

## Regional Advisory Panel

<b>Meeting No. 3</b>	<b>Meeting Minutes</b>	<b>UWA CBD Office, WA Trustee Building, Level 2, 133 St Georges Tce, Perth @ 8am</b>
<b>15/06/2016</b>		

### Attendees

<b>Greg Claydon</b> (Inaugural Chair) CRC for Water Sensitive Cities	<b>Anas Ghadouani</b> CRC for Water Sensitive Cities	<b>Antonietta Torre</b> Department of Water	<b>Max Hipkins</b> City of Nedlands
<b>Jennifer Stritzke</b> Department of Parks and Wildlife	<b>Neil Burbridge</b> City of Armadale	<b>Ben Harvey</b> Department of Planning	<b>Greg Ryan</b> LandCorp
<b>Sergey Volotovskiy</b> Water Corporation	<b>Naomi Rakela</b> EMRC	<b>John Savell</b> Department of Housing	<b>Shelley Shepherd</b> New Water Ways
<b>Belinda Quinton</b> Department of Water	<b>Fiona Chandler</b> CRC for Water Sensitive Cities	<b>Celeste Morgan</b> CRC for Water Sensitive Cities	<b>Adri Dharma</b> CRC for Water Sensitive Cities

### Apologies

<b>David Horn</b> GHD	<b>Bruce Young</b> UDIA	<b>Giles Pickard</b> City of Subiaco	
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Item No.	Agenda Topic
1.	<p><b>Welcome and Apologies</b></p> <p>The Chair opened the meeting at 8.00am and welcomed everyone in attendance.</p> <p>The Chair acknowledged that David Horn, Bruce Young and Giles Pickard are apologies.</p>
2.	<p><b>Record of Discussion</b></p> <p>The Record of Discussion from the last Regional Advisory Panel meeting held on 18 May 2016 were noted and approved by Panel members.</p>
3.	<p><b>Matters Arising From Previous Minutes</b></p> <p>Anas Ghadouani and the Chair have discussed the outcomes of the RAP meeting on 18 May 2016 with the Executives and the Board, respectively.</p>

Item No.	Agenda Topic
	<p>Matters discussed were:</p> <ol style="list-style-type: none"> <li>1. The level of angst within the RAP with respect to the hiatus in activities</li> <li>2. Clarification of budget provisions</li> <li>3. Provisions for key researchers in WA</li> <li>4. Getting some projects started</li> <li>5. Resolving the Regional Manager position</li> </ol>
4.	<p><b>Tranche 2 Update</b></p> <p><b>Communication and Adoption Strategy for Tranche 2</b></p> <p>Fiona Chandler gave a presentation about the Communication and Adoption Strategy for Tranche 2. A detailed document of the presentation is attached. (<i>Attachment 4.1</i>). The Panel had some discussions and provided some feedback.</p> <p>CRCWSC has allocated \$40,000 cash contribution to WA for FY 16/17 to address local priorities for capacity building and adoption. WA can use the leverage and existing relationships with groups such as the New WAtER Ways to use the funding to prioritise delivery. There is also access to in-kind resources from the CRC, researchers, and other activities.</p> <p>There are two elements of research synthesis and application:</p> <ol style="list-style-type: none"> <li>1. Demonstration Projects.</li> <li>2. Case Studies.</li> </ol> <p>It will be beneficial if the Panel discusses and identifies what might be some useful case study examples. The WA 2016 – 2020 Research and Adoption Plan have identified some case studies. The RAP needs to find the ones that can be applied and have a willing partner, and get them in the list.</p> <p>The Panel had questions regarding the case studies and what they will look like. Celeste Morgan explained that it is open for discussion, but as of now, there are two types:</p> <ul style="list-style-type: none"> <li>- Snapshot case studies, which are shorter and quicker</li> <li>- Another version of case study that dives deeper, that will include the lessons, the champions, stakeholders interviews, and so on, which will also be summarised into a shorter version.</li> </ul> <p>With regards to choosing which case studies to do, a list of priorities is being compiled, with case studies that relate to the key needs of the regions being prioritised. The cases chosen have to have information available and stakeholders who are willing to outline both the negative and positive aspects of the project.</p>



Item No.	Agenda Topic
	<p>Demonstration projects require understanding from stakeholders that there will be experimentation along the way and a good amount of certainty that everyone in the group are on board.</p> <p>The Wungong and the Bentley projects are possible demonstration projects. White Gum Valley is a possible case study. The CRC has made a commitment to contribute to the knowledge base around that.</p> <p>A Stakeholders Reference Group will be established for this activity and a nominee from WA will be considered. Antonietta Torre is interested in being a conduit between the group and the RAP. The representative will not only help with WA but will also assist in getting the big picture across Australia. They will also assess where the CRC can get the most value for their resources.</p> <p><b>ACTION:</b></p> <ol style="list-style-type: none"><li>1. Compile proposals of case studies to send to Celeste Morgan.</li><li>2. Request New WATER Ways to prepare a proposal to build on the existing capacity building program with the further funding made available by the CRC in the next FY.</li></ol>
5.	<p><b>Update on Project B2.23 – Protection and restoration of urban freshwater ecosystems: Informing management and planning</b></p> <p>Belinda Quinton presented an update on Project B2.23. A detailed document of the presentation is attached. (<i>Attachment 5.1</i>)</p> <p>There are two components of the project, which will finish in December 2016:</p> <ol style="list-style-type: none"><li>1. Nitrogen transformation processes in wetlands, led by Mike Grace, Monash</li><li>2. Developing an urban river restoration decision support tool, led by Peter Davies, UWA.</li></ol> <p>The products are not going to be finished until December 31, 2016. Local stakeholders have been engaged along the way, so they are familiar with the products and are happy with the trajectory.</p>
6.	<p><b>CRCWSC Board Update</b></p> <p>In the budget discussion, the Research related items were presented to the Board at a high level and not down to individual project details, which will be discussed in the August board meeting. There is also funding available for B2.4 and B2.23 of \$190,000.</p> <p>There is a concern regarding one of the researchers continuing into Tranche 2. The CRC, Department of Water, and UWA are trying to gather funds to support him. The Chair is fairly</p>

Item No.	Agenda Topic
	<p>confident that his contract will be extended.</p> <p>A number of directors are coming to the end of their current terms on the CRCWSC Board. Nick Apostolidis will continue and John Dell will be replaced by Prof Simon Biggs of UQ. Greg Claydon has been reappointed as a Board nominated person. Steve Frost is retiring and Mike Mouritz is nominated to join the Board.</p> <p>With regards to the Regional Manager position, arrangements are getting close to finalisation to the point where the recruitment selection process will begin in the next few weeks. However, it is still unclear whether or not the position will be fully funded by the CRC.</p> <p>Fiona Chandler will be stepping down from the Executive of Adoption position from 30<sup>th</sup> June 2016. She will be working part time on knowledge adoption for the next 3 months before moving on.</p>
7.	<p><b>Other Business</b></p> <p>Other business was not discussed.</p>
8.	<p><b>Meeting Close</b></p> <p>The meeting closed at 9.42 am.</p> <p>The Chair thanked the Regional Advisory Panel members for their attendance.</p> <p>The next meeting is set down for Wednesday, 20 July 2016.</p>

Actions	Description
1.	Compile proposals of case studies to send to Celeste Morgan.
2.	Request New WAtEr Ways to prepare a proposal to build on the existing capacity building program with the further funding made available by the CRC in the next FY.



CRC for  
**Water Sensitive Cities**

**Communication &  
Adoption Strategy  
2016 - 2021**  
Fiona Chandler



Australian Government  
Department of Industry,  
Innovation and Science

**Business**  
Cooperative Research  
Centres Programme

# Communication and Adoption Strategy 2016-2012

- Workshop held in Melbourne in March to engage Executive EPRG, and RAP representatives to identify ‘What would adoption success look like in 2021?’
  - WA representatives – Shelley, John and Antonietta
- Based on understanding what long-term outcomes are sought (Strategic Plan 2014/15 – 2016/17)
- Purpose – to plan what strategies and actions are required (and resources) to deliver the outcomes nationally
- Establish a framework to guide local initiatives

Industry need and vision for a WSC

World-class science, knowledge and innovation tested in local contexts

Industry-ready tools and products

Business case for WSC (and associated projects / programs)

Engaged decision and policy makers (policy supported by industry standards and guidelines)

Diverse and engaged community and end users have the capacity, capability and culture to transition

Cities and towns are actively transitioning to be more water sensitive

## Industry need and vision for a WSC

1. WSC transition strategies are co-developed for each state (region)

## World-class science, knowledge and innovation tested in local contexts

2. Industry end users actively contribute to the **co-development** of research outcomes and relevant tools and products

3. **Learning case studies** founded on on-ground application of leading edge knowledge, tools and products are developed and disseminated

## Industry-ready tools and products

4. **Industry-relevant tools and products** are easily accessible and supported with guidance and advice on their use and contexts

5. Industry has **access to knowledge brokers** to facilitate the application of knowledge, tools, products and services

## Business case for WSC (and associated projects / programs)

6. **Business case frameworks** are further developed & tested in CRCWSC projects (demonstration and implementation) and

7. Industry has access to **guidance and training** to apply business case frameworks

## Engaged decision and policy makers (policy supported by industry standards and guidelines)

8. Policy and decision makers are **supported to deliver innovative policy** outcomes founded on a strong evidence base

## Diverse and engaged community and end users have the capacity, capability and culture to transition

9. Industry has the access to guidance and a range of **training and education programs** to help build the capacity to innovate and transition

## Cities and towns are actively transitioning to be more water sensitive

10. Industry has access & advice on benchmarking & support to develop sound transition strategies to inform the implementation of WSC transition strategies

11. Enduring partnership arrangements exist to support the implementation of WSC transition strategies

# Industry need and vision for a WSC

**1. WSC transition strategies** are co-developed for each state (region)



**Tranche 2 project** co-developed with RAP

- **IRP1: WSC Transition Strategy and Implementation Plan**
- [www.watersensitivecities.org.au](http://www.watersensitivecities.org.au)

# World-class science, knowledge & innovation tested in local contexts

2. Industry end users actively contribute to the **co-development** of research outcomes and relevant tools and products

3. **Learning case studies** founded on on-ground application of leading edge knowledge, tools and products are developed and disseminated



All tranche 2 proposals and projects to have specific communication and adoption deliverables (e.g. case studies) and minimum requirements to ensure researcher-industry engagement and adoption

- **IRP budget**
- **Learning through Demonstration and Integration (Project D1.4)**
  - Project Leader – Celeste Morgan (0.5 FTE)

# WSC tools & products | Knowledge translation | Research synthesis

4. **Industry-relevant tools and products** are easily accessible and supported with guidance and advice on their use and contexts

5. Industry has **access to knowledge brokers** to facilitate the application of knowledge, tools, products and services



IP & commercialisation assessment to identify priorities

Tranche 2 project teams to have dedicated roles, responsibilities & resource allocations for knowledge sharing, dissemination and application

## ➤ **WSC tools and products**

- WSC Toolkit (Project D1.5) – pilot studies, training supported by user manuals & support
- WSC Index (Project D6.2) - working with private / SME to apply locally

## ➤ **CRCWSC cash contribution for local capacity building and knowledge dissemination activities**

# Business case for WSC (and associated projects / programs)

6. **Business case frameworks are tested** in CRCWSC projects (demonstration and implementation)

7. Industry has access to **guidance and training** to apply business case frameworks



Integrated research projects & regional implementation projects

Analysis of existing case studies

New demonstration projects

- **IRP2 Economic Framework**
- **Regional Implementation Projects**
- **Case Studies (D1.4 Demo Projects)**
- **Research synthesis projects**
- **Knowledge translation**
- **Short course 'Developing business case for WSC projects and programs' (D4.1 – Strengthening Education)**

# Engaged decision and policy makers (policy supported by industry standards and guidelines)

8. Policy and decision makers are **supported to deliver innovative policy** outcomes founded on a strong evidence base



Identify priority policy contexts and opportunities

Integrate into IRP

Proactive science-policy influence

Knowledge translation / synthesis

- **Influencing policy (IRP1)** - Build on '*Strategies for influencing the political dynamics of decision-making*' (Project A3.3)
- **Knowledge translation** – cash resources to direct towards priority policy issues

# Diverse & engaged community, and end users - with the capacity, capability and culture to transition

9. Industry has the access to guidance and a range of **training and education programs** to help build the capacity to innovate and transition



Implement recommendations from national needs assessment and prioritisation

Local capacity building initiatives

Demand-based opportunities (associated with Tranche 1 outputs)

- CRCWSC cash contribution for **local capacity building** and knowledge dissemination activities – WA \$40,000 in 2016/17
  - Local work plan to be developed by RAP and local partnership formed with provider to coordinate and deliver
- CRCWSC knowledge translation to develop resources and tools (e.g. case studies)
- Business development of priority courses (e.g. Developing business case for WSC projects and programs)

# Cities and towns are actively transitioning to be more water sensitive

10. Industry has access & advice on **benchmarking** & support to develop & implement sound transition strategies to inform the implementation of WSC transition strategies



Application of the WSC Index / benchmarking tools

RAPs and Regional Manager to coordinate implementation of WSC transition strategy

11. **Enduring partnership** arrangements exist to support the implementation of WSC transition strategies

Influencing strategy

- WSC Index (Project D6.2) - working with private / SME to apply locally
- Regional Manager co-funding and operational support

[www.watersensitivecities.org.au](http://www.watersensitivecities.org.au)

