defined as the study of the interactions among organism and their environment' and one of the challenges associated with the principals of landscape ecology is how to apply them to an urban landscape.[30]

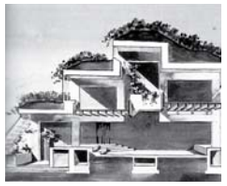
Strang believes that there is a level of denial attached to infrastructure design, which means the common role of the landscape architect is to mitigate infrastructural systems in the hope that we can maintain the image of untouched natural surrounds.[31] Landscape ecology principals in landscape and landuse planning state that a living system has three broad characteristics: structure – the spatial pattern or arrangement of elements; functioning – the movement and flow of animals, plants, water, wind, materials and energy through the structure; and change – the dynamics or alterations in spatial pattern and functioning over time.[32] These are principals which can be applied to the design of urban environments.

Landscapes allow detailed design of typical elements or repetitive structures, facilitating an architectural approach to urbanism. Instead of moving always down in scale from the general to the specific, landscape design begins with the precise delineation of specific architectural elements within specific limits. Unlike other models (planning codes or typological norms for example) that tend to schematise and regulate architectural form and work by prohibition, the limits to architectural design in landscape complexes are technical and instrumental. In landscape urbanism, form matters, but more for what it can do than for what it looks like.

Housing Typologies.

House in Wales by Future Systems.

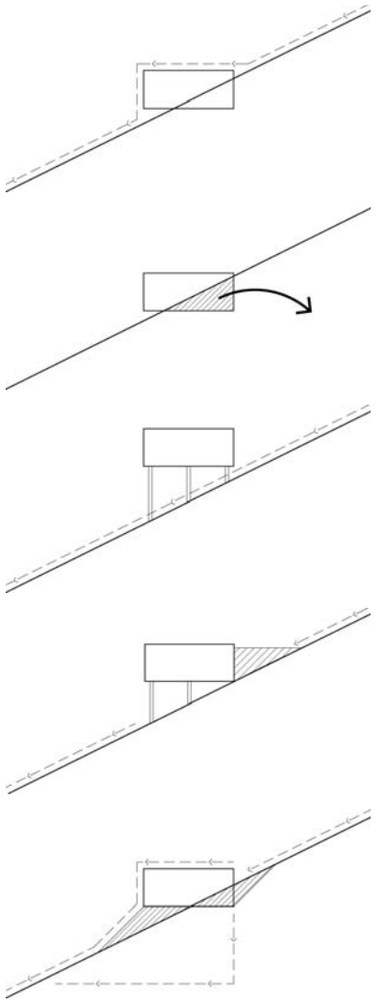
Borneo Sporenburg, Amsterdam.



Locust Hill by Malcolm Wells.

Nakagin Capsule Tower by
Kisho Kurokawa.

Understanding the relationship between housing, topography and water flow.

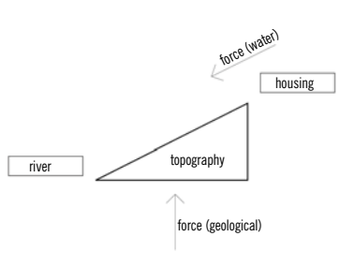


07
Use specific architectural elements

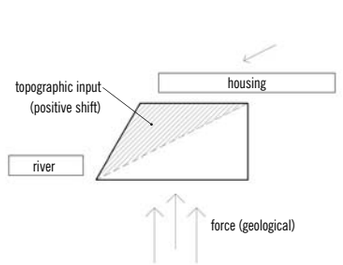
Visible form addresses those infrastructures which are above ground and visually dominant. These infrastructure systems are often associated with object-based design (roads, powerlines, satellites, wind turbines and so on) and usually disregard the context in which they sit emphasising 'engineering, quantitative planning, and standardisation'.[33] But due to the nature and size of these objects they become a fundamental part of their context – both on the ground plane and within views across the site. Infrastructures of this nature are often utilitarian cutting distinct paths through housing, vegetation, and topography. It is these types of infrastructures that have sparked an interest from ecologists and a new stream of design research called infrastructural ecology – 'the meaning of ecology in relation to physical infrastructure such as roads and railways'.[34]

Strang calls for designers to start working more closely with these infrastructure systems due to the sheer size, area and money associated with the design of these objects.

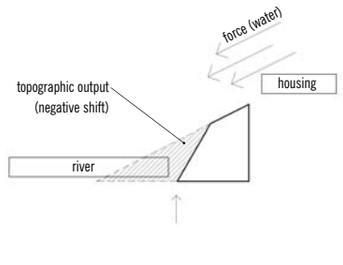
By considering housing as a visible infrastructure it can be influential in the relationship between the systems of topography and water, providing catchment areas, flow passages and storage areas. This research does not focus on the detail design of the object but questions how object, surface and space can be incorporated into one system that accommodates a variety of flows in a variety of directions.



Existing conditions.

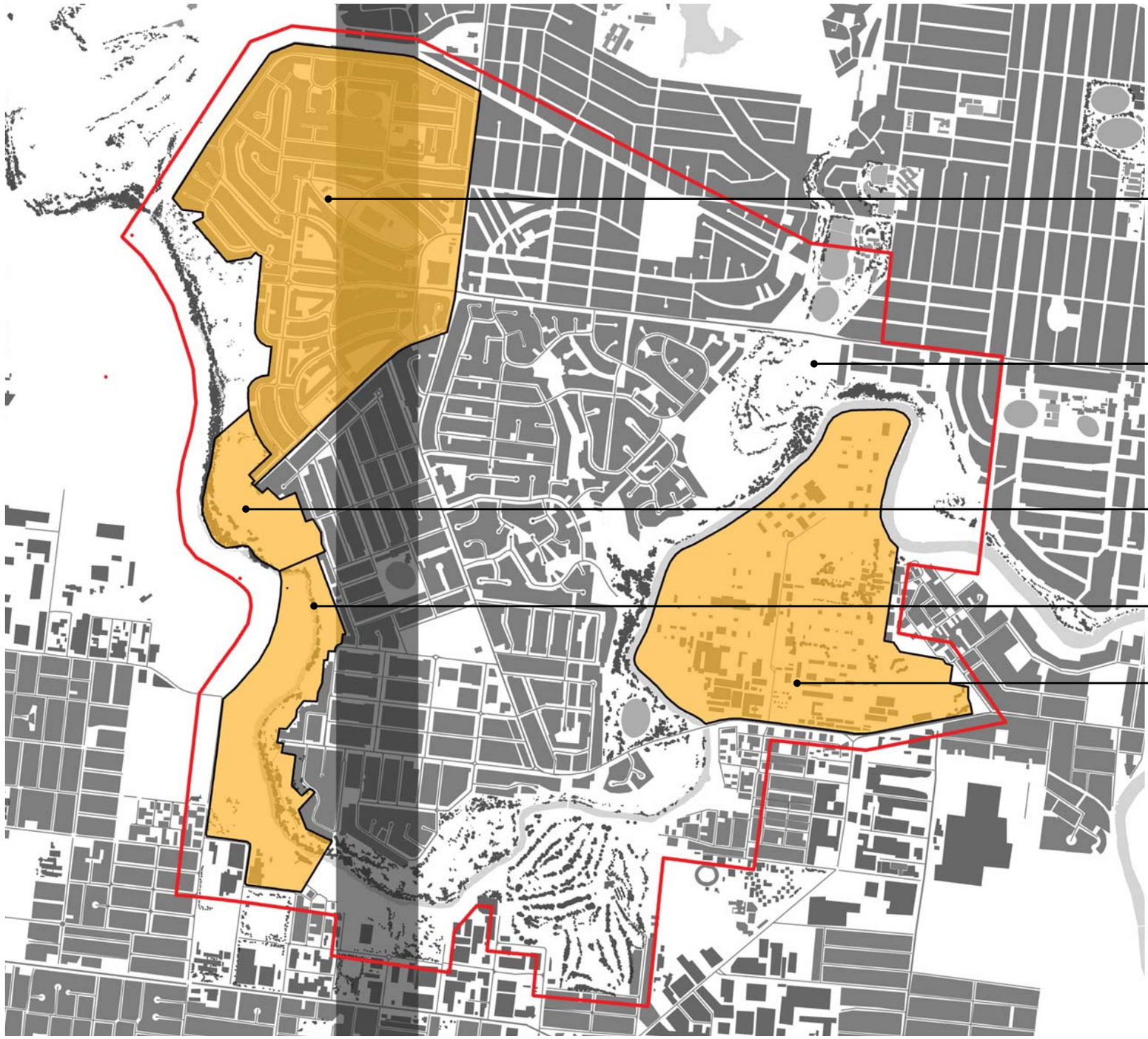


Option 1 - privilege the existing housing.



Option 2 - privilege the river.

Zones of development within a wider field.



Site as field of multiple layers and grounds.
The strategy for the site focuses on the 8km stretch of river and its surrounding suburbs on the north side.

A series of development zones were established as part of the strategy, four of which have been further developed as part of this research.

The four housing scenarios and overall strategy for the site have been investigated using each of Allen' principals and overriding themes as tools to develop analysis, strategy and design for housing.

Part of the testing on site was to investigate whether or not each and every principal could be applied to the development sites across a variety of scales. To create a landscape which did respond to all of the principals would develop an infrastructural landscape which could react to the ongoing dynamics of the site.

To be infrastructural is to work with the following key notions.

01 Prepare the ground: establish the skeleton that drives land form and surface conditions, creating different possibilities for development types that work with the landscape.

02 Be precise and indeterminate: use specific interventions which work with existing processes in the landscape to create change. Although precise, these interventions can have a range of outcomes depending on the reaction and adjustment to the change, but will ultimately contribute to the overall system.

03 Create a directed field: by preparing the ground and determining surface characteristics the landscape becomes a directed field which guides particular activities and the need for further interventions from different design fields.

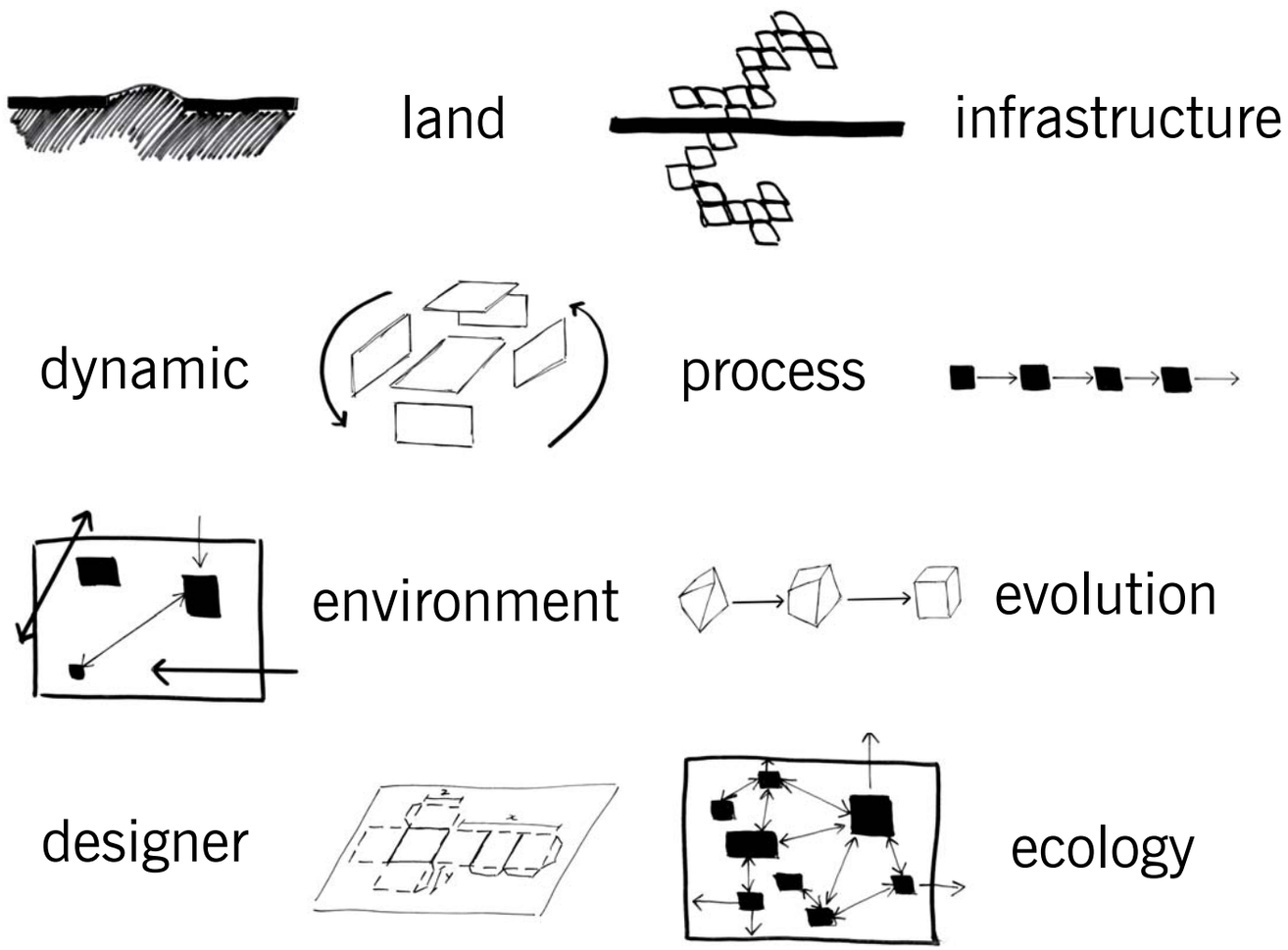
04 Accommodate local contingency while maintaining overall continuity: working with a hybrid system that combines both natural and man-made infrastructures means working a range of scales simultaneously. It is important to understand the effect of change within the site but also the consequences on neighboring areas and the wider network.

05 Organise and manage complex systems of flow: within an urban environment it is important to understanding and consider all systems both visible and non-visible within the site. The landscape needs to allow for the complex movement associated with people and housing developments but also the flow of water and shifting topographies.

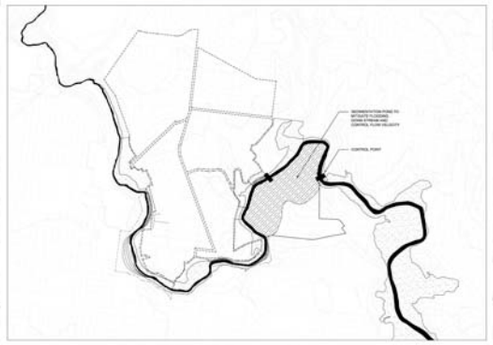
06 Understand the role of ecology: connections and movement are a fundamental part of any system. Understanding the principals of landscape ecology offer the opportunity to look at the quality of these connections and how they can be altered to improve interaction with the environment.

07 Use specific architectural elements: when considering housing a part of the system visible form is important when investigating relationships between the topographic condition, surface characteristics and how these forms may influence the flows and processes within the landscape. These elements work like the 'sticks' to create change within the landscape.

The following section outlines the investigation into each of the zones, Catchment, Drain, Conduit and Sink and the development of the overriding themes Catalyst, Time, Cause and Effect, and Experience.



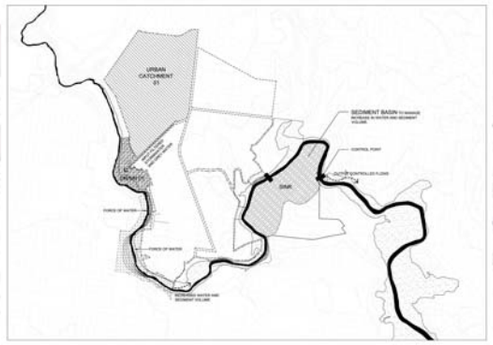
A series of diagrams taken from the 'Dictionary of Infrastructure' developed as part of this research to pull out key components of infrastructural systems and to understand their meaning through the act of sketching.



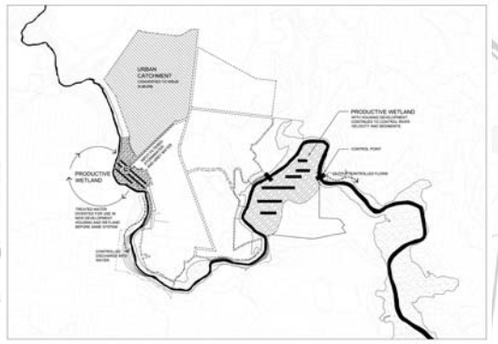
A selection of scenarios that could be implemented from the Strategy depending on the sites economy, extent of water restrictions, and housing market.

Although each of the zones contribute to the overall strategy and work as a unified system it is important that they can also act in isolation.

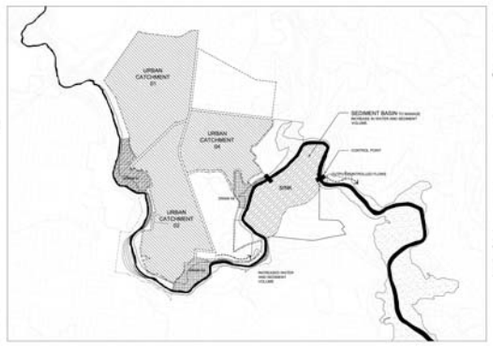
Scenario 1:
Convert the Sink zone into a sedimentation basin to control flooding downstream in the suburb of Flemington.



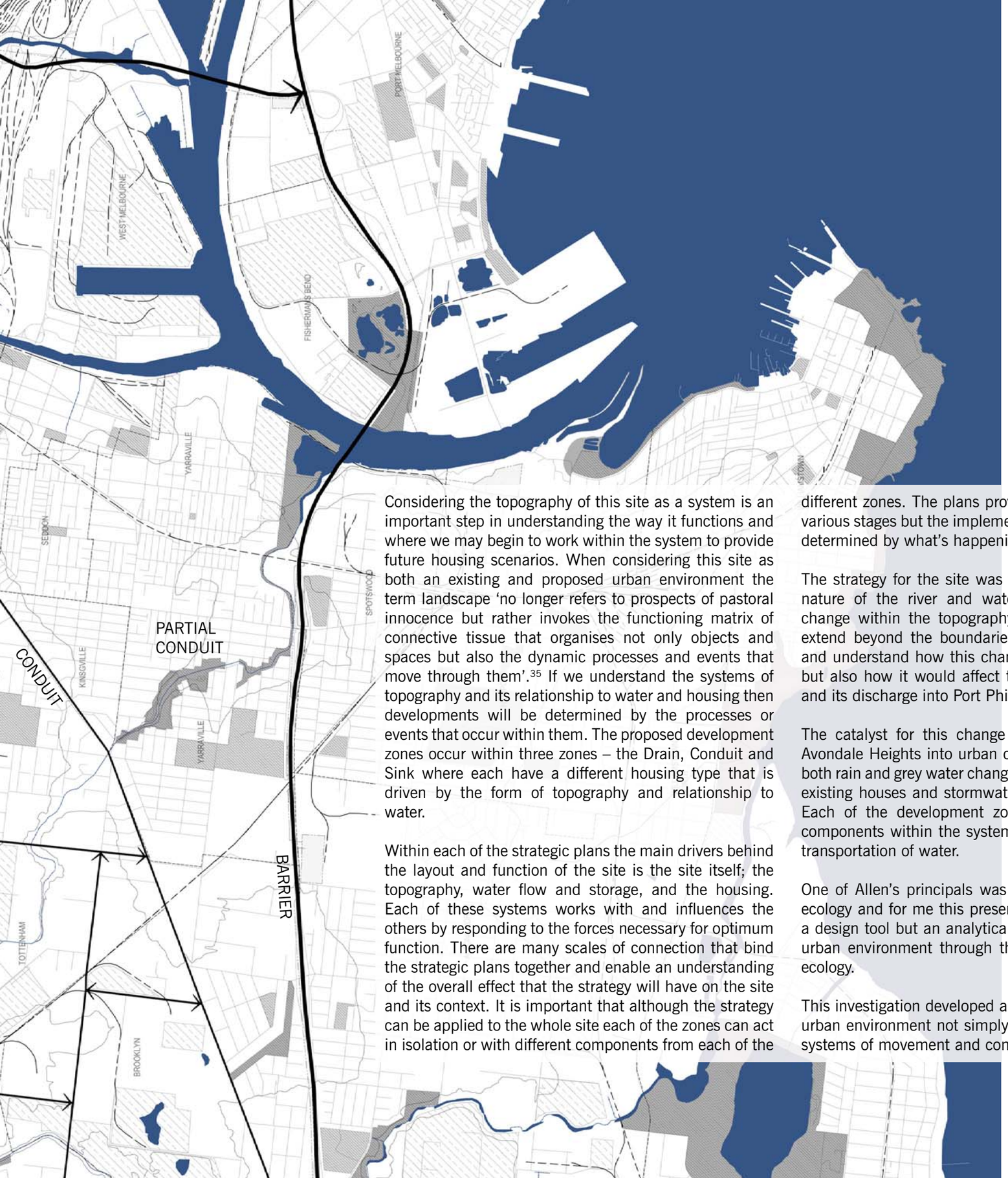
Scenario 2:
Convert one section of the existing suburb into an urban catchment and develop a wetland within the Drain zone to treat the water. The sink would remain a sedimentation basin to retard the extra volume of water within the river and the increase in sedimentation loads from erosion in the Conduit zone.



Scenario 3:
Develop the Drain and Sink zones with new housing. The dwellings within the Drain would contribute their grey water to the system integrating the housing with the wetland which could produce clean water for the residents to use.



Scenario 4:
Convert most of the suburb into urban catchments and corresponding Drain zones. The Sink would initially take extra volumes of water and sediments but each catchment zone could act as isolated systems that produce clean water for re-use.



Considering the topography of this site as a system is an important step in understanding the way it functions and where we may begin to work within the system to provide future housing scenarios. When considering this site as both an existing and proposed urban environment the term landscape 'no longer refers to prospects of pastoral innocence but rather invokes the functioning matrix of connective tissue that organises not only objects and spaces but also the dynamic processes and events that move through them'.[35] If we understand the systems of topography and its relationship to water and housing then developments will be determined by the processes or events that occur within them. The proposed development zones occur within three zones – the Drain, Conduit and Sink where each have a different housing type that is driven by the form of topography and relationship to water.

Within each of the strategic plans the main drivers behind the layout and function of the site is the site itself; the topography, water flow and storage, and the housing. Each of these systems works with and influences the others by responding to the forces necessary for optimum function. There are many scales of connection that bind the strategic plans together and enable an understanding of the overall effect that the strategy will have on the site and its context. It is important that although the strategy can be applied to the whole site each of the zones can act in isolation or with different components from each of the different zones. The plans provide the framework for the various stages but the implementation of the plans will be determined by what's happening on site.

The strategy for the site was to work with the dynamic nature of the river and water movement to instigate change within the topography. To do this I needed to extend beyond the boundaries of the development site and understand how this change could be implemented but also how it would affect the entire flow of the river and its discharge into Port Phillip Bay.

The catalyst for this change is to convert sections of Avondale Heights into urban catchments and to harness both rain and grey water changing the interaction between existing houses and stormwater and greywater systems. Each of the development zones then act as different components within the system of catching, storing and transportation of water.