<http://crc.metroproof.com.au/>



ABOUT

RESEARCH

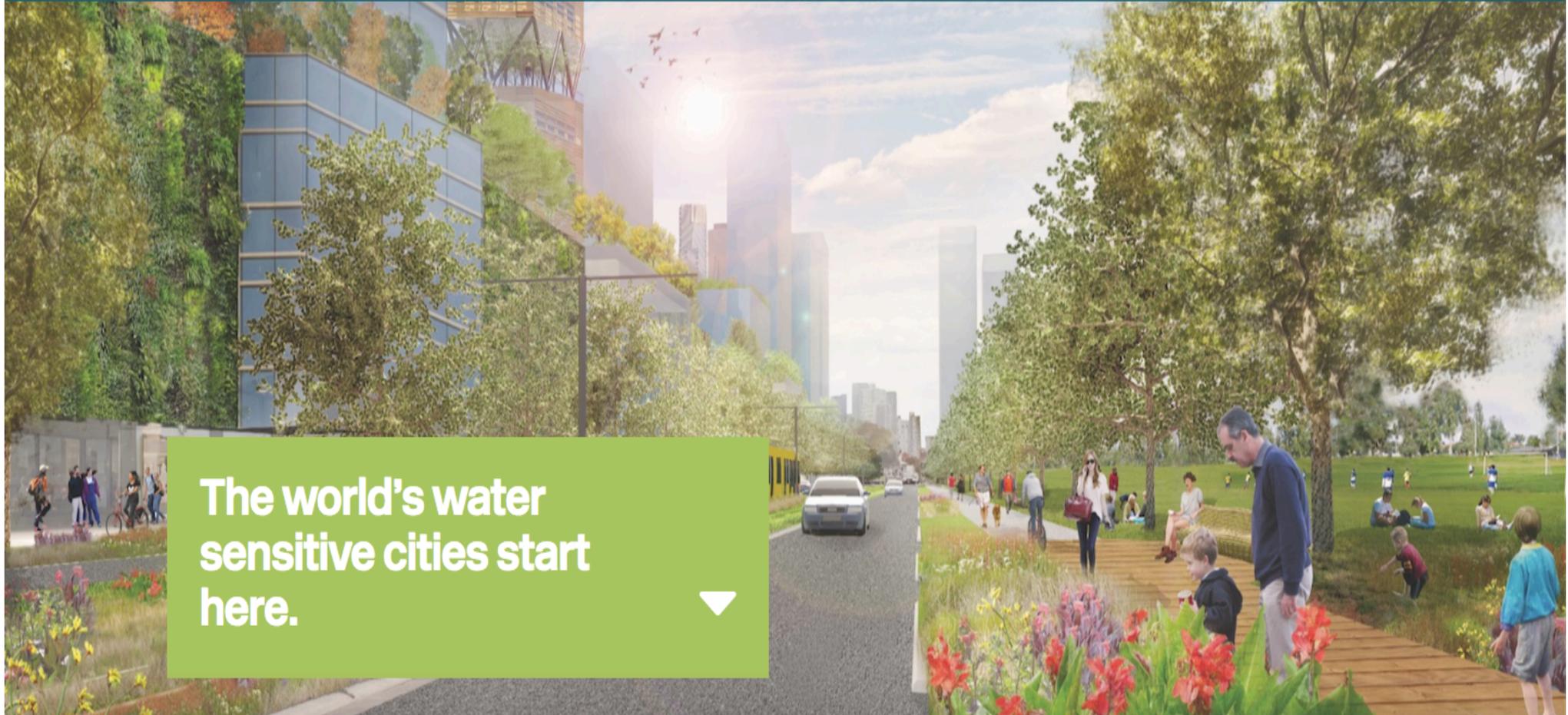
SOLUTIONS

COLLABORATE

RESOURCES

NEWS+EVENTS

Q SEARCH



The world's water sensitive cities start here. ▾





CRC for  
**Water Sensitive Cities**

**2012 - 2021**



# *CRC Water Sensitive Cities*

*Project B2.23 – Restoring urban freshwater ecosystems:  
Informing management and planning*

*Project Update – June 2016*

*Project Leader: Peter Davies & Mike Grace*



There are two discrete project within B2.23:

Project a) is led by Mike Grace and based out of Monash University in Melbourne looking into Nitrogen transformation processes in wetlands.

Project b) is led by Peter Davies based out of UWA in Albany developing an urban river restoration decision support tool.

Both projects finish December 2016





# Using stable isotopes to unravel nitrogen processing in wetlands

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Keryn Roberts

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Perran Cook<sup>1</sup>, Michael Grace<sup>1</sup>, Wei Wen Wong<sup>1</sup> and Andrew Mehring<sup>2</sup>



THE UNIVERSITY OF  
WESTERN AUSTRALIA  
*Achieve International Excellence*

<sup>1</sup> Water Studies Centre, Monash University, Australia

<sup>2</sup> Scripps Institution of Oceanography, USA

# Constructed Wetlands

- Treat stormwater nitrogen loads
- Management of vegetation and sediment
- Monitoring – water quality

Denitrification

Assimilation



# Constructed Wetlands

- Transformation will result in the enrichment of  $\delta^{15}\text{N}$  and  $\delta^{18}\text{O}$  of  $\text{NO}_3^-$  in the residual pool

Denitrification  $\delta^{15}\text{N} \sim 2\text{‰}$

Assimilation  $\delta^{15}\text{N} \sim 5\text{-}15\text{‰}$



# Study Sites

Cascades on Clyde, Melbourne



Kelletts Drain, Melbourne



Anvil Way Compensation Basin, Perth



# Study Sites

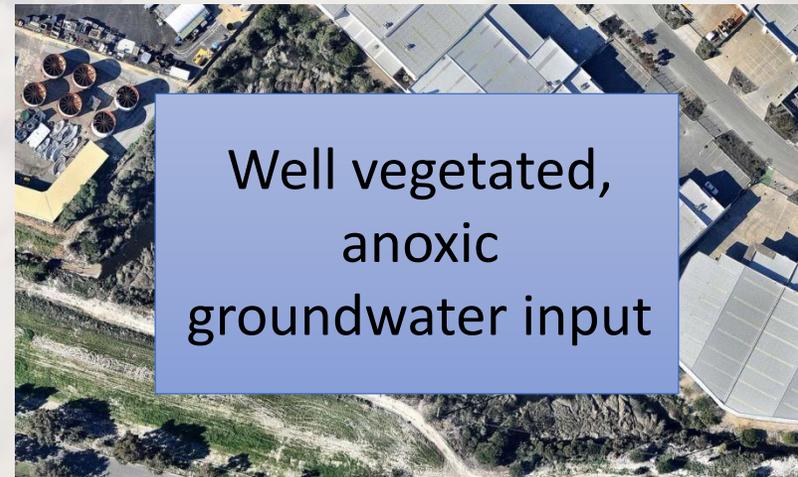
Cascades on Clyde, Melbourne



Kelletts Drain, Melbourne

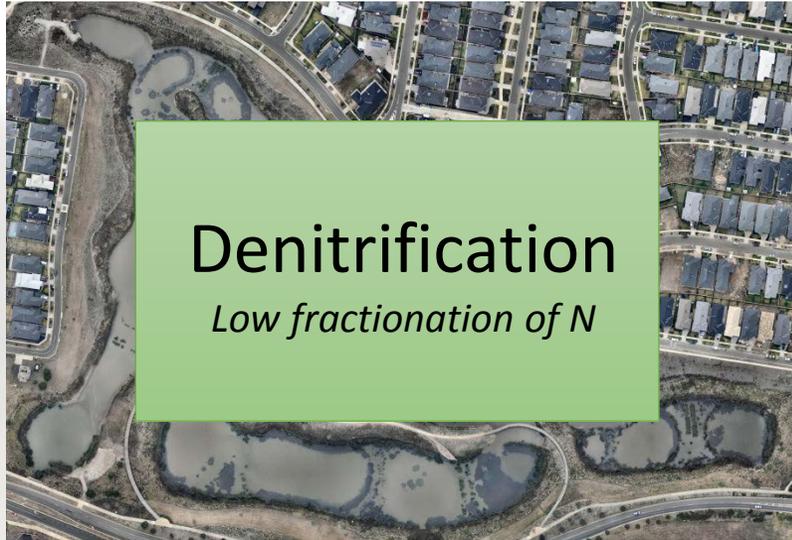


Anvil Way Compensation Basin, Perth

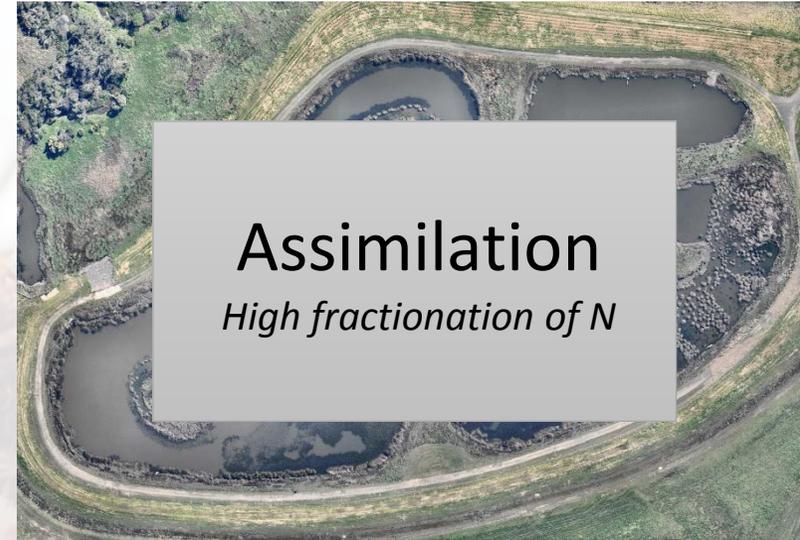


# Hypotheses

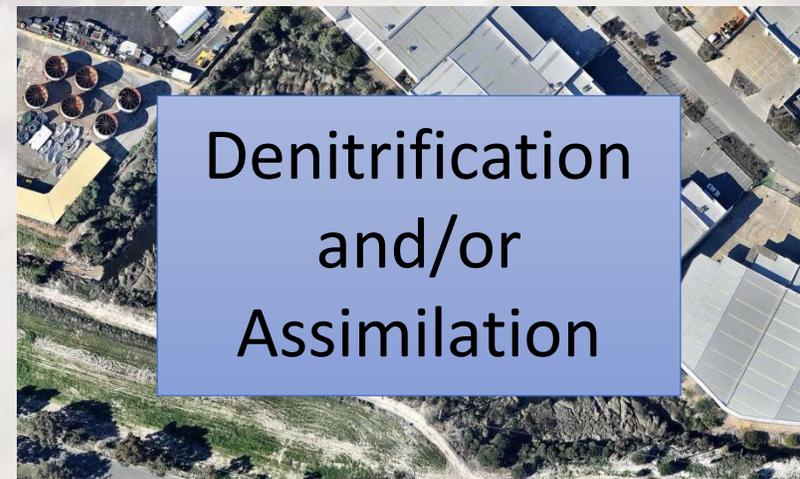
Cascades on Clyde, Melbourne



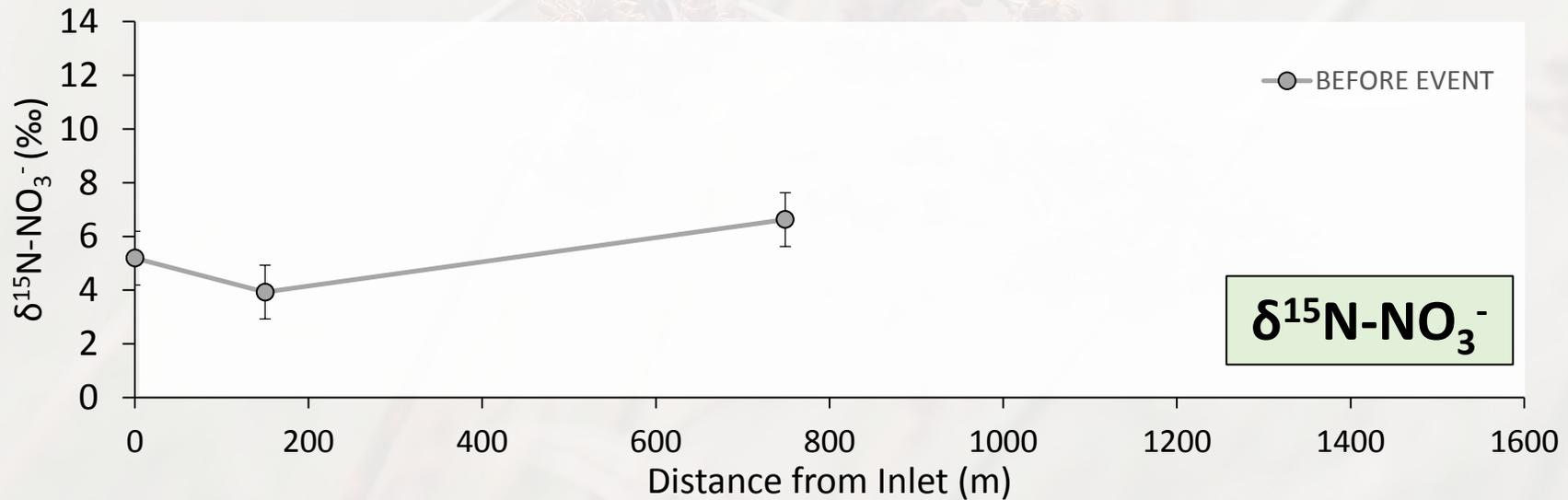
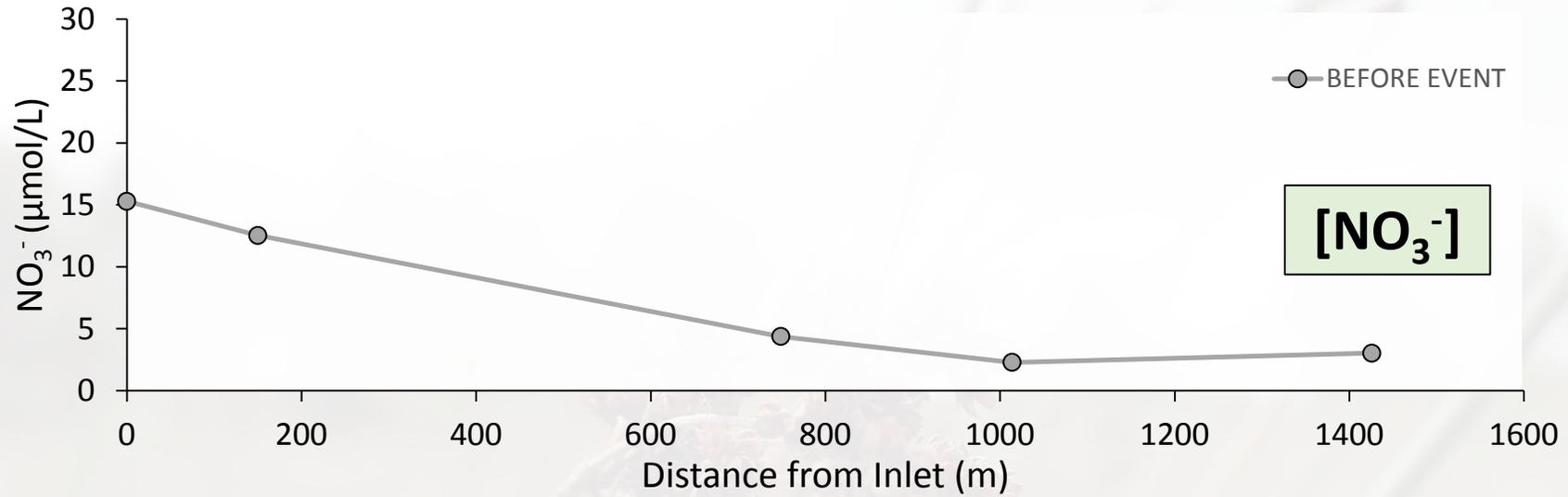
Kelletts Drain, Melbourne