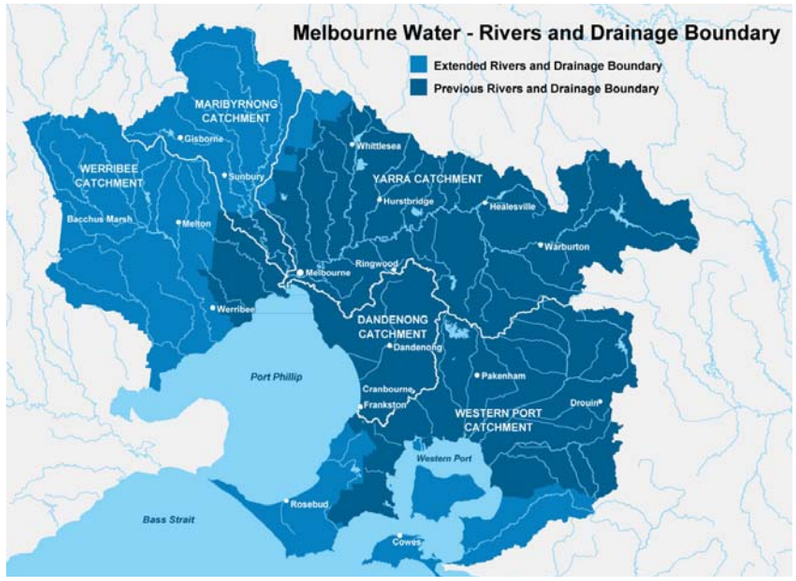
One of Allen's principals was to understand the role of ecology and for me this presented an opportunity not as a design tool but an analytical tool for understanding an urban environment through the principals of landscape ecology.

This investigation developed a way of reading an existing urban environment not simply as lines on a page but as systems of movement and connection. Freeways become barriers, roads conduits, linear spaces corridors and open spaces are either patches or nodes depending on whether they are connected to a conduit.

Field Operations often use the notion of patch + node, points + lines within their work to generate design, here it is about understanding site and its connections to the wider context and how a new design may affect the systems surrounding it.

One of the problems I had was representing the many connected and varied types of movement that exist if you consider all types of infrastructure both visible and non visible. The plan dscribing the wider catchment of the river in no way represents the complexity that these systems create, and although an in depth analysis was done; only a select few layers have been pulled out.

Although I believe this plan gives you a clear understanding of the sites context it does not describe the dynamic nature of the infrastructure systems beyond their object qualities. To shift this perception I have developed the key operating systems of Catchment, Drain, Conduit and Sink, and while each have separate qualities and agendas they are all inherently related and link through the operating systems and site conditions.



The area of operation for Melbourne Water. The proposed Urban Catchment zone sits within the Maribyrnong Catchment.

Urban Catchment Plan:
Impervious surfaces of rooftops and roads become catchment, distribution and discharge points. The road layout (not the topography) drives the hierarchy of flow.

Catchment

The Catchment area chosen for investigation is a section within the existing suburb of Avondale Heights. The structure of the catchment is an urban environment constructed with impervious road surfaces, large set backs and nature strips. Stormwater is currently collected in a system of pipes hidden beneath the road and visible only through locations of pits and drains. Potable water is discharged into the sewer system and there is no connection between the residents and their water infrastructure.

The current function of the catchment is to instigate quick relief from storm events by directing run-off into to the stormwater system where it is discharged into the Maribyrnong. As this is an urban catchment it also allows for the function of human and vehicle movement, and contains social, cultural and political forces.

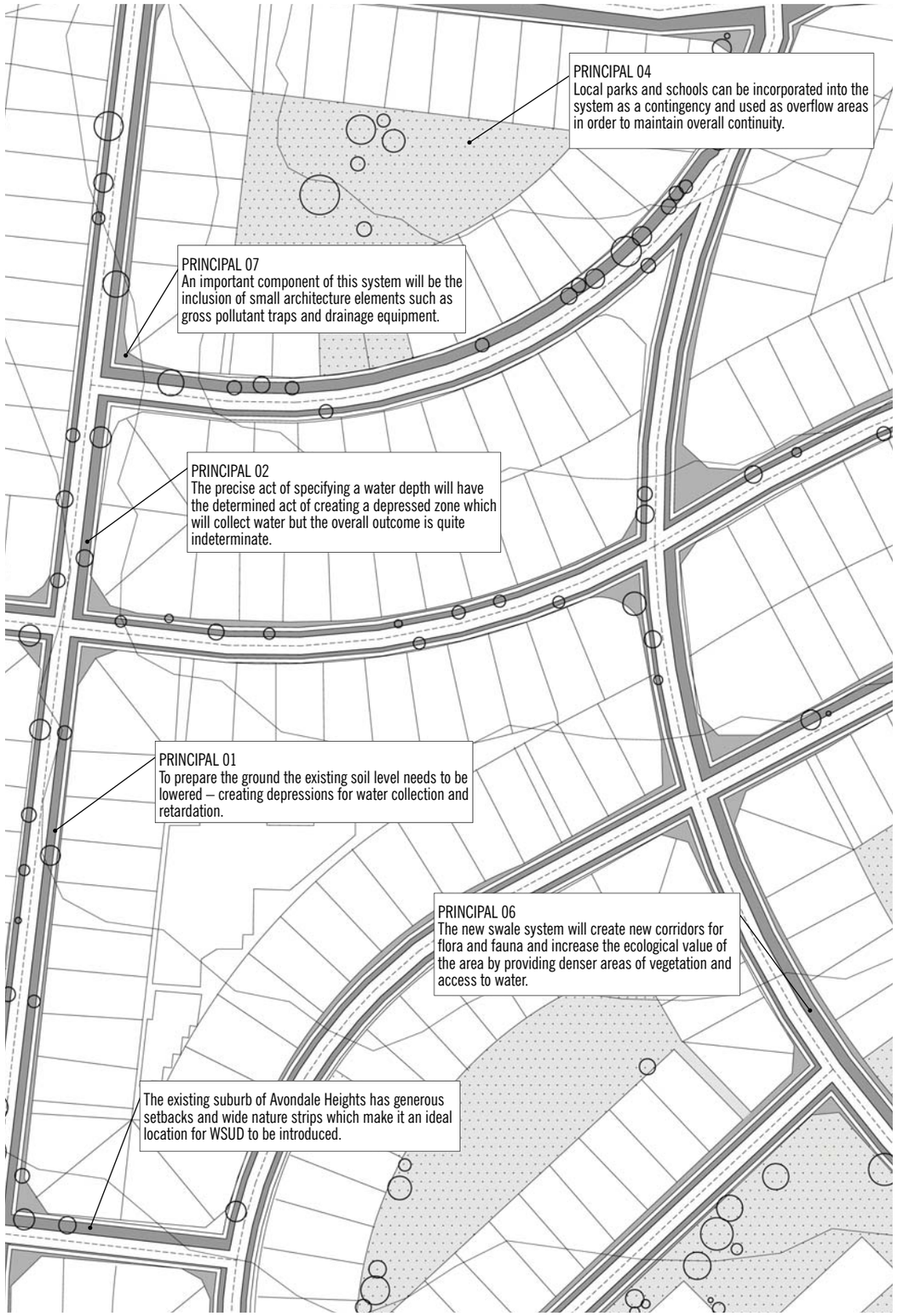
To convert this suburb into a catchment there are two scenarios. The first does not change the physical or programmatic aspects of the area and simply taps into the existing stormwater system and treats the water in a productive wetland within the Drain zone before it reaches the river. This option would require minimal cost setup within the catchment but relies on the existing infrastructure systems and their ongoing maintenance.

The preferred scenario is to take advantage of the catchments structure by converting the area into a WSUD suburb. Both stormwater and grey water is re-directed into swales which are placed within the nature strips and diverted via overland flow into the Drain zone where it will again be treated before discharge or re-use. The landscape will now act as a drainage infrastructure superseding the existing underground system. This scenario alters the layers within the landscape by bringing the water infrastructure to the surface enabling residents to engage with the system. This will dramatically change the suburb creating a new ecology for flora and fauna as well as human activity. By converting grey water there is a constant flow of water into the Drain zone which improves function of the wetland and increases the amount of reusable water.
By complimenting the existing surface types in the suburb with filtration and treatment surfaces the environment becomes an integrated water infrastructure. By taking advantage of the large set backs in the suburb and preparing the ground by created depressions within these zones they become areas of water collection and filtration.

There is evidence within the suburb that the residents have a close connection with their environment and often take over the spaces adjacent to or within close proximity of their home. By creating these new garden spaces they become a direct field in which the residents have the opportunity to plant, maintain and take pride in these new spaces.

When considering a new definition of landscape if you consider it an infrastructure the notion of surface become an important factor when considering the ability of something to be productive or to have multiple uses.

By using different surface types to define the system, the environment itself drives the design and becomes the infrastructure which sets up the skeleton for future use. This offers a new landscape approach to WSUD superseding procedures that do not address the overall system within the site, or the connection between the system and the residents and opportunities that this type of water infrastructure can offer.



Remove existing concrete kerb and channel then convert into planted / grassed swales for treatment of storm and grey water

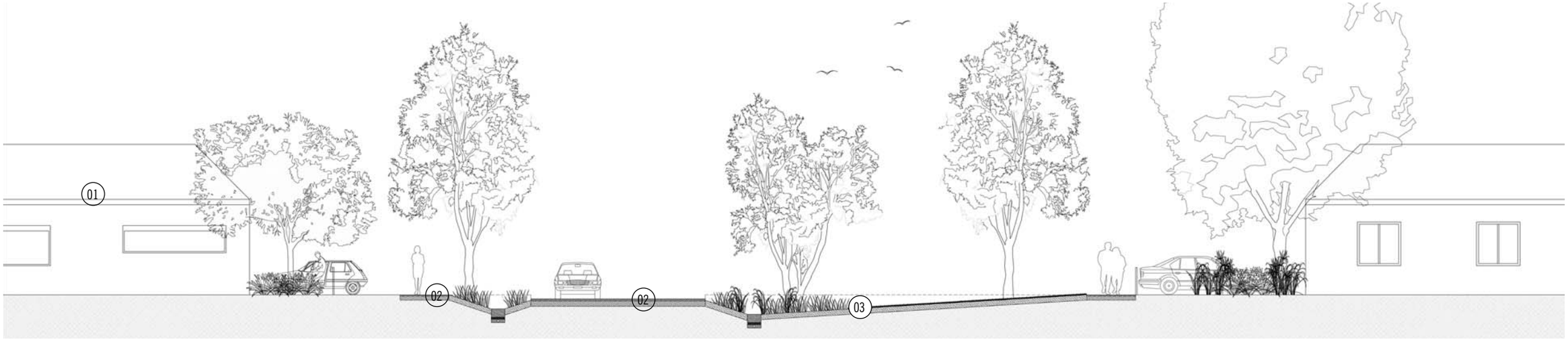
Prepare the ground by removing soil, creating depressions for water collection and treatment

Diver grey water from existing housing into swale system

Use existing roof surfaces to capture rain water

Use existing impervious surfaces for collection and distribution of water and to maintain access within the site

Investigative photo-montage describing the conversion of Avondale Heights into a water sensitive suburb.



Typical section describing the surface types in the converted suburban street, using the WSUD Engineering Procedures Manual as a guide for edging details, slope and filtration methods

Urban Catchment surface conditions plan

Surface type 1 – collection (roof surfaces)

Surface type 2 – drainage (Impervious surfaces)

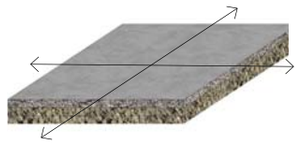
Surface type 5 – storage enabling the landscape to accommodate local contingency while maintaining overall continuity

Surface type 4 – treatment

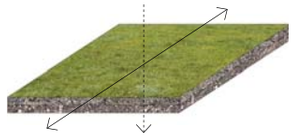
Surface type 3 – filtration (vegetated surfaces)

Impervious, angled roof for catchment of rain water

Flat roof for production (human use) or treatment

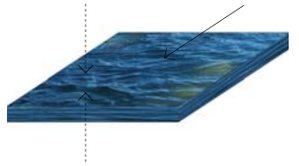


Impervious surfaces distribute and direct run-off and rain water



Distribution and filtration of run-off and rain water

Filtration and treatment of run-off and rain water



Collection of run-off and rain water

Description of Urban Catchment surfaces which form the main infrastructures within not only the Catchment but also across the other design scenarios.

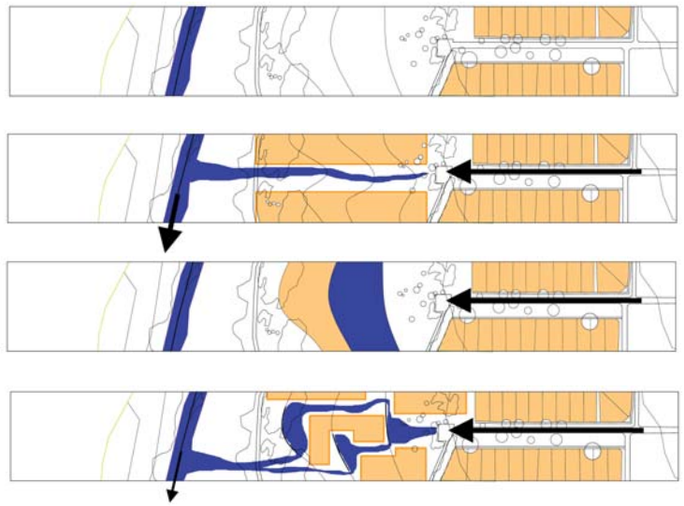
Existing topographic conditions

Existing water paths

Existing topographic mesh

Existing grades

Understanding the relationship between housing, existing topography and the force of water flow.

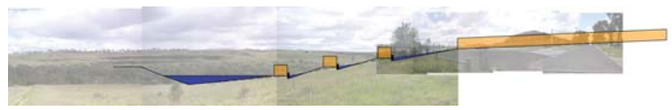


Existing conditions.

Direct force:
Housing creates a channel directing water into the river.

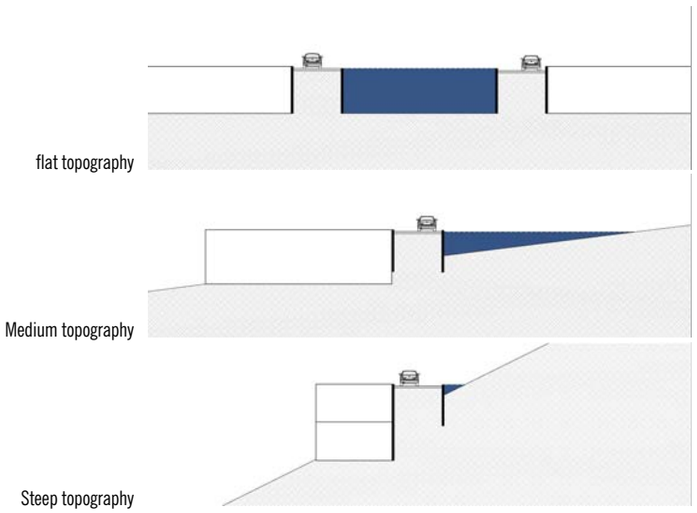
Blocked force:
Housing acts as a dam wall creating areas of retardation and potential wetlands

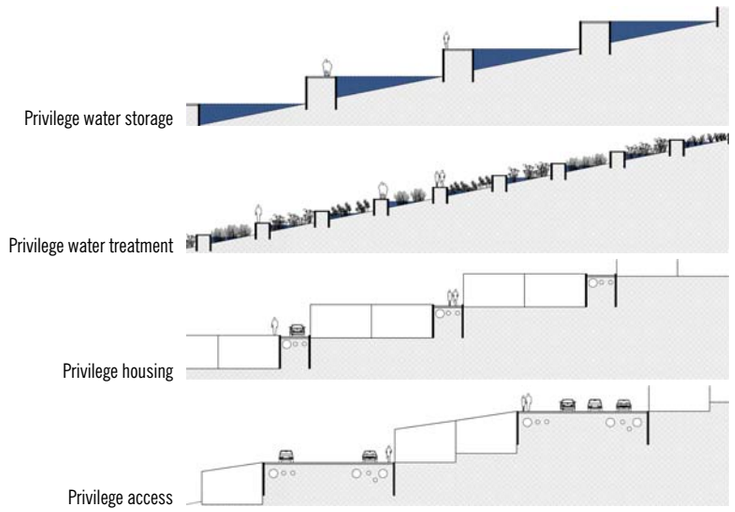
Interrupted force:
Housing acts as both a dam wall and channel.



Testing the notion of ‘open space’ with the inclusion of a specific housing typology

Sectional diagrams describing the relationship between topography, water and housing





Drain

The drains structure is defined by the flow of the river, its flood zone and the existing suburb of Avondale Heights. Its spatial pattern is determined by the topography which currently facilities the flow of water directly into the river through surface and subsoil flow. The Drain site is quite steep and grades range from 1:4 to 1:14 There is a substantial area of grassland between the existing housing and the river which does not appear to have a high level of use, structured or non-structured.

The drain will change by improving the current function and relationship between existing and new housing with the river. At present there is no connection to the river other than a single pedestrian path with limited access.

The first stage of development for the Drain is to create a productive landscape to treat the Catchment water and discharge it into the river where it will flow through the Conduits and be collected within the Sink. The landscape here becomes infrastructural in the operation of water treatment. The wetland configuration sets up the framework for the next stage by providing locations for roads and housing, acting as the primary infrastructure. Once housing is developed the system would adjust to provide potable water to the housing, creating an internalised system that works in conjunction with the development.

This site was about working with change over time by using specific architectural elements to influence the shift. One of Allen's original arguments stated that infrastructure design begins with the precise delineation of specific architectural elements within specific limits.

Thinking of landscape in this way opened up the notion that infrastructure as object could actually be a useful design tool.

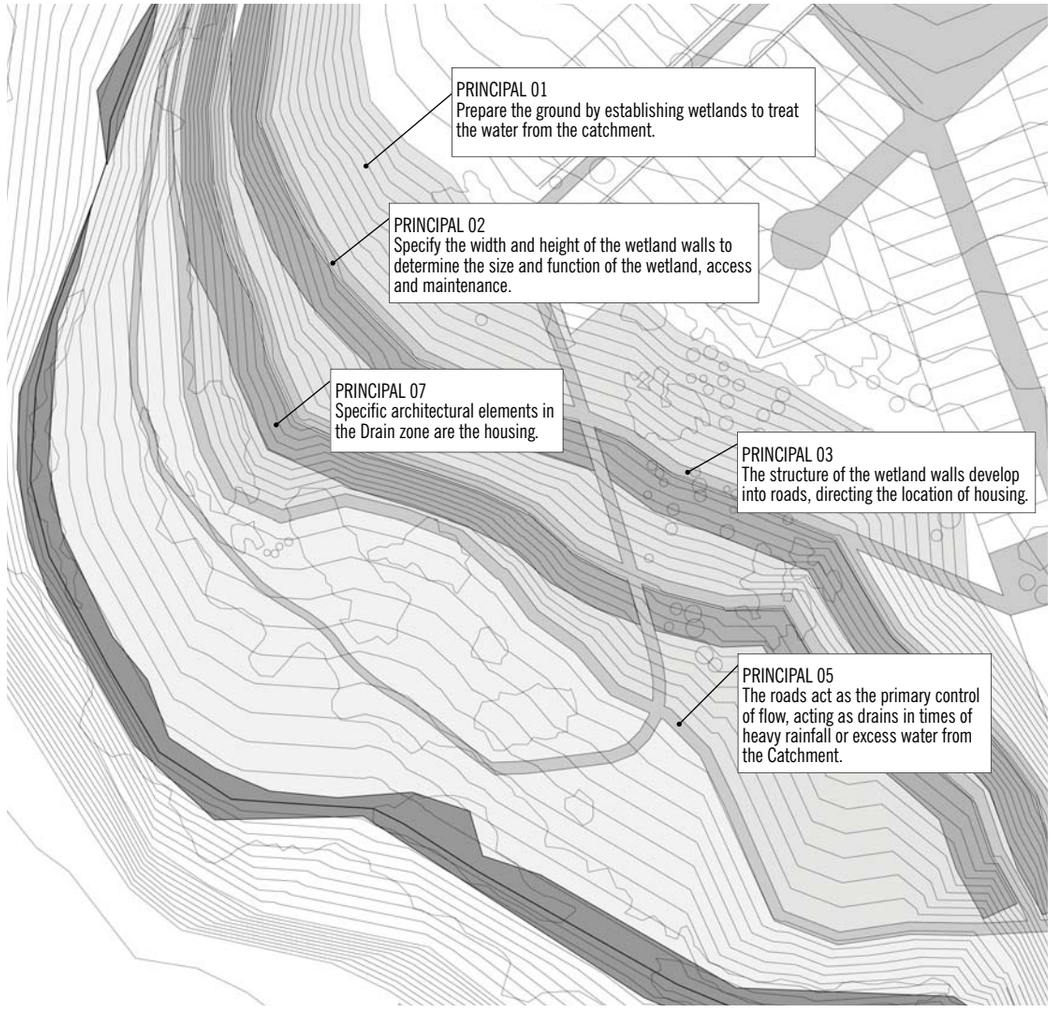
Landscape design does not often begin with the positioning of an object but here they are used to manipulate the flexible nature of the topography and water as the force of their movement reacts against the object. The architectural element used to do this is simple two walls that sit at a precise height depending on the slope of the adjacent ground.

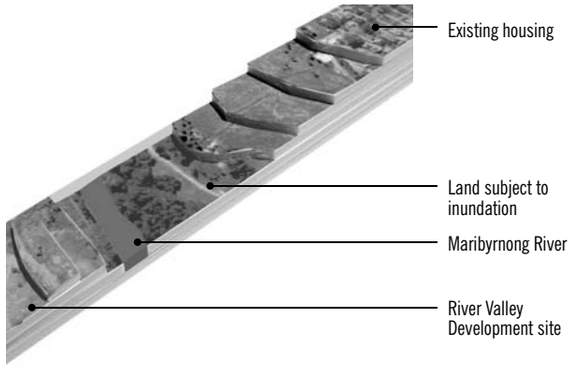
The site then goes through a series of shifts influenced by the force of change in the catchment. At each stage the development could cease however the effects on neighboring areas and potential change across many scales would need to be addressed.

This AVR describes just one of the many outcomes that could occur during this development process. By Privileging one component over another different outcomes could also arise.

One of questions I had when I started this design test was whether or not I could introduce housing along the Maribyrnong without losing existing open space. By working within the topography of the site and the forces of water movement object and landscape become one system providing new types of open space with an increase in possibility for use.

The next stage of development would be to understand the system as it changes in response to the new housing. It is envisaged that once the housing becomes a part of the system they would contribute grey water and re-use the treated water on site. Thus, minimizing future discharges into the Maribyrnong.





Topographic model of existing conditions on site.

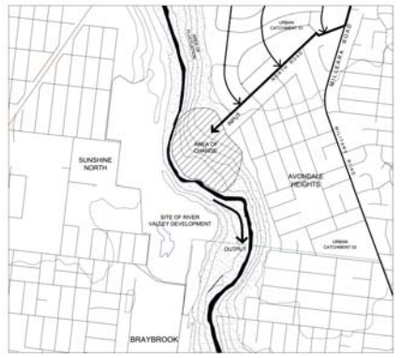


Diagram describing the structure, function and area of change for the Drain zone.

01 Position of architectural elements.

Two simple walls which sit at a precise height depending on the slope of adjacent ground.