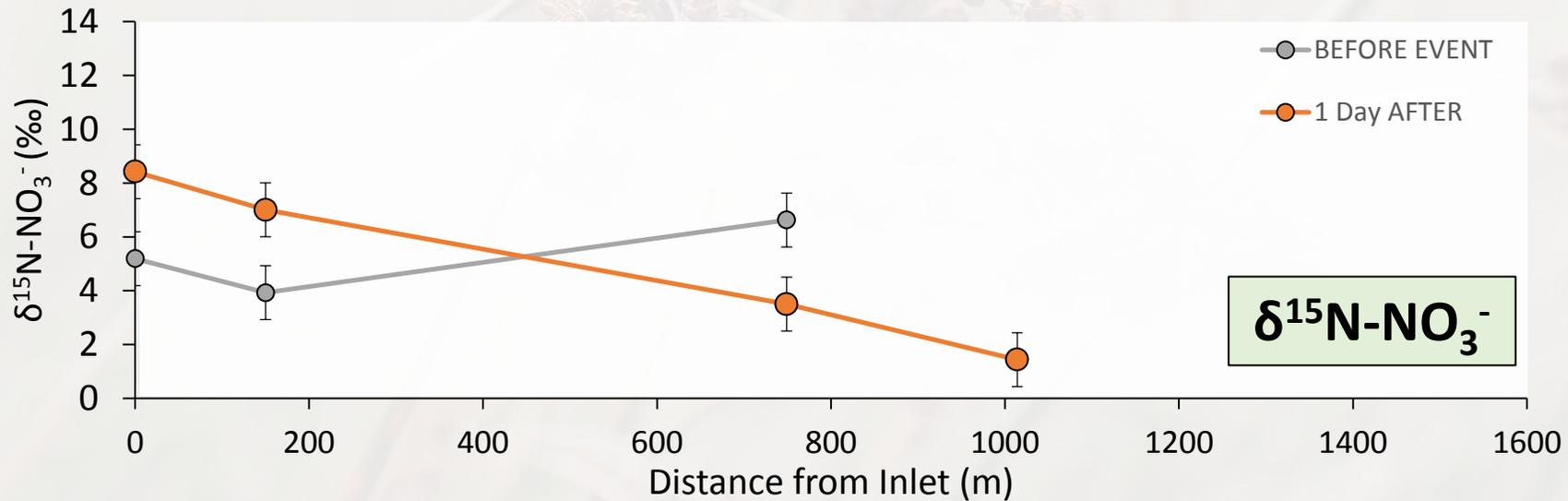
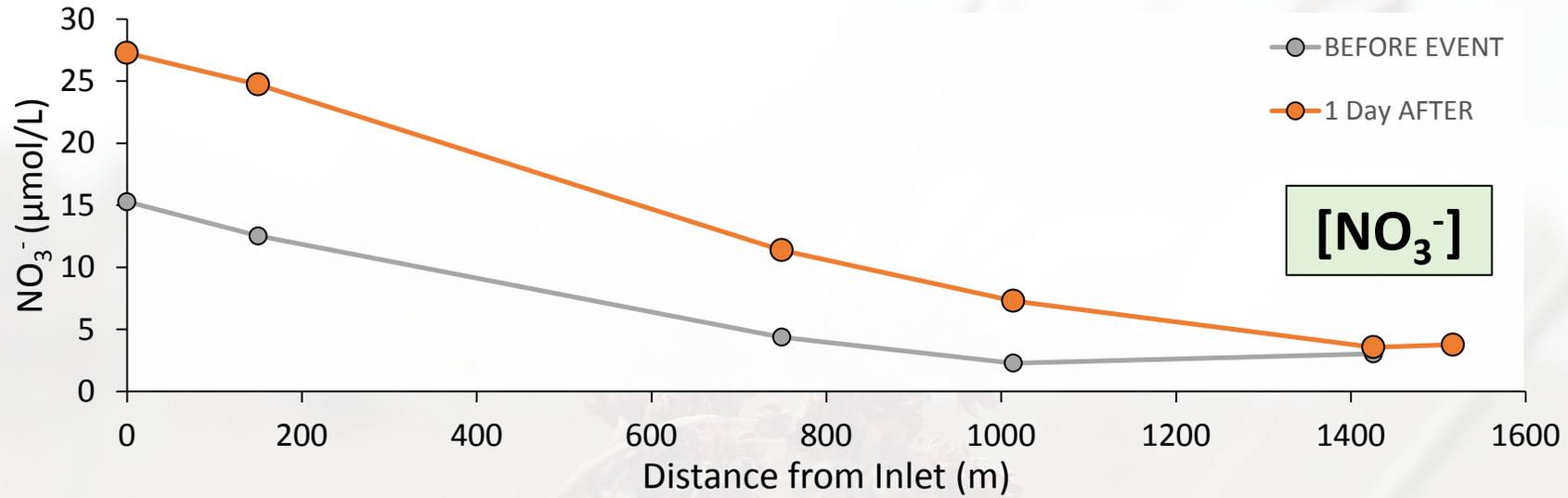
Anvil Way Compensation Basin, Perth



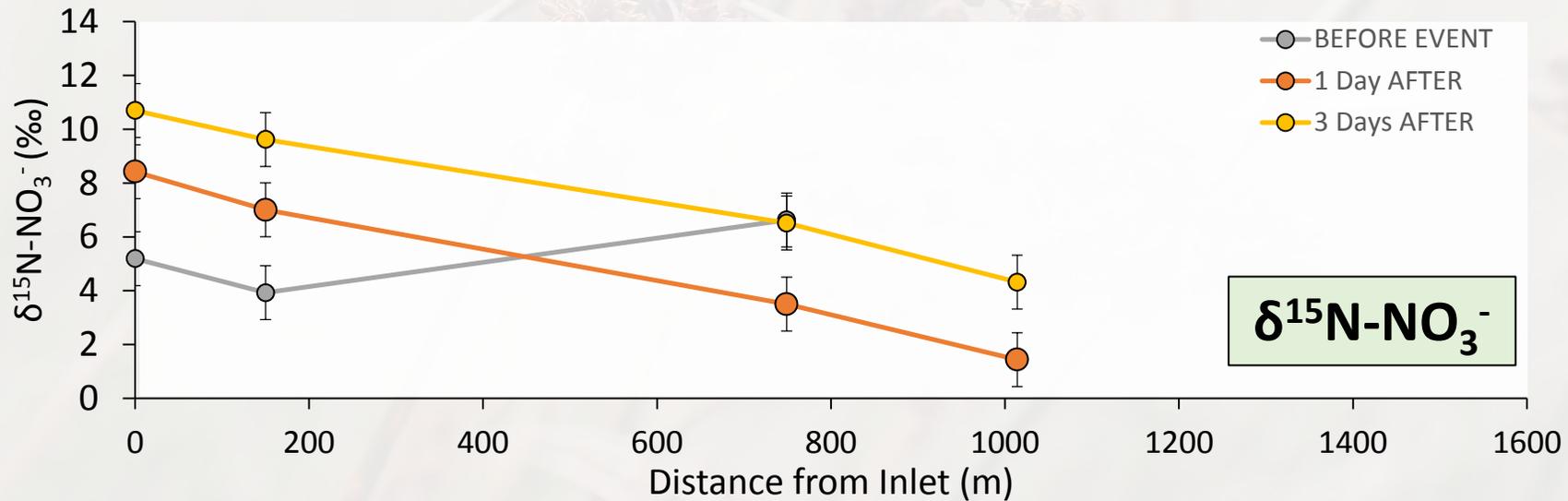
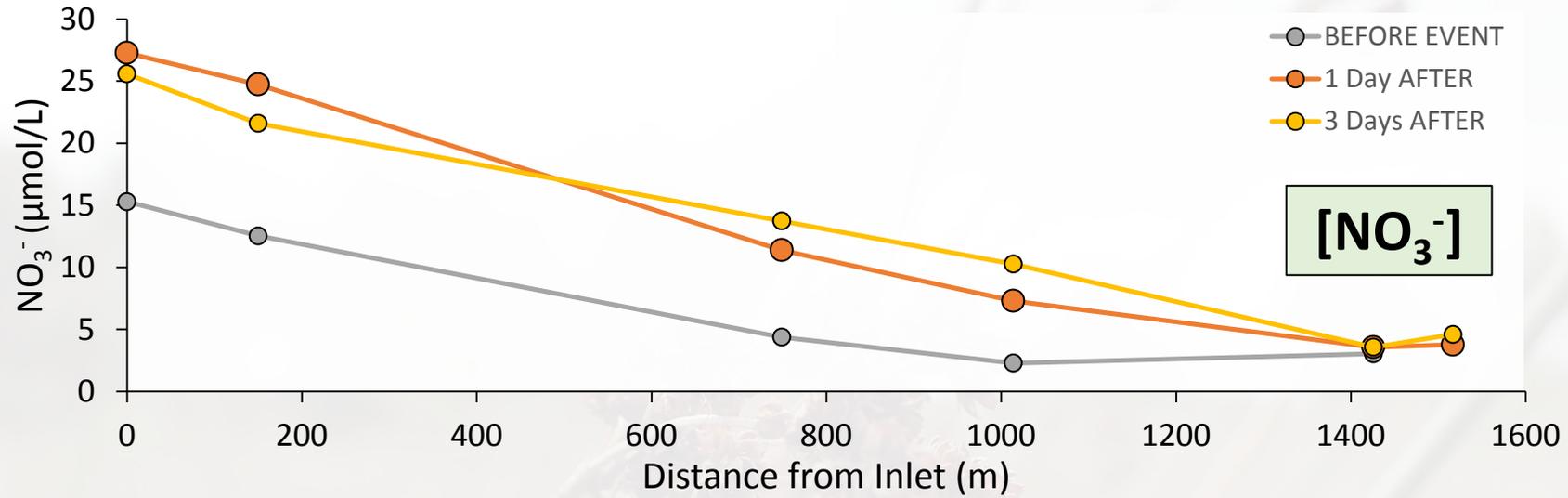
# Cascades on Clyde



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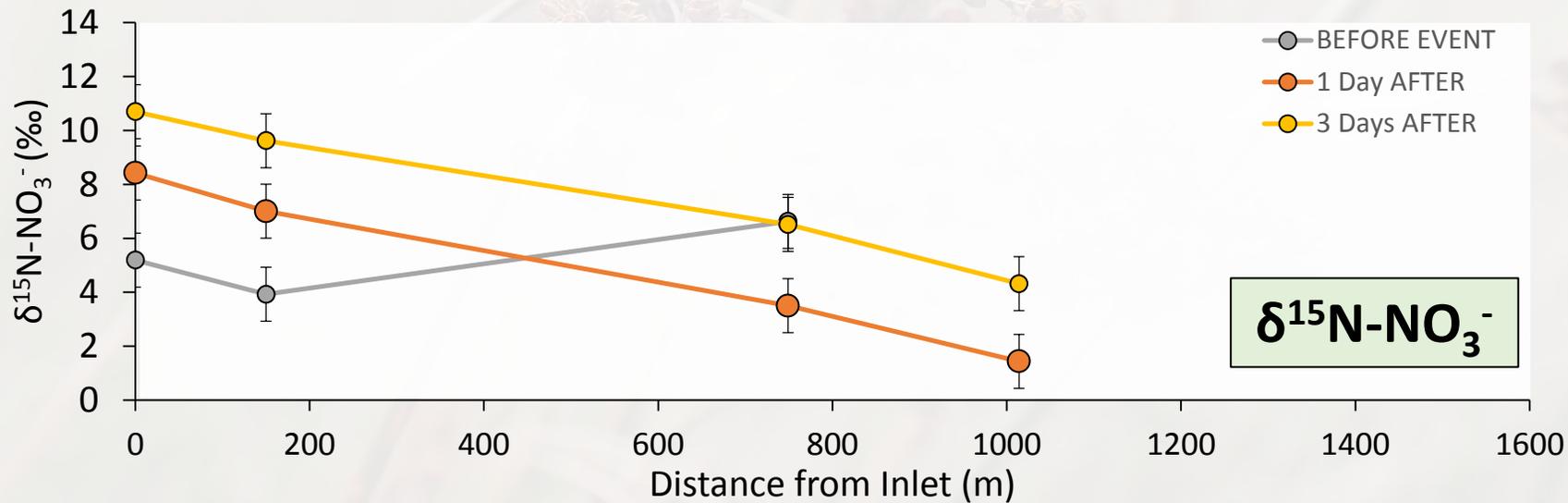