02 Placement of fill to create access.

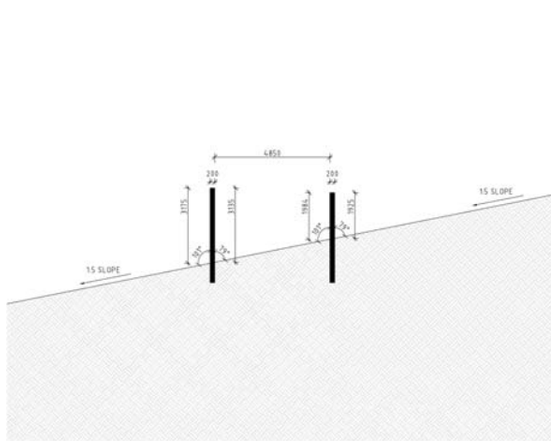
Walls are initially filled with excavated soil from the Catchment and topped with an impervious surface to provide access into the site.

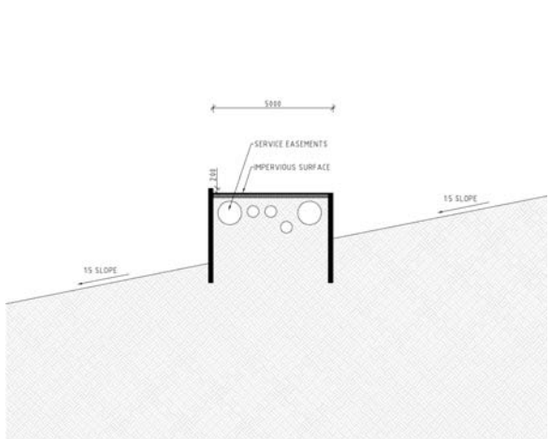
03 Collection of water from the Catchment.

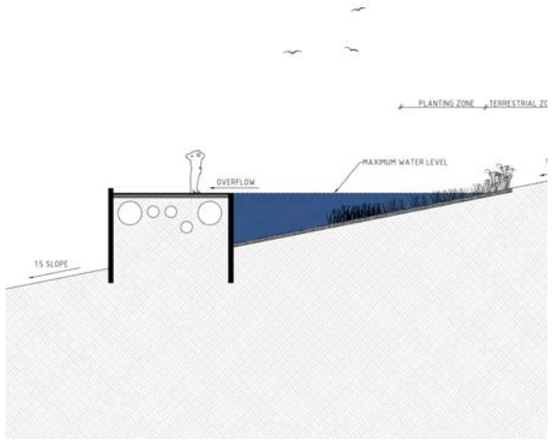
First stage of water production on site, where the walls / road act as dams, also creating a unique opportunity for recreation and ecology.

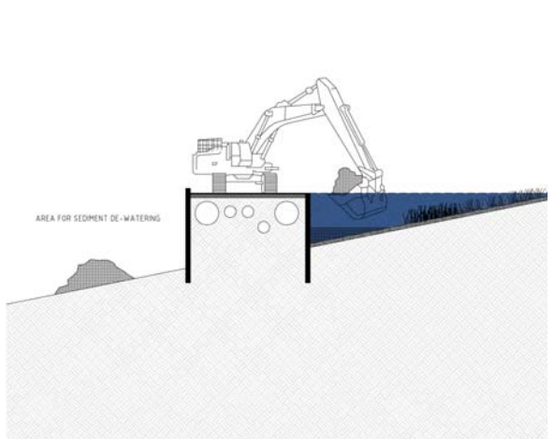
04 Removal of sediments.

Sediments from the ponds are removed and distributed on the opposite side of the wall to level the adjacent ground. The build up of sediments could take up to 5 years so the site would remain a production and recreation zone allowing the landscape to mature before the development of housing.

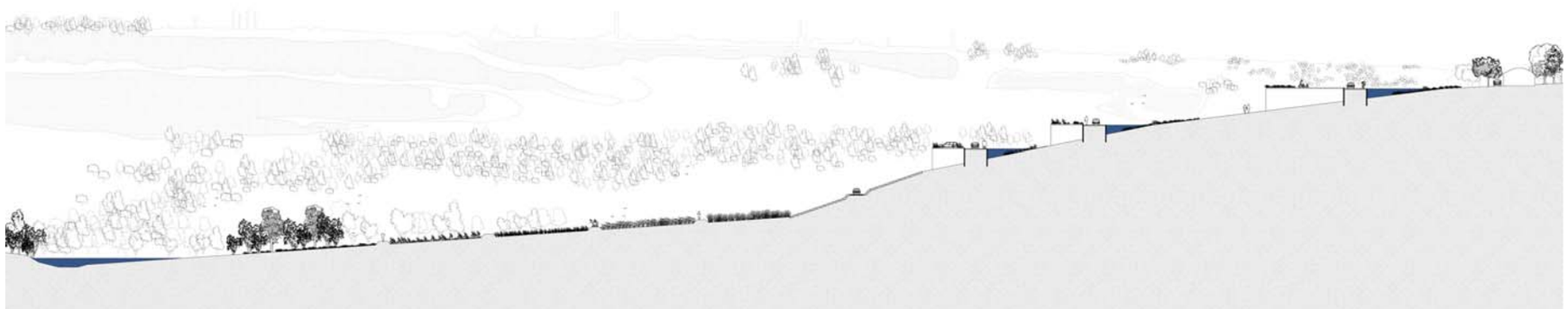








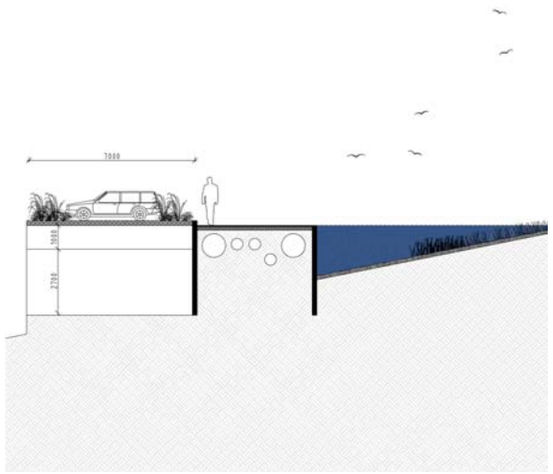
Progressive example of one type of development which could occur in the Drain zone. This testing was done on a 1:5 slope however as the slope changes the type of housing and water collection also changes creating a variety of housing types and environments across the site.

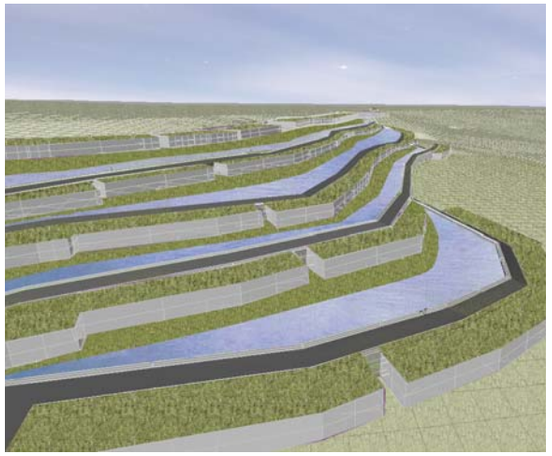


Typical cross section describing the relationship between topography, water and housing

05 Attach dwellings to services within the road.

Once the need for housing arises the flatter areas of ground become ideal building sites. Services could be located within the access routes to minimise disturbance to the ponds.

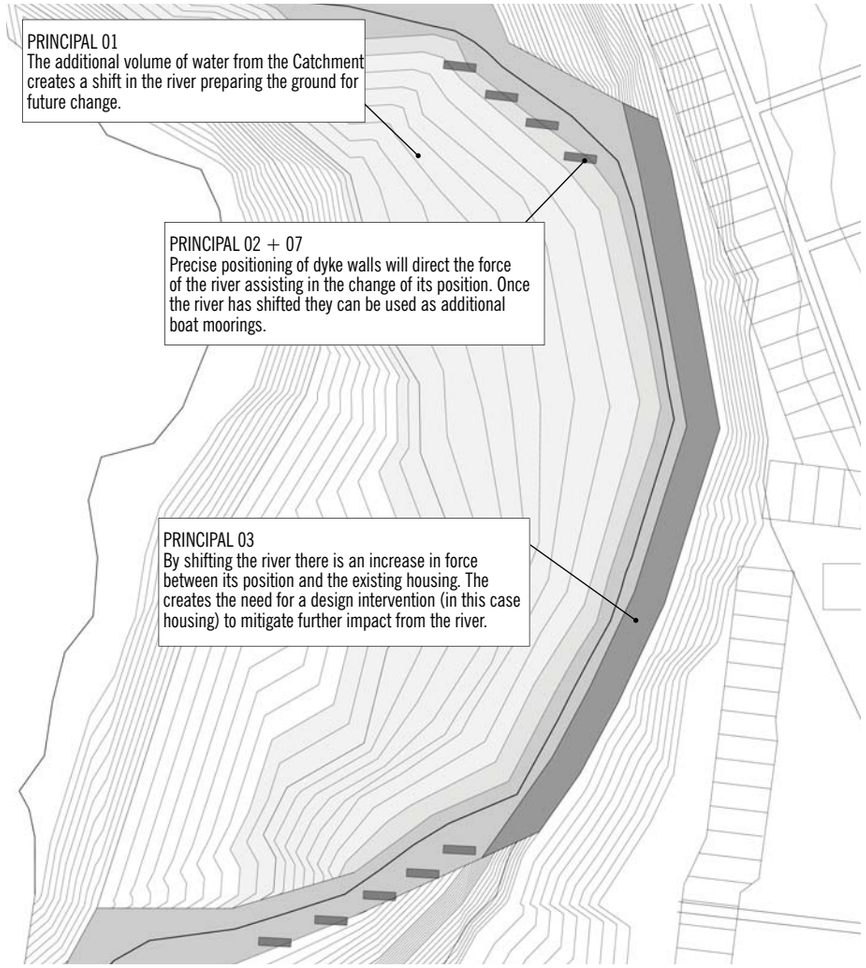


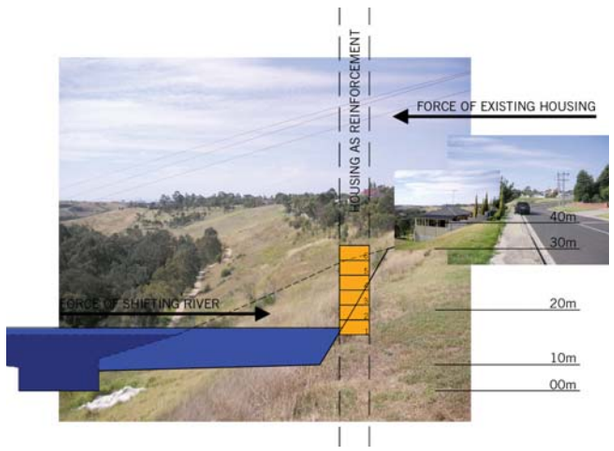


Perspective render describing the main surface conditions

Perspective montage describing the possible occupation of the site

Topographic model describing the sites condition after the addition of housing, the visible flat areas are the rooftop spaces which become usable open space whilst increasing the amount of housing.





Conceptual section describing the relationship between the existing housing and the river. The housing in the Conduit zone would act as a barrier between the two creating a close relationship to the river for the new residents but without interfering with existing view lines.

Diagrammatic plan describing the shift in river and increase in force between the existing housing and new river path. This directs the need to provide a barrier which will stop further erosion. The housing in this scenario becomes a thick line that has the potential for up to 8 stories of development.

Conduit

The Conduit zone is an area of transition where the river initially flows the fastest, due to the new output from the Catchment, creating a dynamic relationship between the force of the river and the existing housing. The conduit acts like an infrastructure providing a smooth transition between one point and the next. Here the landscape is providing the medium for that transition becoming the pipe which contains the water.

The area available for housing in this zone is very narrow due to the proximity between the water and existing housing but there is considerable difference in height between the two. This has limited the type of housing that would suit this zone and lends itself to a high density apartment style living where there is little or no adjacent open space.

However, in this zone this housing type creates a very close proximity to the water enabling every resident a view of the water from their home and the ability to interact with it directly.

Before housing does occur however the increase in volume of water within the Maribyrnong would need to be addressed, which in this scenario is done within the conduit and sink. By increasing the force in the river and with the help of architectural elements the water will react and should start to shift the topography.

This shift in the river will increase the force of the relationship between the existing housing and the river and create a catalyst to provide a barrier which will stop further erosion and damage to the houses.

This act, and the placement of the walls within the river are very precise moments. Allen writes that by specifying what must be fixed and what is subject to change infrastructures can be precise and indeterminate at the same time. Although this seems like a contradiction in terms when considering the fluctuating nature of the river there is always going to be a degree of indeterminacy in the form of the water and topography.

As a designer it is the involvement in the design and placement of the object that becomes important and I believe one can only achieve this if they have an understanding of the systems and forces at play and the characteristics of site. What also became apparent during the design process was that a high level of precision would require the involvement of a number of different disciplines.

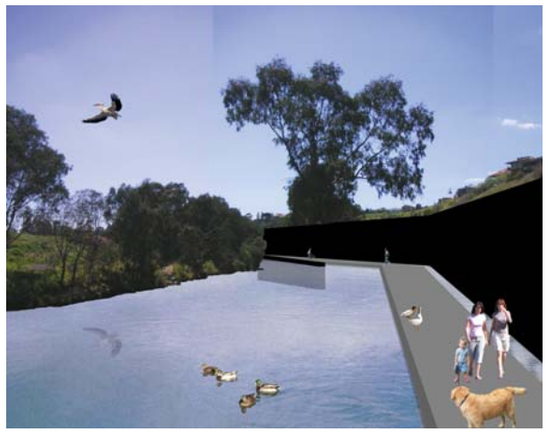
By understanding that you cannot completely control the dynamic nature of the river the line presents a series of option for dealing with the edge between the housing and the shifting water level.

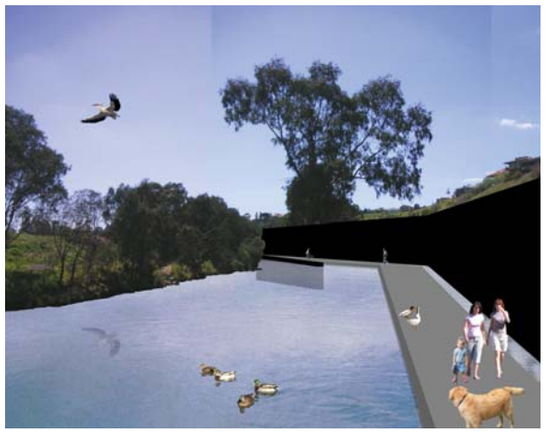
By working with both precision and indeterminacy at the same time landscape and infrastructure become one system reacting and changing to a variety of forces.

Testing the Amsterdam housing model along the banks of the Maribyrnong.

Montage describing a potential edge condition along the housing line that takes into consideration a shifting water line.

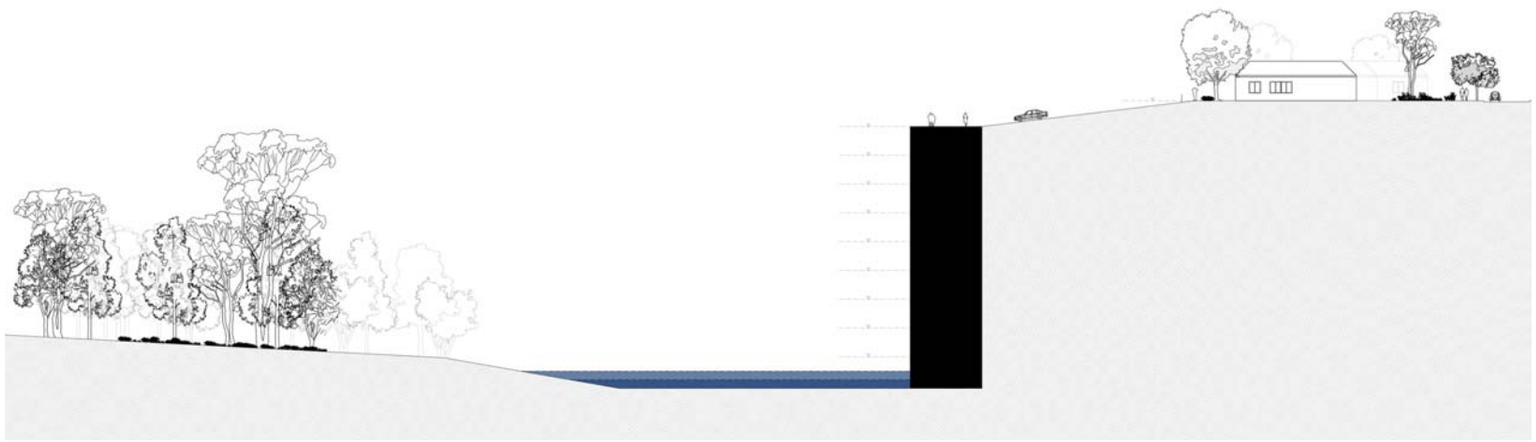
Elevation describing the relationship between the river, new housing and existing suburb.





Montages describing potential edge conditions along the housing line that takes into consideration a shifting water line.

Existing condition within the Conduit zone.



Proposed condition describing the shift in river and new housing line which does not hinder the views from the existing suburb.

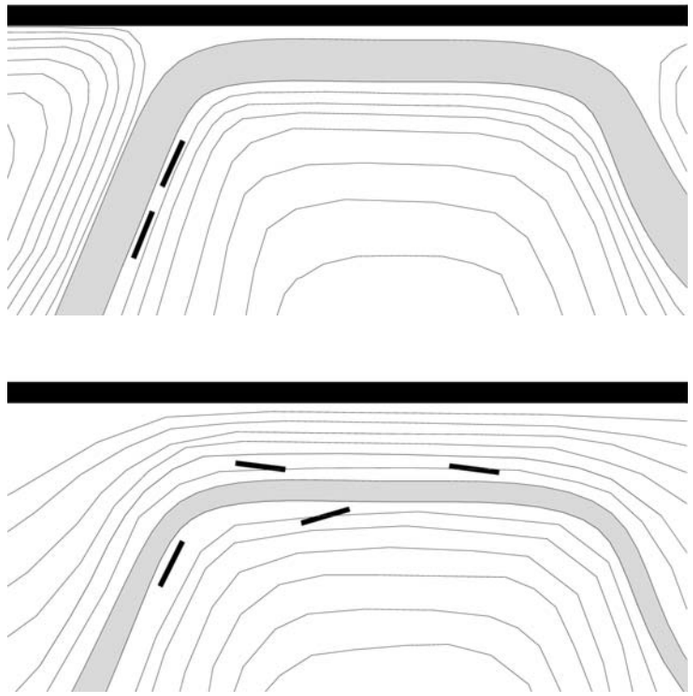
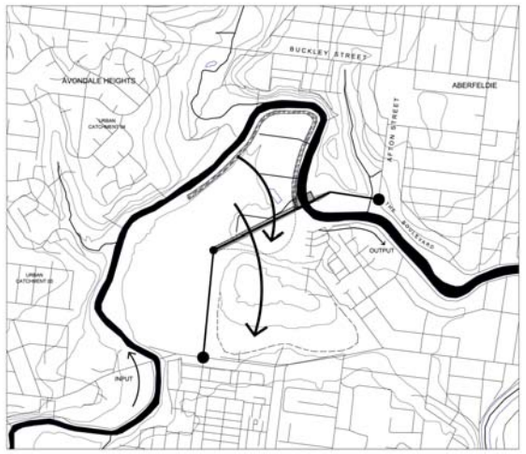
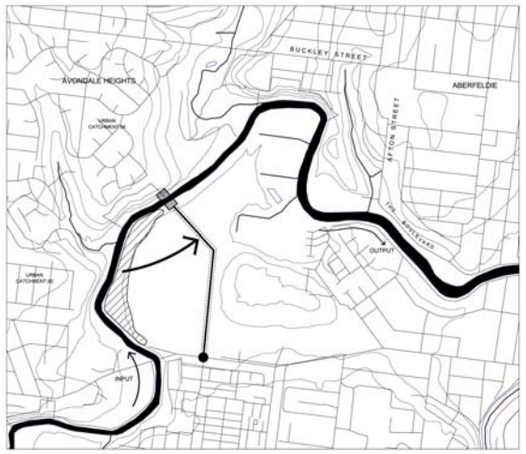


Diagram describing some of the different possible outcomes through changing the location and position of the walls. The housing line remains a constant.

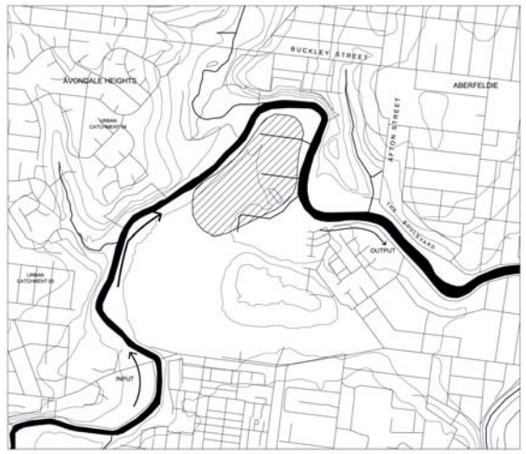
Montage of existing housing types into a new dynamic landscape



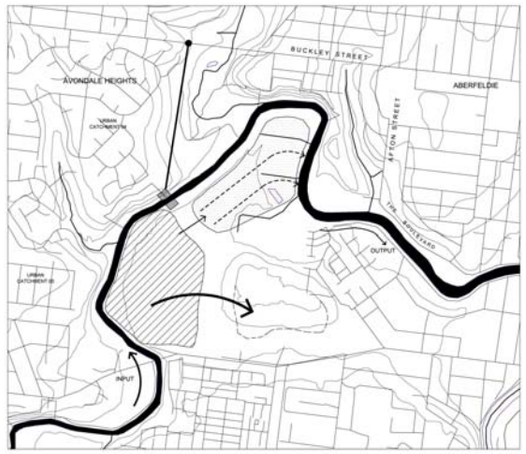
Stage 1:
Relocate part of the existing dyke wall to a new road base forming connections into the site. Excess soil is used to extend the existing mound on site for additional future housing.



Stage 3:
Relocate the remaining dyke wall to additional road connections.



Stage 2:
Removal of the dyke wall increases the flood zone of the river. This area will act as a sedimentation and retardation zone to control flooding downstream and the increase in volume of water from the Catchment.



Stage 4:
Second area for retardation and sedimentation is now available and the original site can be developed into a wetland. Roads will gradually be added to the site by using the excavation of built up sediments in the pond.

Sink

The Sinks structure is defined by the rivers edge and suburb of Maribyrnong. It contains many low rise buildings and topographic mounds needed for the specific uses of the explosives factory existing on site.

The site currently functions in isolation – excluded from the flood zone due to the construction of dykes along the river and it is not open to the public.

Due to the flat topography in this site its primary change would normally be for housing development but within the test site it is a prime water treatment and production zone, sedimentation basin and control point.[36]

Here the landscape works as an infrastructure across many scales by creating a solution to existing flooding downstream and by being able to accommodate changes within each of the other zones. The zone can also act as an isolated area providing the proposed housing with clean water.

This site is one of the areas flagged for development under the Melbourne 2030 Scheme and by turning it into a flood zone traditional development methods are not longer applicable, but they can still be implemented.