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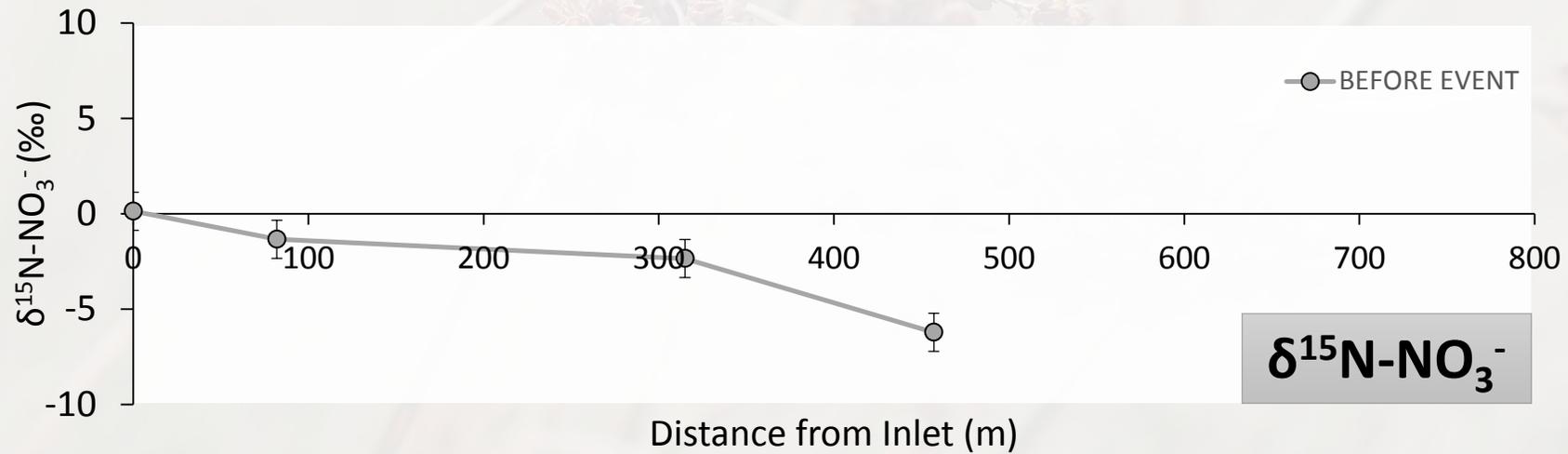
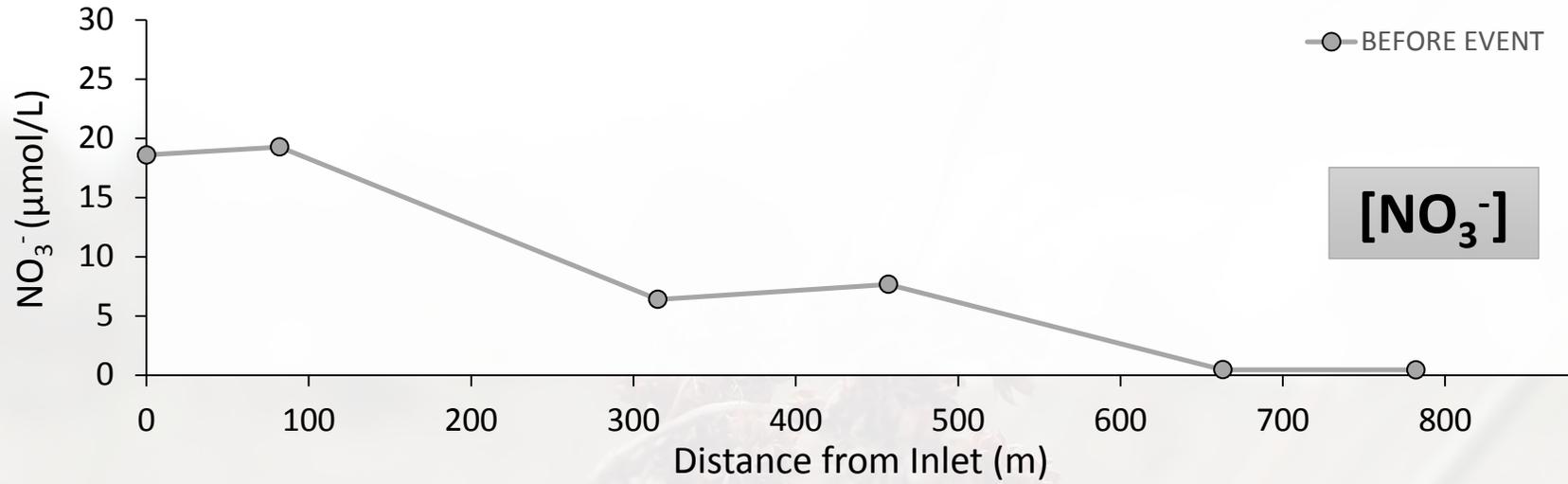


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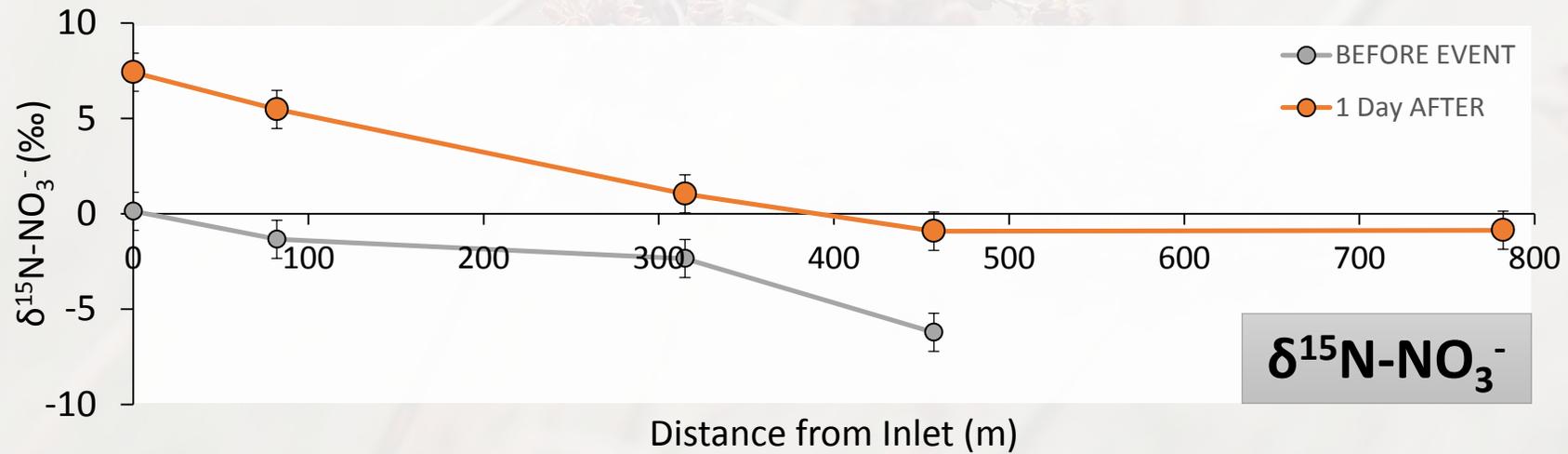
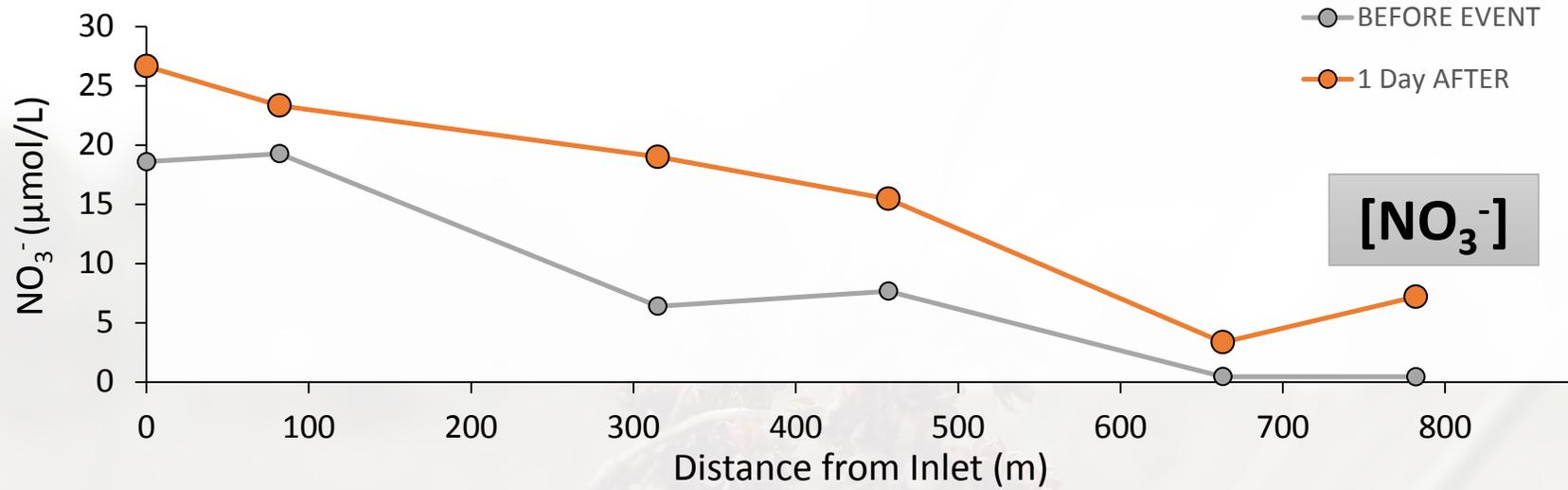
- **Nitrification** of ammonium is producing lighter  $\text{NO}_3^-$  decreasing the  $\delta^{15}\text{N-NO}_3^-$  in the 'residual' pool
- Moving toward the outlet  $\text{NO}_3^-$  becomes more limited promoting  **$\text{N}_2$  fixation** introducing lighter  $\delta^{15}\text{N}$  into the system



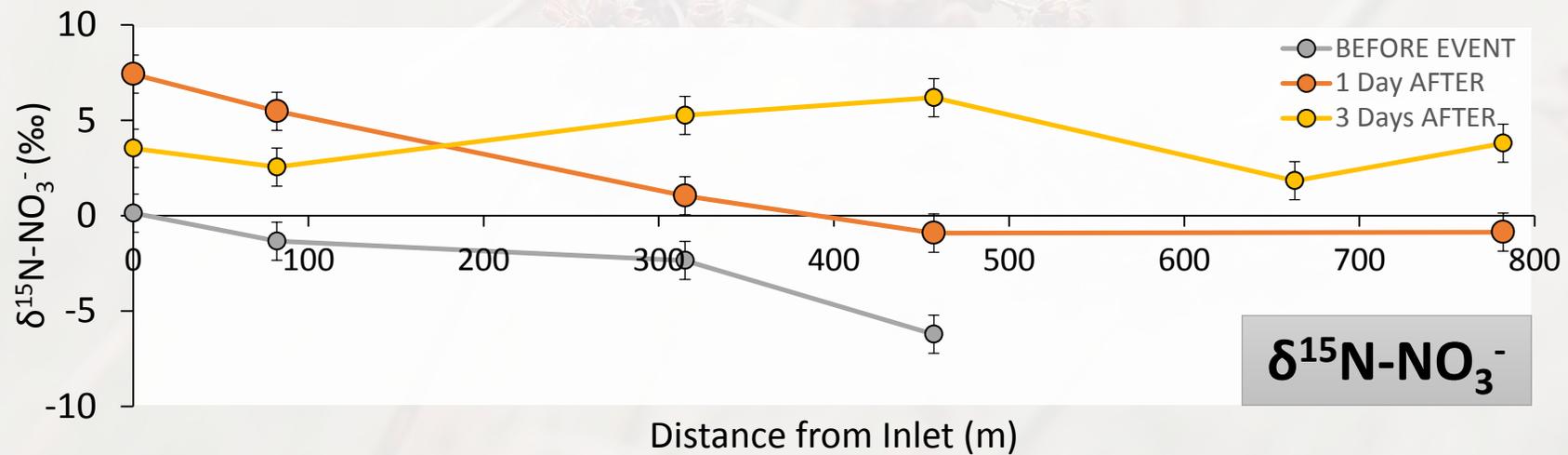
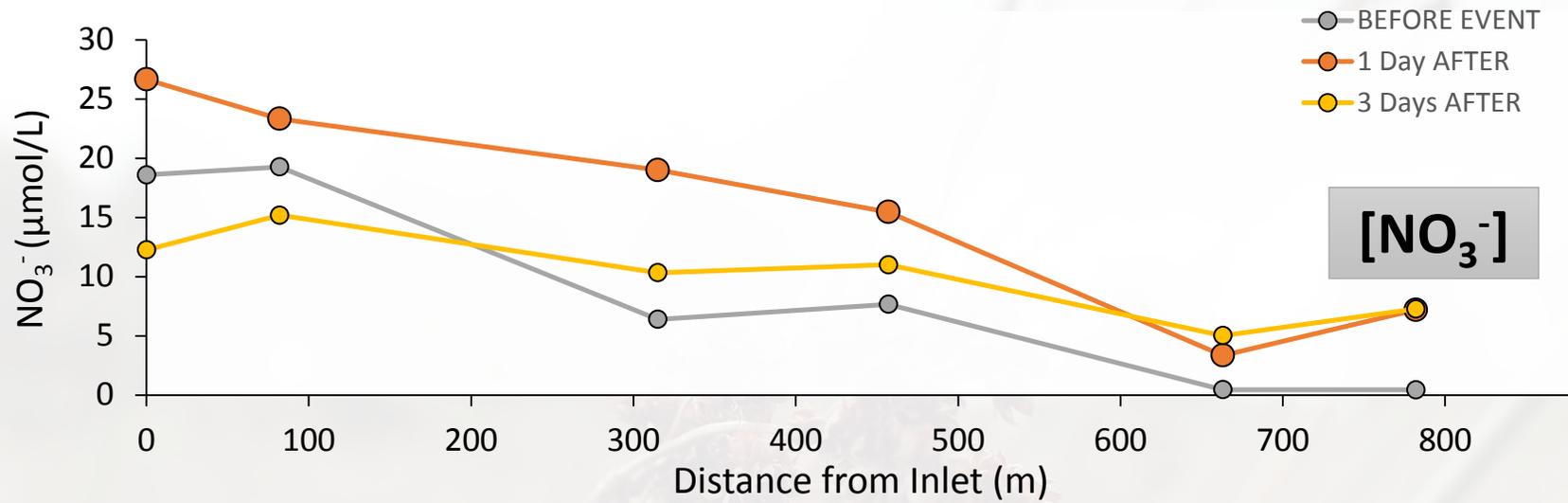
# Kelletts Drain