Using simple cut and fill techniques, the first stage of development is to create a series of channels which become shallower as you move further into the site, acting as indicators for changes in water level. These areas would gradually fill up with sediments which can be moved to the other side of the road to build up the topography. Eventually the area becomes a combination of channels, shifting topography and areas for housing development. This scheme becomes a directed field which guides where the development can occur but does not set any limits to the type of development.

The notion of experience has always resonated throughout the research and part of understanding the operation of an infrastructural system is about the different types of movement that occur across systems and against their normal flow.

Interestingly when I was working on the design of this site I found myself designing the plot layouts and housing styles as the landscape was driving the desired output. One thing I started to do was allocate open plots for recreational links across the site. I stopped because I was no longer designing infrastructurally – there was nothing to stop these spaces from being built on as they did not have a multiple level of function and operation.

The key open spaces within the sink thus rely on the shifting level of water within the river, a dynamic situation which restricts the placement of permanent objects.

Designing housing plots in an infrastructural way would be a future challenge within this research and questions the role of experience and aesthetics in its evolution.

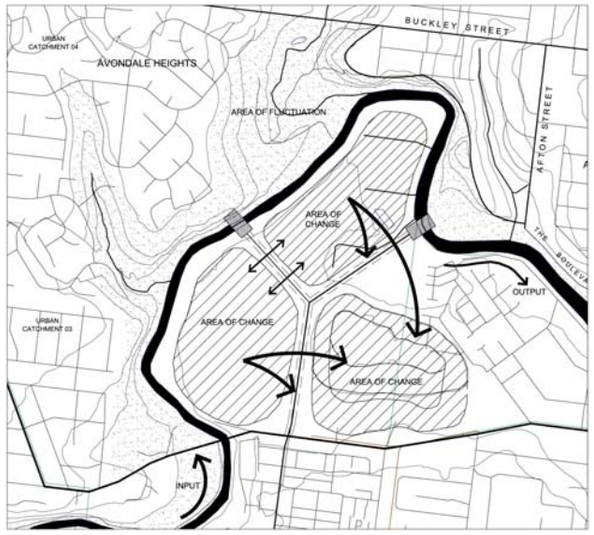
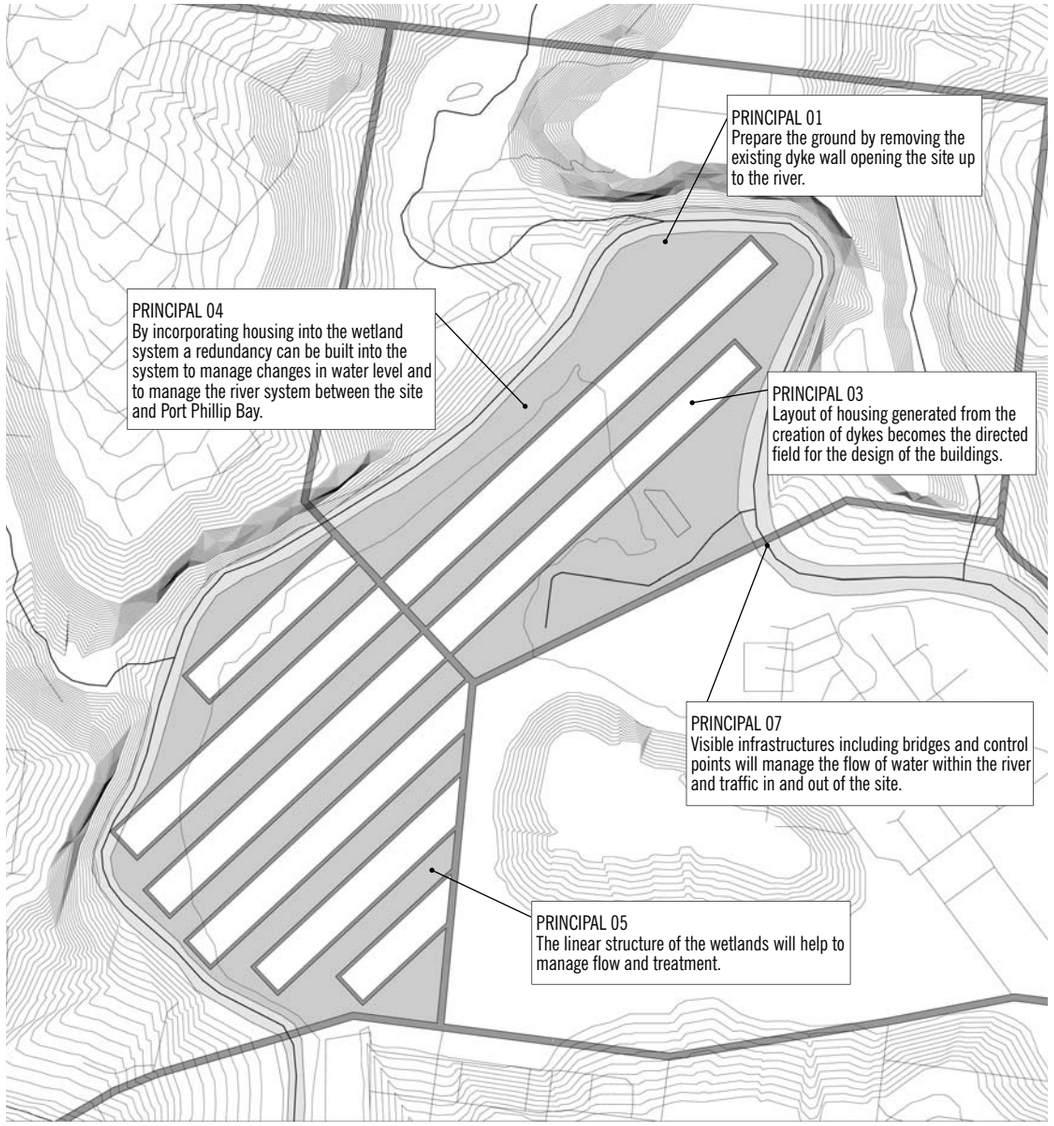
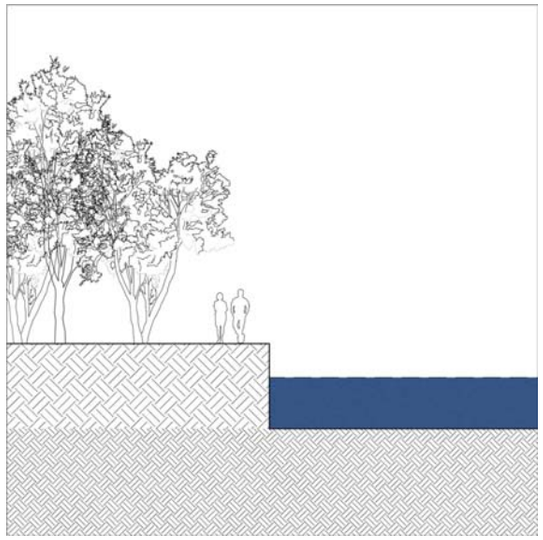
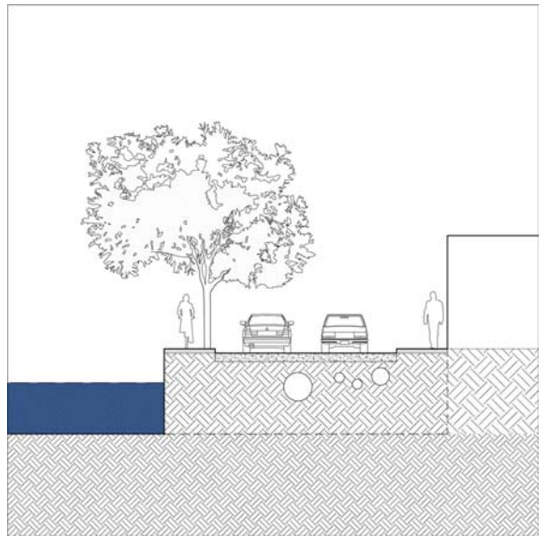
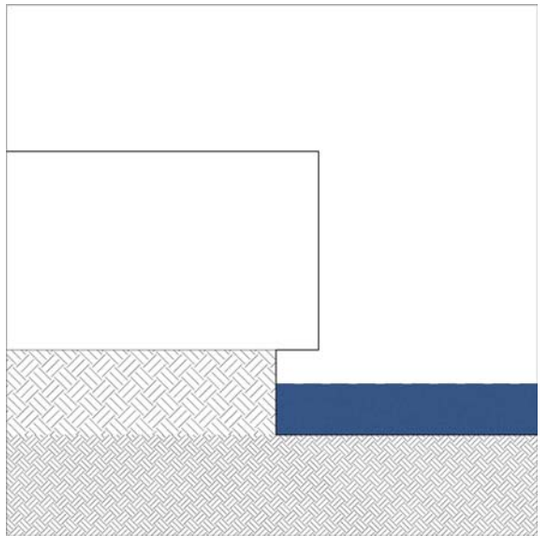


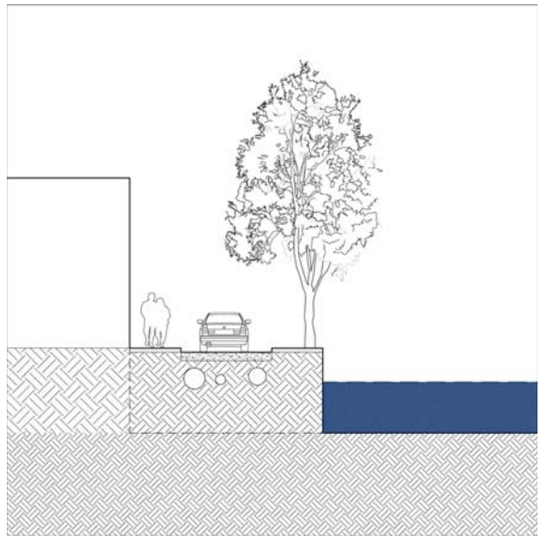
Diagram describing the structure, function and area of change for the Sink zone.



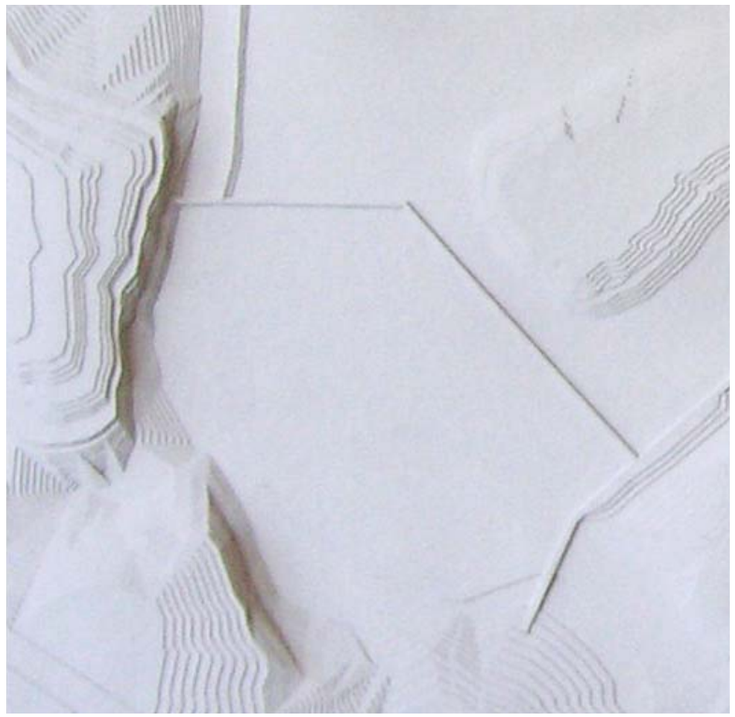


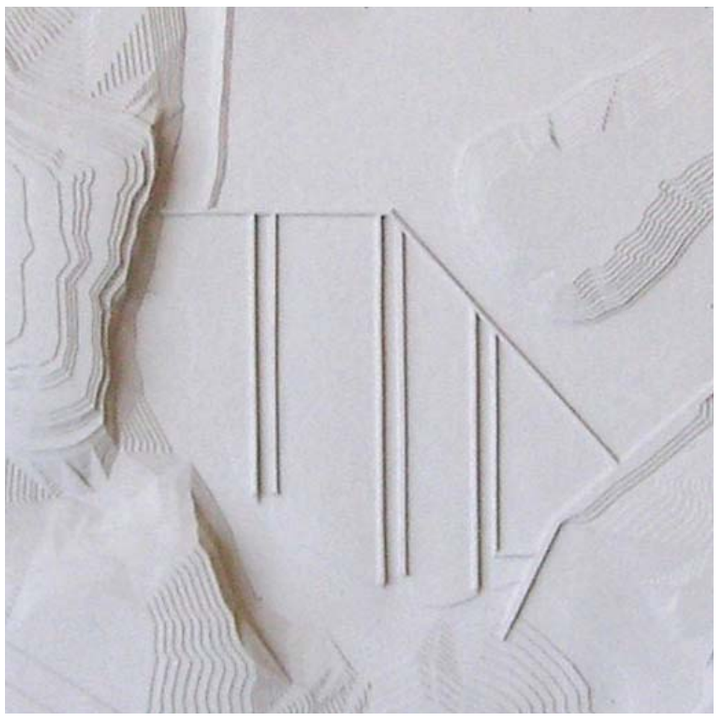


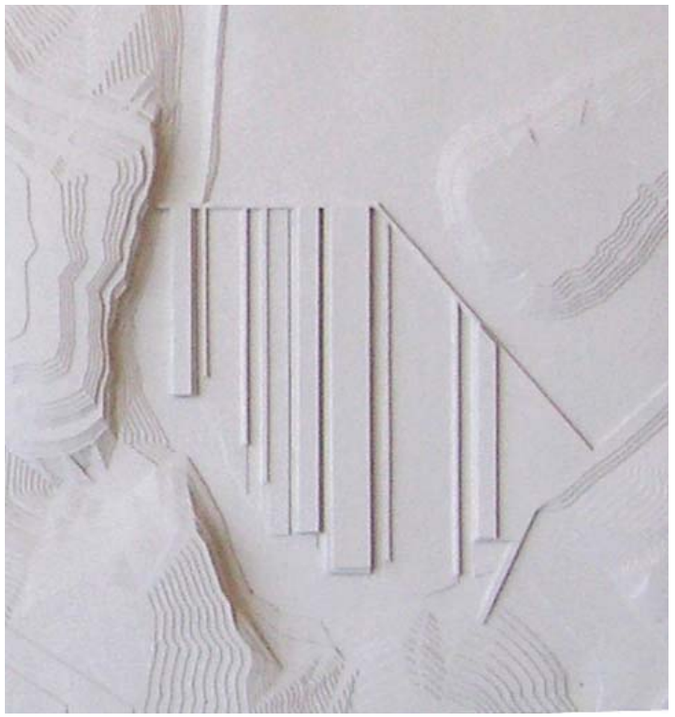




Sections describing the four main relationships between the potential housing and flood zone. Channels are based on a distance of 14m which is the maximum distance required for the equipment to move the sediments and gain access for maintenance.







Topographic models describing the change over time within the Sink zone.

Opposite page: Montage describing new housing zones and a dynamic landscape. At times the channels will be flooded and as such the entire development will have water frontages. At other times the water will recede and provide open space for recreation and access

Conclusion

This research started by trying to establish a series of definitions and categories in which one could understand the terms ‘landscape’ and ‘infrastructure’. This proved to be difficult because these words are essentially dynamic in that they can shift in meaning depending on the context in which they are used. Defining the words through text was problematic for a project based research degree because the text did not engage with the processes on site and the operation of the systems of water and topography. This was one of the problems with The Mesh Book – it was a text heavy publication with little or no examples of the processes associated with design or the systems of landscape and infrastructure. For the discipline of landscape architecture, the principals behind the words – not the words themselves – are useful for design.

This research investigated the principals of infrastructure design using the work of Stan Allen as a vehicle to understood how the principals could be applied to the design of landscape. Understanding how the landscape can precede housing development is to understand it as an infrastructure – one which does not focus on the static nature of built infrastructures but as a dynamic system which works with the qualities of movement and change.

To consider every system that contributes to the urban environment was a daunting task and so this research chose to focus on the systems of water and housing, as a specific architectural element, and how they could contribute to the system of landscape existing on the site. To take this research further would be to understand and look at a range of systems – economical, political, social, environmental and so on. Each of these are important components of the urban landscape and could be tested using the same techniques described within this research. The potential of these principals is that they could be applied to a range of situations and scales – depending on the brief for the design.

Designing infrastructurally is about thinking beyond normal boundaries instigated through project briefs and budgets and to consider how landscapes are part of a much wider interconnected system. To think infrastructurally is to understand the complexity of the urban landscape and the cause and effect that alterations to operating systems will have on the function of the landscape and our relationship to the environment.

This research started with the premise that the landscape is indeed an infrastructure, but if we consider housing a part of the system landscape architects can develop strategies which deal with the development of housing over a much larger time frame and which lets the landscape direct the location and density of the housing.

Each of the sub questions were answered during the course of the research through a series of investigations and design exercises. The questions were not investigated directly, instead the strategy of the principals drove the research which in turn developed solutions. The notion of infrastructure seemed to drive the design process.

The investigations into topography as an infrastructure and how one can understand the notion of surface and slope developed an understanding of the relationships that develop if you consider housing to be a part of the topographic system. To take this further it would be interesting to try and develop a contour mapping system that could be applied to built form so that each of the surface layers within the urban environment could be described.

Considering topography and the system of water initially started out as isolated exercises but it become apparent that the two were fundamentally linked and that they both influenced each other, much like a built infrastructure, you can’t have the form without the flow and visa versa.

Understanding these systems in their entirety meant considering the consequences for change across all scales, and the more information that was discovered the more scales seemed to be needed. Part of the challenge of this question was being able to step back from the drawings and to let the site drive the investigation, not the desired scale or paper size.

The question of representation came up frequently when trying to establish a way of communicating the dynamic nature of the landscape as most representations were in the end static. Being able to develop strategic plans which talked about change over time and the operation of the landscape was an important outcome for this project.
When considering the representation of the systems within the landscape the importance of composition became apparent, and questioned whether the form needs to look good, or as Allen suggested that it is more about how the form functions, not what it looks like.[37] Whether or not ‘function’ is enough is an interesting question for design within a cultural society.

The overriding themes that this research developed in order to understand how landscape architects should design infrastructurally will resonate through the practice of design and within my role as a professional and an educator within the field. By taking the precision and systematic approach from infrastructure design and the flexible, dynamic nature of landscape I was able to create a hybrid environment and understand the potential in the way landscape operates.

Stan Allen once said that ‘If architects assert that signs and information are more important than infrastructure, why would bureaucrats or politicians disagree’.[38] If landscape architects assert and demonstrate that the urban environment is the most important infrastructure, no-one should disagree.

Endnotes

1 MESH was the seventh conference held in the 'Edge' series.
2 At this time Julian was a lecturer in the Landscape Architecture department at RMIT. He is now completing his PhD at the University of Queensland.
3 Excerpt from The Mesh Book introduction written by Julian Raxworthy and myself.
4 JB Jackson, Discovering the Vernacular Landscape, United States: Yale University, 32.
5 In the Landscape Architecture and Places journals which talked specifically about infrastructure and landscape the articles focused on the built form and the need for a closer integration with the system as an object.
6 James Corner uses the term 'agency' to emphasise the activities of design and the effects of constructed landscapes in time.
7 Victorian Government, 'Municipal Strategic Statement - Clause 21.03', Maribyrnong Planning Scheme, 9 December 1999, 1.
8 op cit.
9 Creating a new system for 'open space' and housing development could supersede the notion of the 'green wedge' and allow a much closer relationship between the environment and urban living. A 'green wedge' refers to a parcel of land set aside by the government to preserve open space and restrict the spreading of urban development but is often not used to its full potential.
10 Stan Allen, Points + Lines: Diagrams and Projects for the City, New York: Princeton Architectural Press, 1999, 73.
11 Alex Wall, 'Programming the Urban Surface', in Recovering Landscape: Essays in Contemporary Landscape Architecture, James Corner (ed), Princeton Architectural Press, New York, 1999, 233-249, 233.
12 Gary Strang, 'Infrastructure as Landscape', Places: Infrastructure as Landscape, Landsacpe as Infrastructure, vol 10, no 3, summer 1995, 9-15, 10.
13 Grahame Shane, 'The Emergence of "Landscape Urbanism": Reflections on Stalking Detroit', Harvard Design Magazine. Fall 2003/Winter 2004, Number 19, 4.
14 James Corner, 'Terra Fluxus', The Landscape Urbanims Reader, Charles Waldheim (ed), New York: Princeton Architectural Press, 2006, 21-33, 29.
15 Richard TT Forman, Land Mosaics : the Ecology of Landscapes and Regions, United Kingdom: Cambridge University Press, 1995, 5.
16 Roel van Gerwen, 'Force Fields in the Daily Practive of a Dutch Landscape Architect', The Mesh Book: Landscape/ Infrastructure, J.Raxworthy and J.Blood (eds), Melbourne: RMIT University Press, 2005, 233.
17 Kathy Poole, 'Potentials for Landscape as Infrastructure, Part 1: Six-and-a-Half Degrees of Infrastructure', The Mesh Book: Landscape/Infrastructure, J.Raxworthy & J.Blood (eds), Melbourne: RMIT Univeristy Press, 2005.
18 The 'butterfly effect' refers to very small effects (a butterly flapping its wings) creating massive change (a tidal wave) across many scales.
19 Alex Wall, 'Programming the Urban Surface', 233.
20 Gary Strang, 'Infrastructure as Landscape', 10.
21 Robert Thayer, 'Increasingly Invisible Infrastructures', Landscape Architecture, vol 85, no 06, June, 1995, 156.
22 op cit.
23 Rae Zimmerman, 'Social Implications of Infrastructure Network interactions', Journal of Urban Technology, vol 8, no 3, 97-119, 98.
24 ibid, 104.
25 Gary Strang, 'Notes from the Underground', Landscape Architecture: Infrastructure, vol 85, June 1995, 33.
26 Harry Granick, Underneath New York, New York: Fordham University Press, 1975 (1947).
27 James Corner, 'Terra Fluxus', 29.
28 A feedback loop is an environmental alteration that creates a chain reaction.
29 Gary Strang, 'Notes from the Underground', 35.
30 Wenche E. Dramstad, James D. Olson and Richard T.T. Forman, Landscape Ecology Principals in Landscape Architecture and Land-Use Planning, Harvard University Graduate School of Design, Island Press and the American Socieity of Landscape Architects, 1996, 12.
31 Gary Strang, 'Notes from Underground', 33.
32 Wenche E. Dramstad, James D. Olson and Richard T.T. Forman, Landscape Ecology Principals in Landscape Architecture and Land-Use Planning, 14.
33 Sebastien Marot, 'The Reclaiming of Sites', in Recovering Landscape: Essays in Contemporary Landscape Architecture, James Corner (ed), Princeton Architectural Press, New York, 1999, 45-57, 46.
34 Dr Ing. Hein van Bohemen, 'Infrastructure, Ecology and Art', Landscape and Urban Planning, no 59, 2002, 187-201, 187.
35 Alex Wall, 'Programming the Urban Surface', 233.
36 The Department of Defense site is highlighted in the Victorian Government Urban Development Program Report 2003 as a zone for future residential supply by 2009.
37 Stan Allen, Points + Lines: Diagrams and projects for the city, 53.
38 ibid, 51.

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