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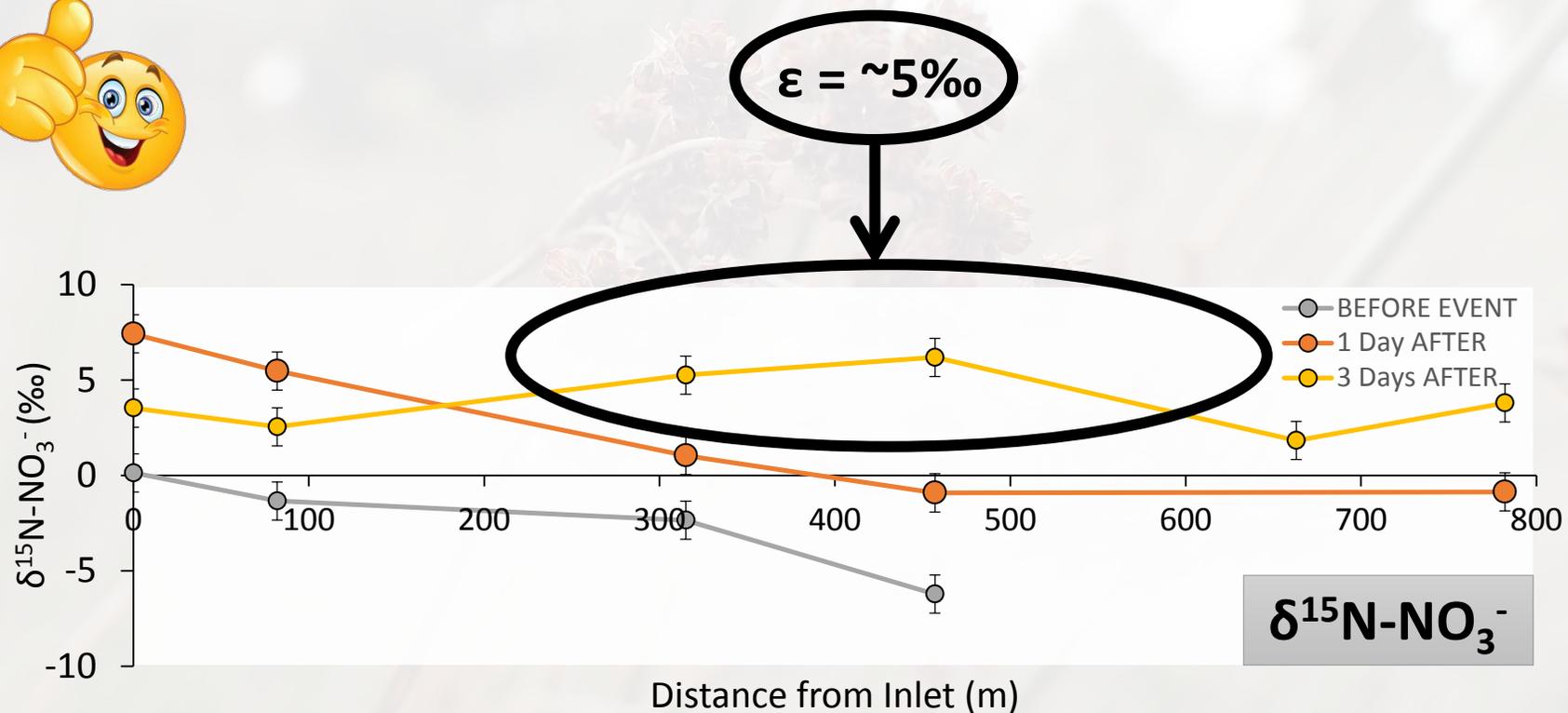


# Kelletts Drain

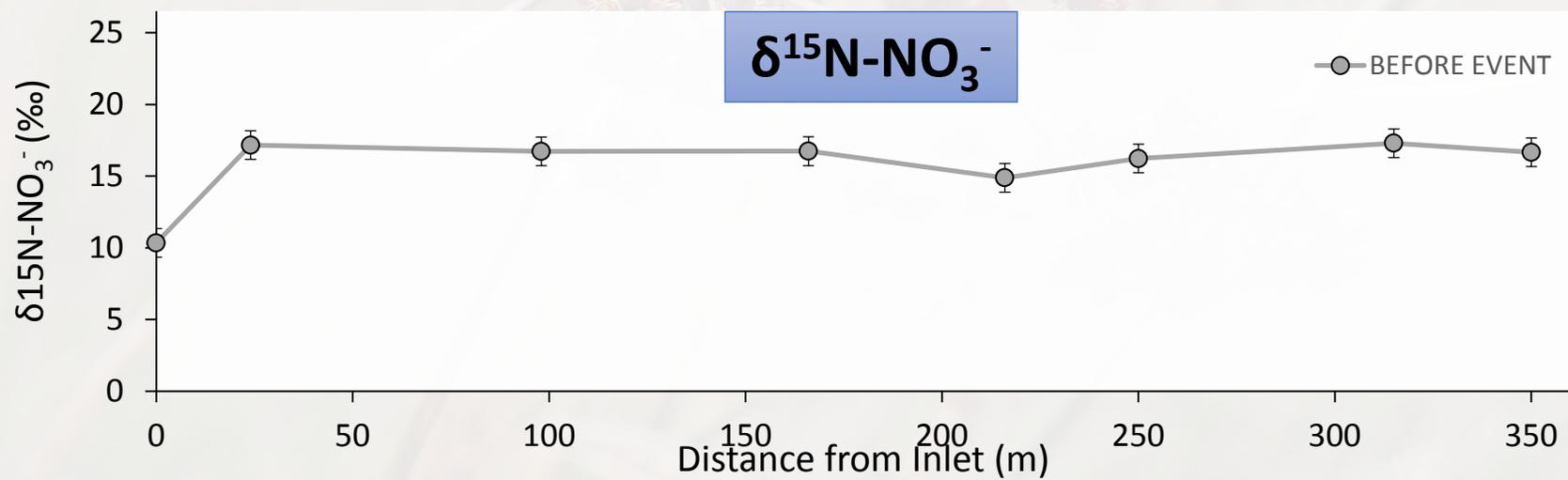
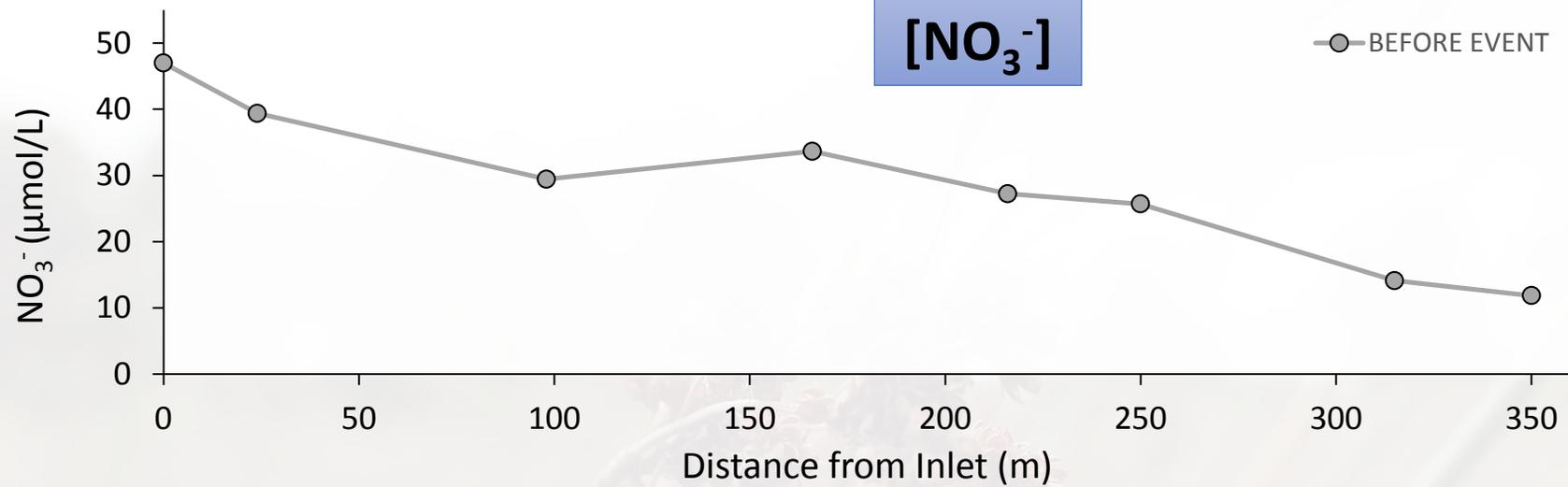


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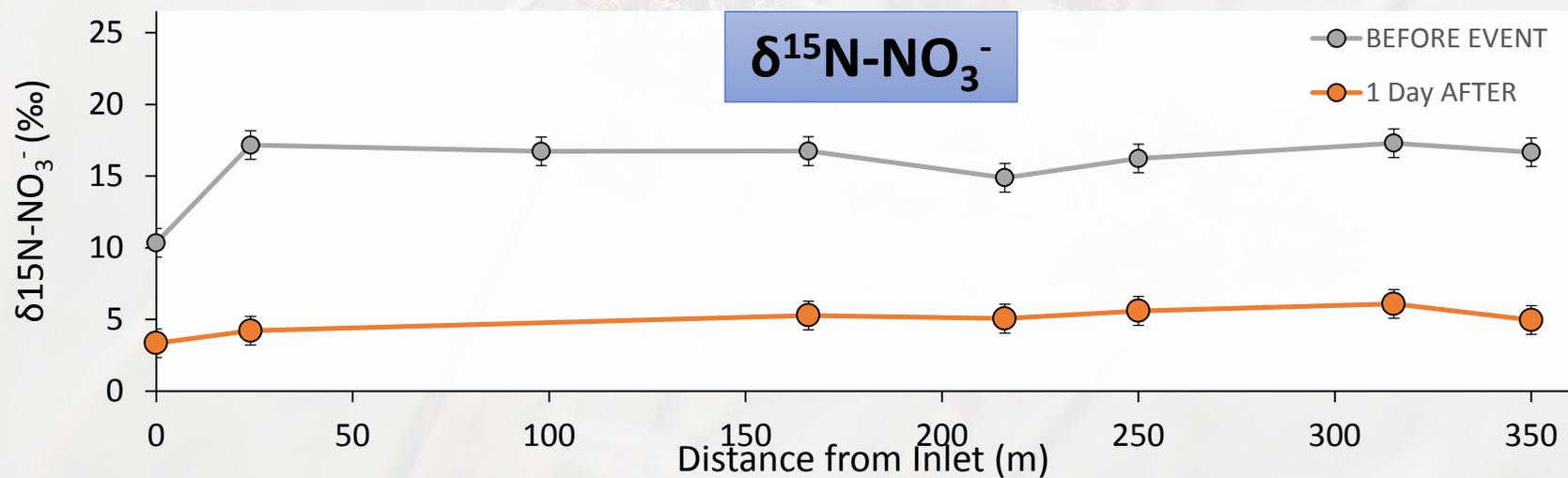
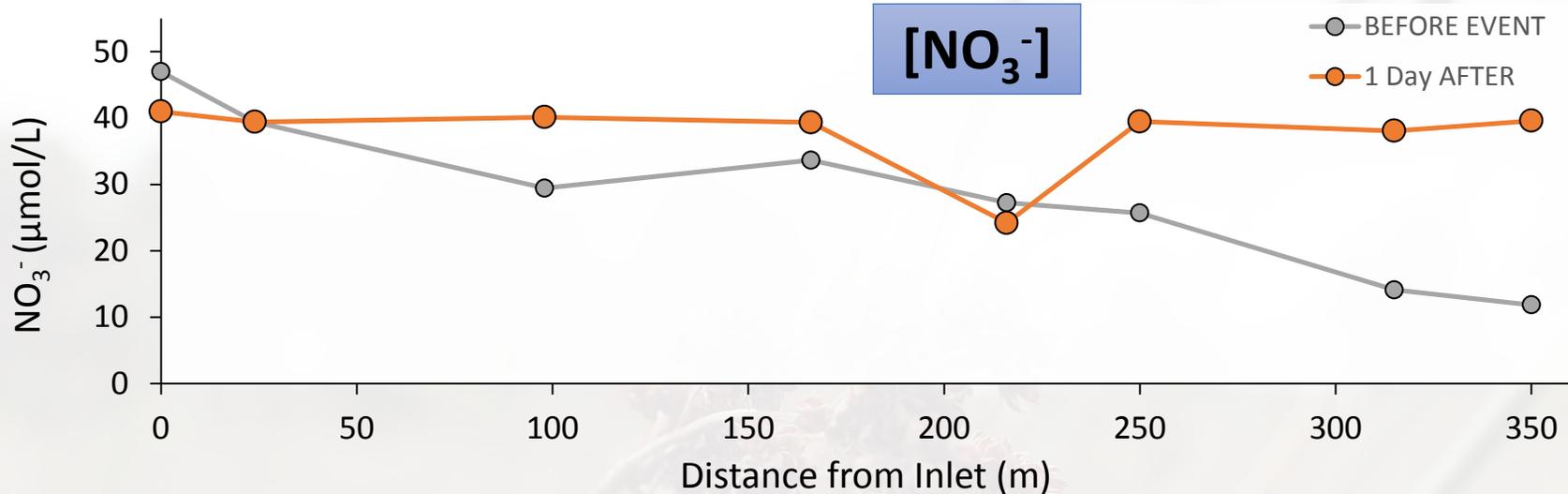
- The residual  $\text{NO}_3^-$  gets heavier 3 days after the event which is consistent with assimilation



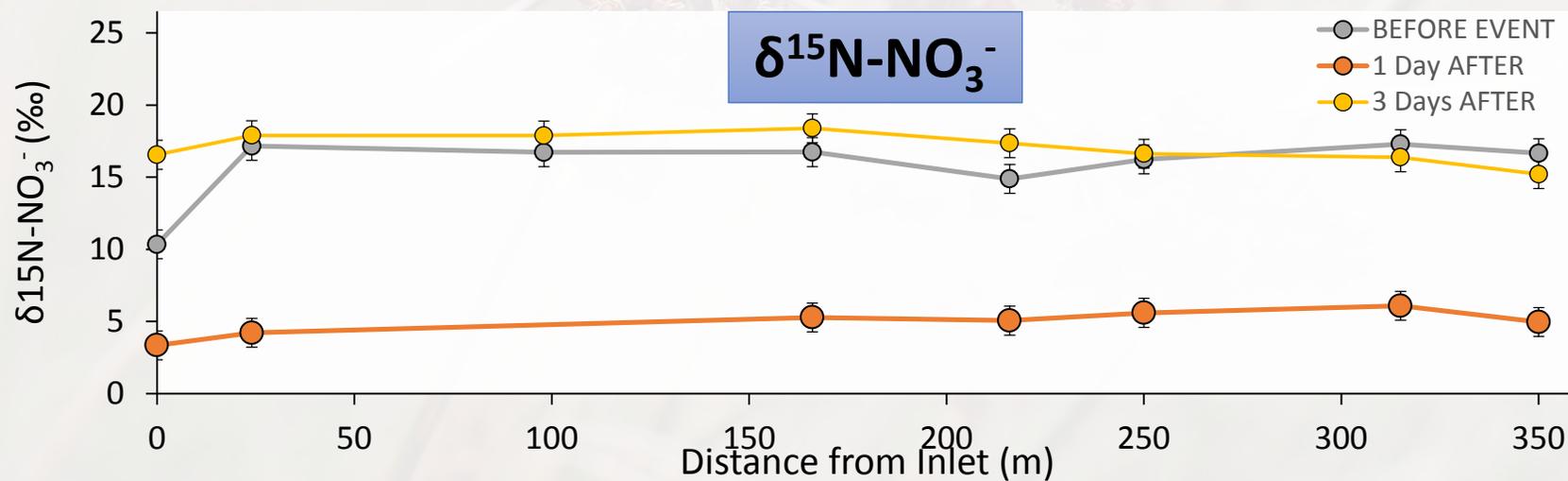
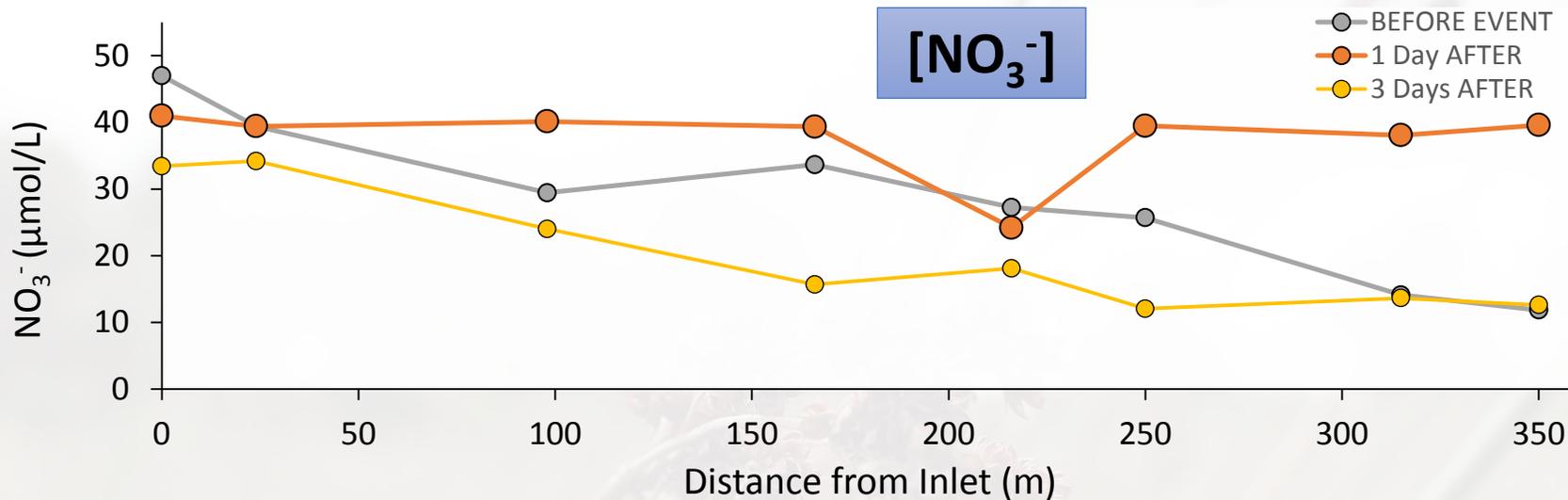
# Anvil Way



# Anvil Way



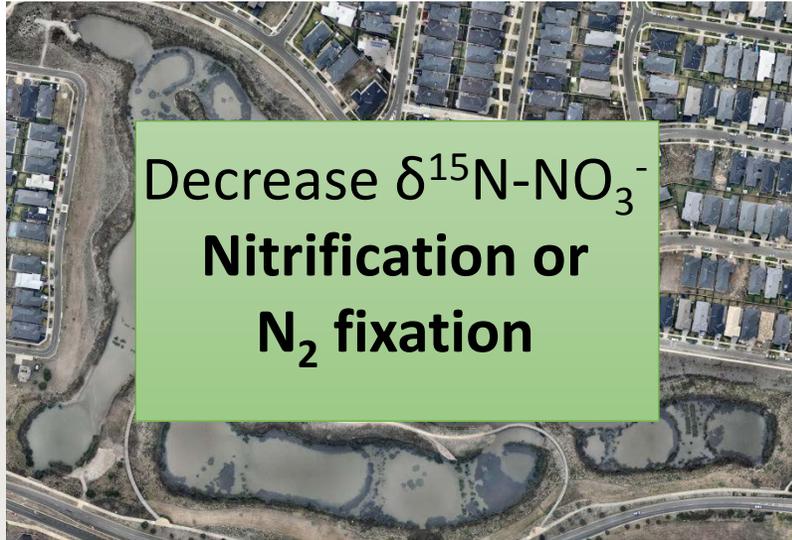
# Anvil Way



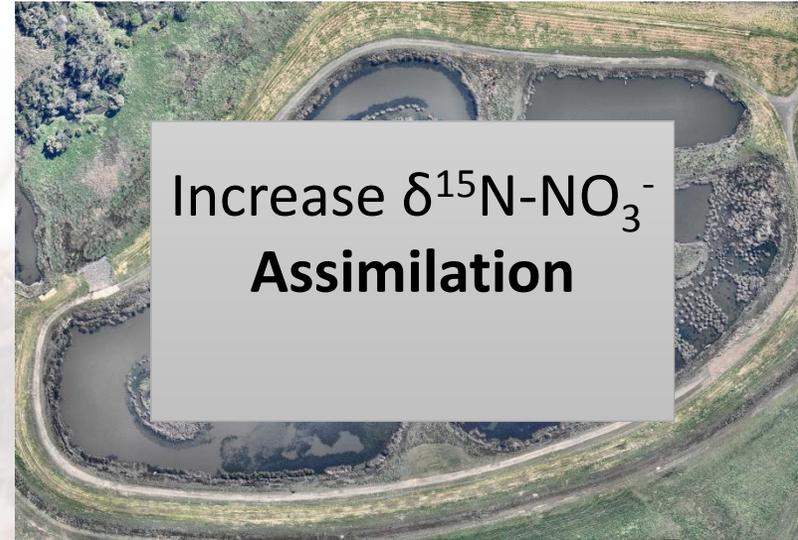


# What did we see?

Cascades on Clyde, Melbourne



Kelletts Drain, Melbourne



Anvil Way Compensation Basin, Perth



# Conclusions

- The use of  $\delta^{15}\text{N}$  and  $\delta^{18}\text{O}$  of  $\text{NO}_3^-$  (and fractionation factors) for wetland components confirm the assimilation and denitrification *enrichment* trends observed in the literature
- Wetlands do NOT behave uniformly – vegetation/turbidity and water flow paths greatly influence how (and if) nitrogen is removed.



*Project Description*

Project B – Developing urban river restoration decision support system is led by Peter Davies and undertaken by Dr Leah Beesley in Albany.

The Department of Water River Health team were introduced as co-delivery partners in 2015.

The objective of the project is to develop a suite of decision support tools that can assist urban river managers to prioritise effective on ground activities that will repair or protect the important “drivers” of stream ecosystems.

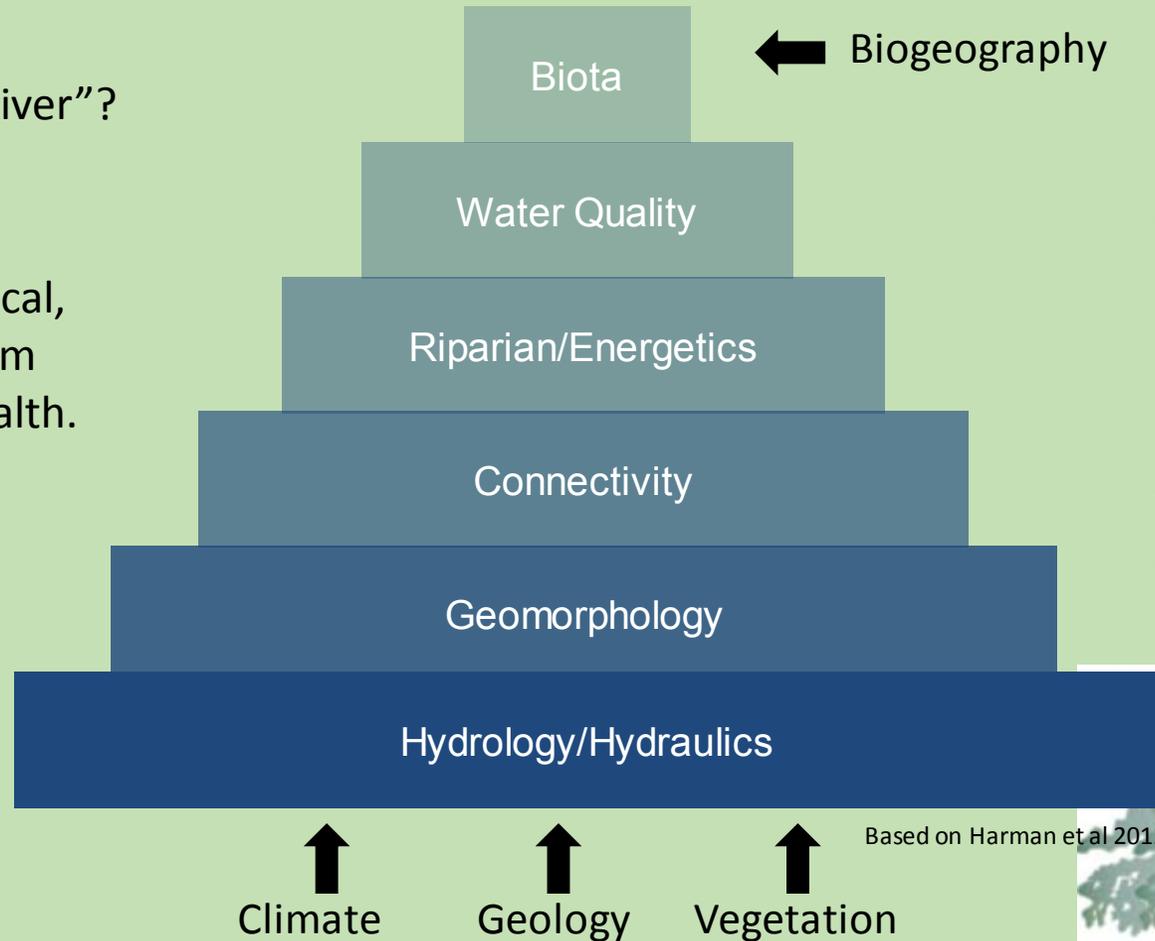
What do we mean by “driver”?

**UWA: Leah Beesley, Peter D Davies, Neil Pettit & Paul Close**  
**Dept. Water: Belinda Quinton, Tim Storer**



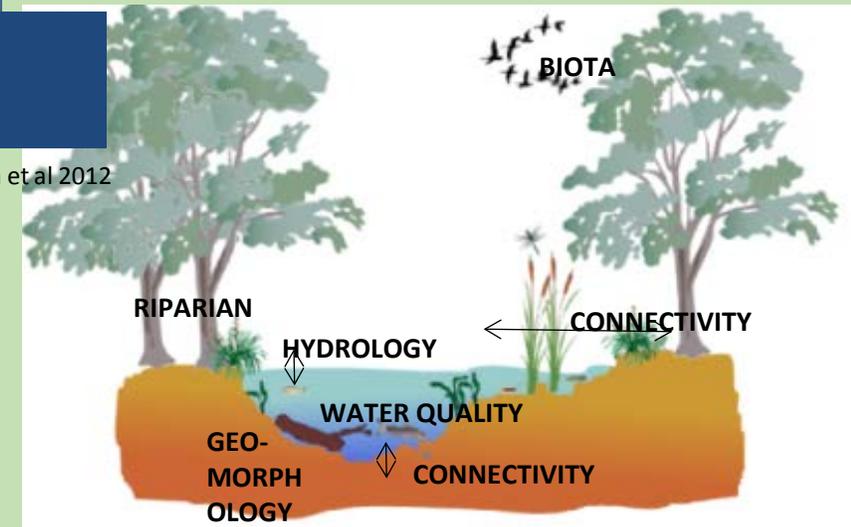
What do we mean by “driver”?

Components of the physical, chemical and biotic system that influence stream health.



Hydrology is the master driver of stream health....

But, if river managers are not in a position to alter the current state, what else can we do to still improve the ecological condition?

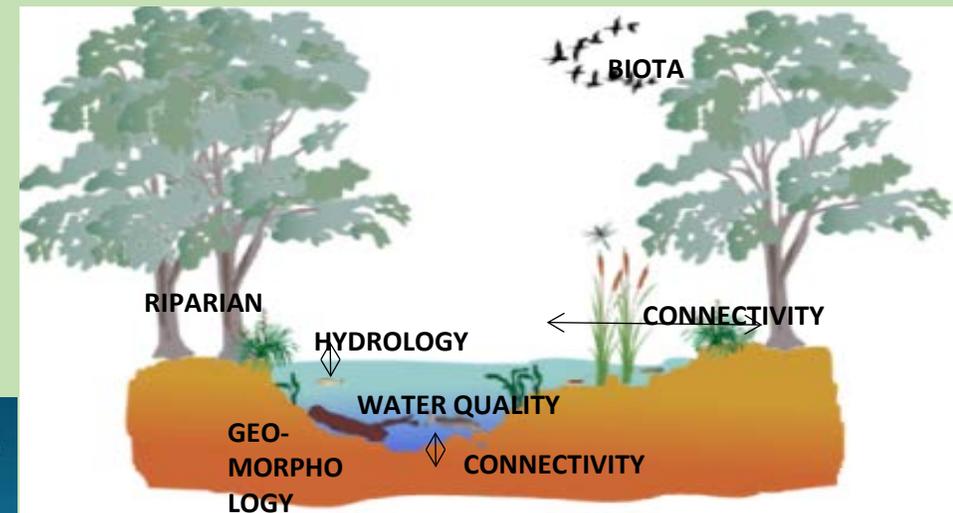


Can we do more in our urban stream than just ‘pretty them up’? Can we improve ecosystem function?

Much of the early work in this project focused on these drivers of stream health and exploring their capacity to recover from the stress of urbanisation. The reviews across multiple disciplines indicated that:

*Management effort will yield greatest result when it targets ecosystem components that:*

- a) Exert significant influence on ecosystem function of a site,*
- b) Are highly altered from their aspired state, and*
- c) Have a good capacity to recover.*



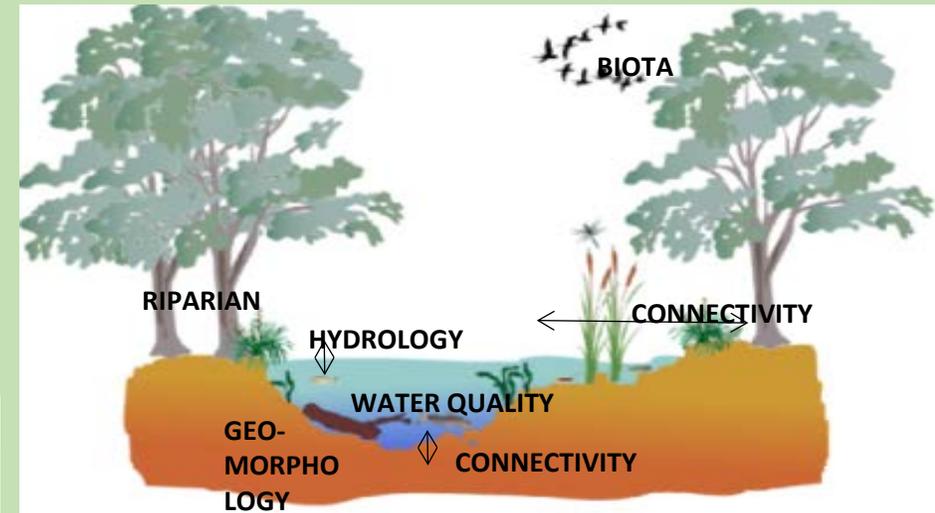
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*Management effort will yield greatest result when it targets ecosystem components that:*

- a) Exert significant influence on ecosystem function of a site,*
- b) Are highly altered from their aspired state, and*
- c) Have a good capacity to recover.*

How does one figure this out?



## Project Background

During the development of a River Action Plan or River Restoration Plan, a systems assessment and prioritisation process is undertaken.

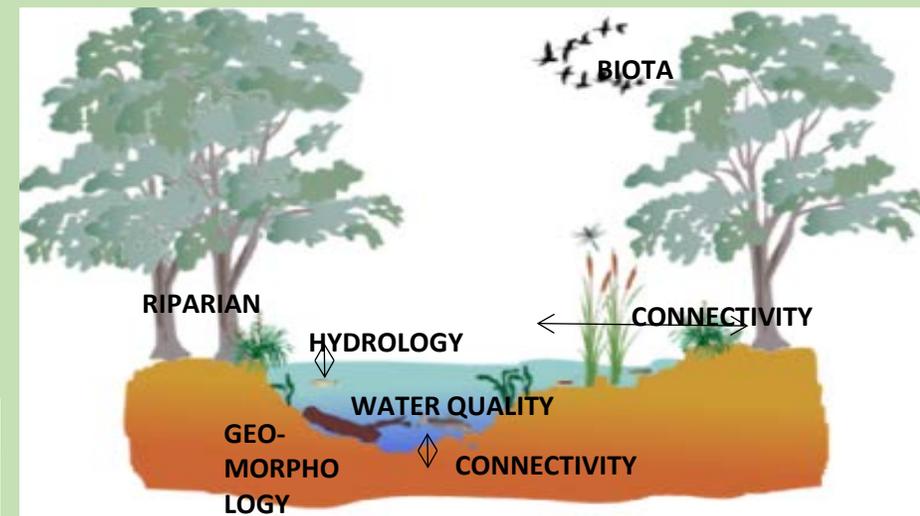
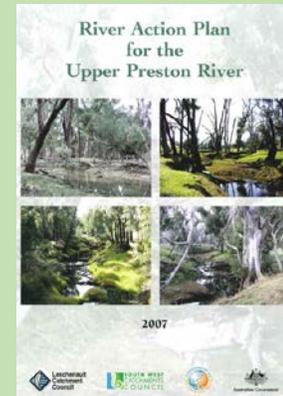
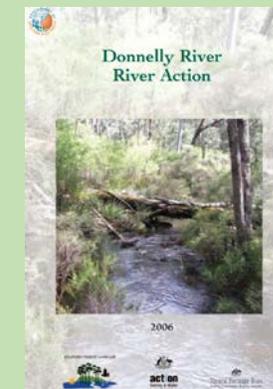
When data has been compiled from the systems assessment, it can be challenging deciding what is important in rehabilitating or protecting the site.

Identifying which suite of driver is important for a particular site is key.

Early work developing typologies for this project identified that depending if you are in a headwater environment or lowland environment, surface runoff or groundwater driven environment, the relative influence of each driver, is different.

Management actions at one site, may be more or less beneficial at another site depending on the relative influence of the driver that the particular action targets.

1. Exert significant influence on ecosystem function of a site,
2. Are highly altered from their aspired state,
3. Have a good capacity to recover.



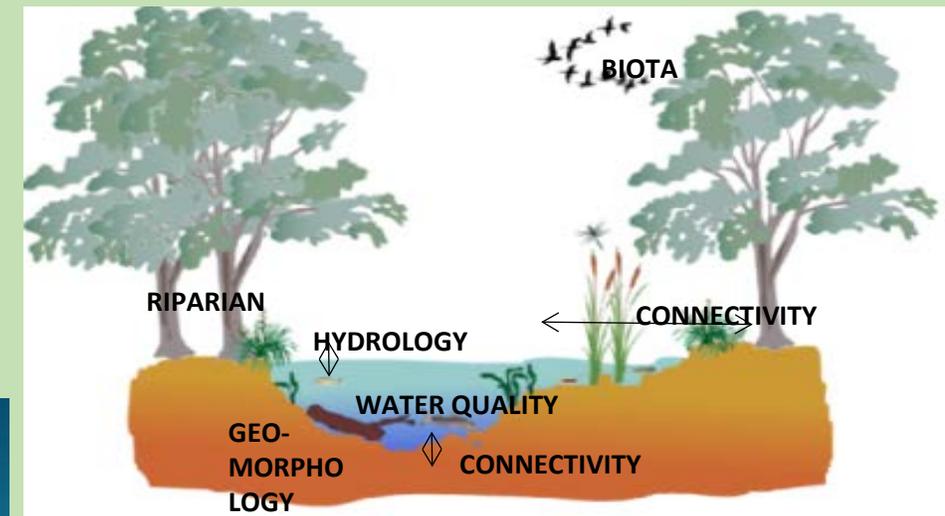
Project Outputs

B2.23 is developing an Urban Water Restoration Framework that guides managers through the system assessment and prioritisation process when developing a River Action Plan, with urban specific tools and guidelines along the way.

These supporting tools include:

- (i) 'RESTORE' - a tool that synthesizes multi-disciplinary current state of knowledge to guide the **prioritisation of important drivers and on-ground management actions**,
- (ii) the determination of multiple **biotic indicators** of stream condition to help managers evaluate the state of urban waterways and restoration success,
- (iii) an analytical framework that allow **site-specific reference condition to be predicted for biotic indicators**, and
- (iv) **guidelines** for determining appropriate **riparian buffers**.

1. *Exert significant influence on ecosystem function of a site,*
2. *Are highly altered from their aspired state,*
3. *Have a good capacity to recover.*



# Restoration Framework...

*Guiding managers along a restoration pathway*



*Background*

*Management need*

*Who should use this tool?*

*What does it do?*

*Instructions for use*

*Supporting documents*

*Scientific justification*

# What is the framework, & what does it do?

The *Framework* is a series of questions that directs managers to obtain the information required to assist them to make three key decisions.

Decision 1. which on-ground actions should be implemented to optimise ecological improvement or protection at their site, given urban constraints.

Decision 2. what ecological targets are being aimed for and what parameters (i.e., ecological indicators) should be monitored to assess the success of the intervention.

Decision 3. when and how should monitoring take place to evaluate the success of the restoration intervention.

The *Framework* uses knowledge from many sources to assist in the decision-making-process.

[Framework Overview](#)

[Start the Framework](#)



# *Framework overview...*

The Restoration Framework guides managers through 11 steps.

Step 1. Explicitly state the goal or aims of your restoration activity

Step 2. Use the RESTORE tool to determine which ecosystem components are management priorities

Step 3. Identify the ecological elements you want to improve/protect/create for the priority ecosystem components

Step 4. Identify an ecological indicator to describe each ecological element

Step 5. Determine the aspirational condition for each indicator

Step 6. Determine the current condition of each indicator this will reveal how much the indicator has departed from aspiration

Step 7. Set a realistic target for each indicator given your management intervention

Step 8. Create a list of on-ground actions that should improve the ecological elements of interest (see BMP table)

Step 9. Refine targets given on-ground actions

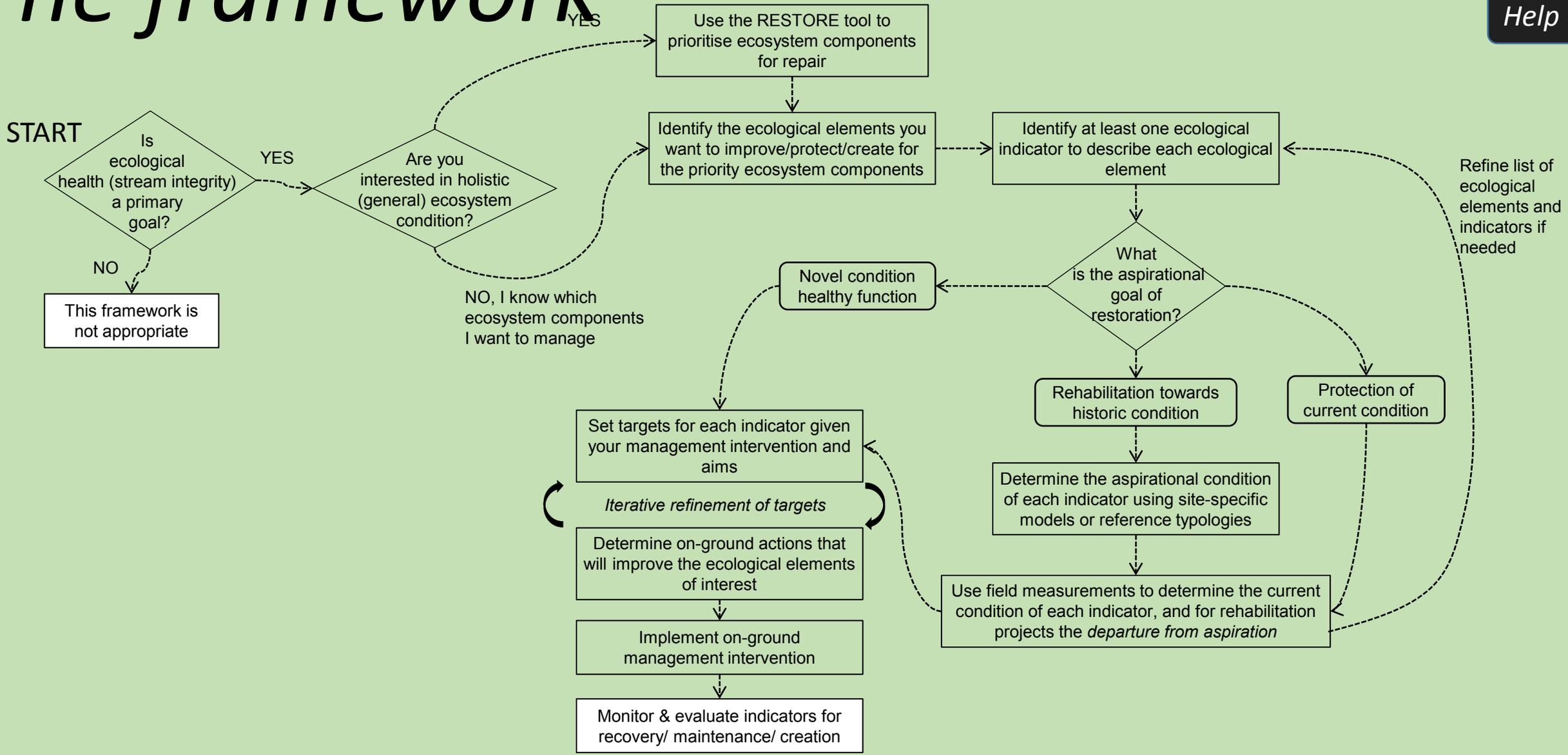
Step 10. Implement on-ground actions

Step 11. Monitor ecological indicators at the appropriate spatial-temporal scale to evaluate success.

[Start the Framework](#)

[See the Framework visually represented](#)

# The framework



Start the Framework

# Setting the scene...

? More information about the question

Provide information about your restoration activity and your goals.

## Question

## Answer (select)

Are you wanting to protect, repair or create an urban waterway? ?

Rehabilitation

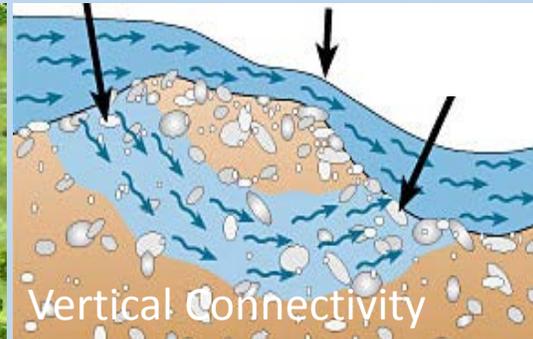
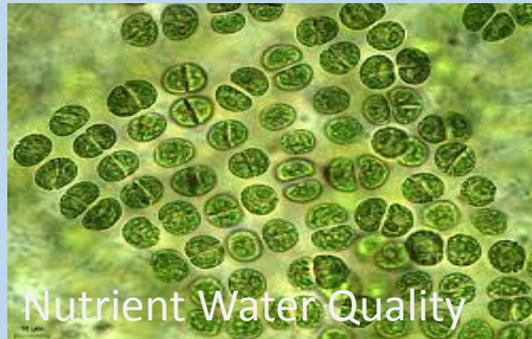
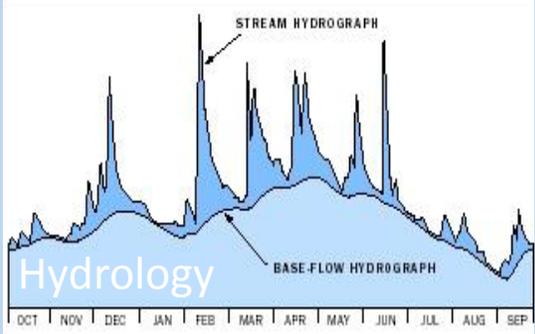
What is the aspirational goal for the site? ?

Historical reference condition

Go to RESTORE

# RESTORE...

*Optimising ecological gains to urban stream sites by prioritising the natural ecosystem components for repair*



*Management need*

*Who should use this tool?*

*How does the tool work?*

*Instructions for use*

*Supporting documents*

*Restoration Framework*

*Scientific justification*

*Click here to begin*

# What is RESTORE?

RESTORE is a conceptual tool that supports urban stream restoration.

The tool synthesizes existing knowledge from multiple disciplines and across multiple spatial scales of influence (site/reach → catchment/region) to determine *the ecological components that should be the focus of management attention*.

RESTORE's premise is that management effort will yield the largest ecological return when it targets ecosystem components that:

- (i) exert significant influence on the ecosystem function of the site,
- (ii) are highly altered, and
- (iii) have a good capacity for recovery.



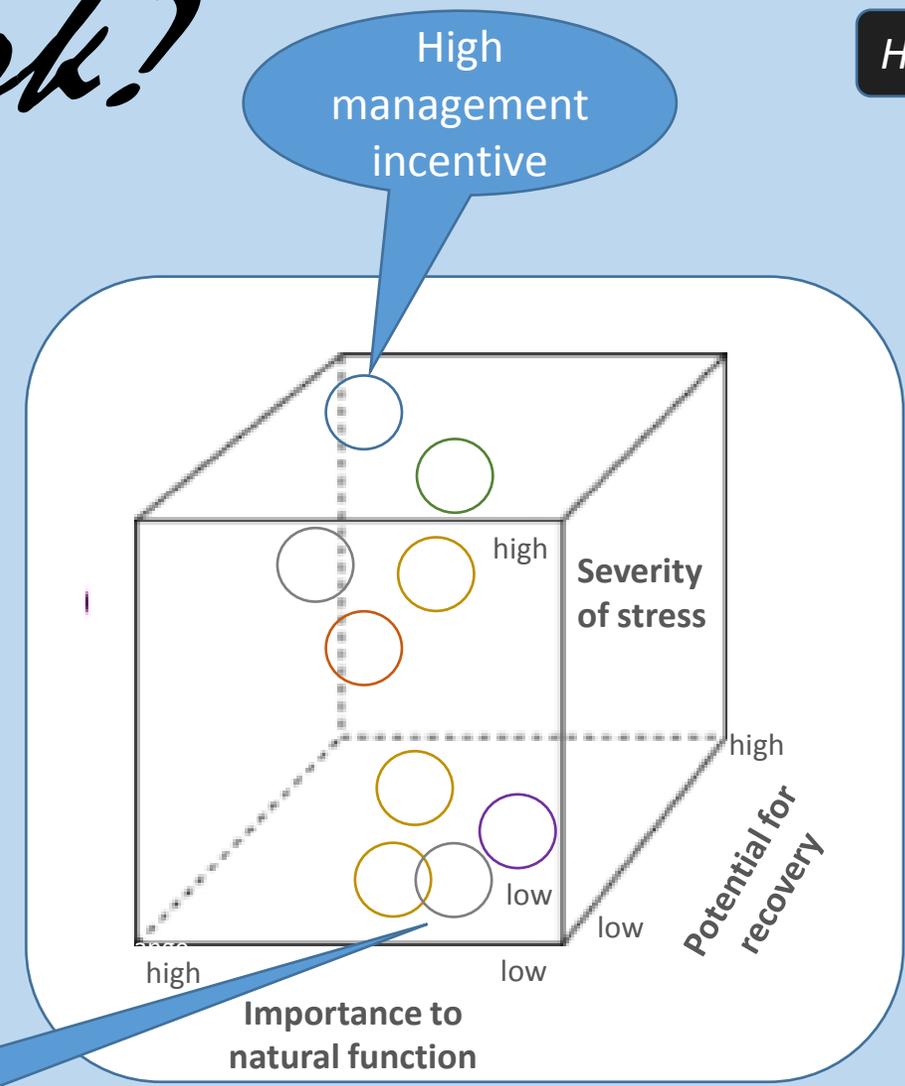
# How does the tool work?

There are 9 components important to stream health:

- biota
- hydrology
- riparian zone,
- physical water quality
- vertical connectivity.
- nutrients
- geomorphology
- longitudinal connectivity
- lateral connectivity

The tool ranks stream components according to three criteria:

- Criterion 1. Importance to natural ecosystem function
- Criterion 2. Severity of its departure from reference condition
- Criterion 3. Potential for recovery



Low management incentive

Ecosystem components that receive a high score should be prioritised over components that receive a low score.

Prioritisation happens behind the scenes, all you need to do is answer a series of questions.

[Click here to begin](#)

# Knowledge underpinning the tool

Home

Help

The three criteria are prioritised using information about the environmental characteristics both today (current) and in the past (e.g. historical condition) and by information about urban development

## Environmental characteristics

### Large Scale Factors

- Climate
- Vegetation
- Geology
- Physiography  
Biogeography
- Prior agricultural land use

### Meso & Fine Scale Factors

- Position in River Continuum
- Tributary effects
- Instream habitat attributes
- Etc.

## Urban development & infrastructure

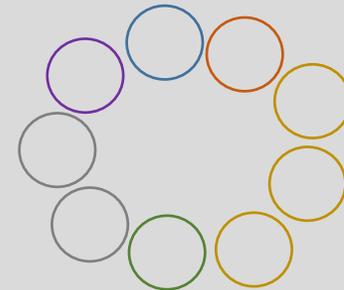
### Large Scale Factors

- Area of urban catchment
- Type of stormwater management
- Future development projections of catchment
- Fragmentation of river network by roads
- Dam or barriers in catchment

### Meso & Fine Scale Factors

- Distance from stream to urban development
- Stormwater drains at site
- Groundwater pumping nearby
- Leaky water and wastewater infrastructure
- Barriers to fish passage
- Flow regulating structure upstream

## 9 Ecosystem Components Driving Stream Function



- Criterion 1. Importance to natural ecosystem function
- Criterion 2. Severity of stress due to urban development
- Criterion 3. Potential for recovery

# Questions need to be answered from different spatial scales & different perspectives...

Home

Help

## Current characteristics

Site

Catchment

*You need to answer questions about the current characteristics of your site and your aspirational condition.*

Current condition:  
32 site questions

Current condition: 13  
catchment questions

[Click here](#)

[Click here](#)

## Historical or aspirational condition

Site

Catchment

*You need to answer questions about your site & the catchment it sits within.*

Aspirational condition:  
14 site questions

Aspirational condition:  
7 catchment questions

[Click here](#)

[Click here](#)

# Current environmental attributes of the site...

Instructions. Answer the questions below using the current physical attributes of the site.  
A visit to the site or GIS mapping may assist.

? More information about the question  
💡 How does this affect stream function?

	Question	Answer (select)	Question	Answer (select)
Geomorphology	What is the stream order of the site? ? 💡	3	What is the dominant geomorphic unit? ? 💡	run
	What is the orientation of the stream channel? ? 💡	East-west	Is there much spatial complexity in geomorphic units?	Low complexity
	What is channel sinuosity? ? 💡	meandering	What is the soil pH of the channel bank? ? 💡	unknown
	What is the material of the channel bed ? 💡	Sand and gravel	Is the site upstream of a knick point? ? 💡	no
Riparian	What is the width of the riparian buffer? ? 💡	10 – 50 m	What % of the riparian veg. has been cleared? ? 💡	>50%
	Is the riparian zone trees, shrubs or grass? ? 💡	forested	What % of the riparian veg. is non-native? ? 💡	>75-100%
	What is the dominant soil type of the riparian zone? ? 💡	sand	What season does most leaf litter fall ? ? 💡	autumn
	What is the slope of the riparian zone? ? 💡	< 10%	How much organic matter is there in the soil? ? 💡	low
Flow / WQ	Is flow perennial or intermittent?	perennial	What is the min. depth to groundwater during the year?	2-4 m
	Does the site experience protracted periods of low flow?	yes	Is the site connected downstream of a flow regulating structure? ? 💡	no
	Do low flows occur during warm months? ? 💡	yes	How stained (coloured) is the water? ? 💡	Deeply tannin stained
	Does the site experience high velocity scouring flows?	unknown	Is baseflow falling or rising? ? 💡	rising
Others	Is the site near a tributary? ? 💡	> 100 m from tributary	Is the site connected to a floodplain? ? 💡	Not connected
	How much LWD is there in the channel? ? 💡	< 1 piece per 10m	Is there a natural recharge area nearby? ? 💡	NA
	Has past agriculture led to elevated salinity? ? 💡	yes	Are there threatened or endangered species at the site?	Not at site, but in system
	Are there ASS at the site or nearby upstream? ? 💡	no	How far is the site to a refuge?	< 1 km

# Current urban attributes of the site and reach...

Instructions. Answer the questions below using the current urban attributes of the site. A visit to the site or GIS mapping may assist.

- ? More information about the question
- 💡 How does this affect stream function?

## Question

- How close to the stream is urban development? ? 💡
- Do stormwater drains feed into the site or upstream? ? 💡
- Do subsurface drains feed into the site or upstream? ? 💡
- Is groundwater pumped within 100m of the site? ? 💡
- Do underground water mains and sewage infrastructure leak? ? 💡
- Are there barriers to fish passage at the site ? 💡
- Has the stream channel been revetted? ? 💡
- Could channel redesign cause a flood risk to people or infrastructure? ? 💡
- Is the site connected downstream of a flow regulating structure? ? 💡
- Is the site close to an artificial aerator? ? 💡
- Are there levees or regulating structures preventing floodplain inundation? ? 💡
- Is there a point source WQ pollution occurring at the site or in the upstream reach? ? 💡
- Is there a non-point source WQ pollution occurring at the site or in the upstream reach? ? 💡

## Answer (select)

50-100 m	⤴ ⤵
At the site	⤴ ⤵
< 1 km upstream	⤴ ⤵
Yes – residential bores	⤴ ⤵
None or little leakage	⤴ ⤵
Yes – a culvert	⤴ ⤵
Rock lining in places	⤴ ⤵
Highly unlikely	⤴ ⤵
Yes, downstream of detention basin	⤴ ⤵
no	⤴ ⤵
no	⤴ ⤵
Yes, industrial discharge	⤴ ⤵
Yes, residential use of herb/pesticides	⤴ ⤵



# Current environmental attributes of the catchment...

Instructions. Answer the questions below using the current physical attributes of the site.  
A visit to the site or GIS mapping may assist.

? More information about the question  
💡 How does this affect stream function?

## Question

## Answer (select)

Geology/  
Physiography

Is the catchment flat or steeply sloped? ? 💡

Very flat (<1% slope)

Is the soil permeability of the catchment low or high? ? 💡

Sand, high permeability

Flow / water

Can rainfall intensity be high? ? 💡

yes

What is the flow class of your site? ? 💡

Stable winter baseflow

What is the min. depth to groundwater during the year? ?

2-4 m

Is the climate drying? ? 💡

markedly

Others

Is the aquatic food web of river system reliant on the migration of fish from the ocean/estuary? ? 💡

unlikely

Do biota of interest have a high capacity for dispersal? ? 💡

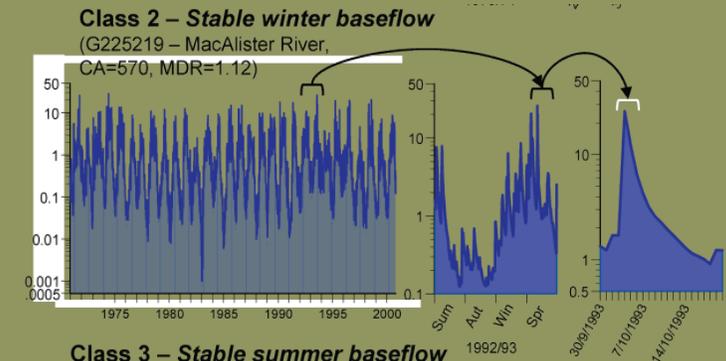
unknown

Are non-native aquatic species present downstream but not at your site? ? 💡

yes

*Stream Function:* catchment slope affects how much rain flows over the surface (i.e. runoff) of the land, hence it affects stream flow. Flatter landscapes experience lower runoff than sloped landscapes.

*Susceptibility to Urban Stress:* studies have found that flat landscapes experience reduced peak discharges than sloped landscapes after urbanisation (Utz et al 2011, Hopkins 2015); therefore, sloped landscapes are more susceptible to urban flow stress.



# Current urban attributes of the catchment...

Instructions. Answer the questions below using the current urban attributes of the site. A visit to the site or GIS mapping may assist.

? More information about the question

💡 How does this affect stream health?

## Question

What % of the catchment is impervious? ? 💡

How large is the catchments' urban area? ? 💡

What is the dominant type of stormwater management? ? 💡

What is the drainage density? ? 💡

What % of natural vegetation has been cleared

Could channel redesign cause a flood risk to people or infrastructure? ? 💡

Is there currently, or likely to be, urban development in the upstream catchment? ? 💡

Is there likely to be coarse sediment (sand, gravel) running into drainage lines associated with ongoing urban development? ? 💡

Is there likely to be fine sediment (silt) running into drainage lines associated with ongoing urban development or agriculture? ? 💡

Is the river network upstream of the site highly fragmented by roads and other urban development? ? 💡

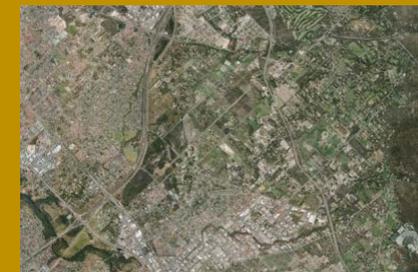
Is much of the upstream river network buried? ? 💡

Is there a dam upstream that is affecting the thermal or oxygen regime of the site?

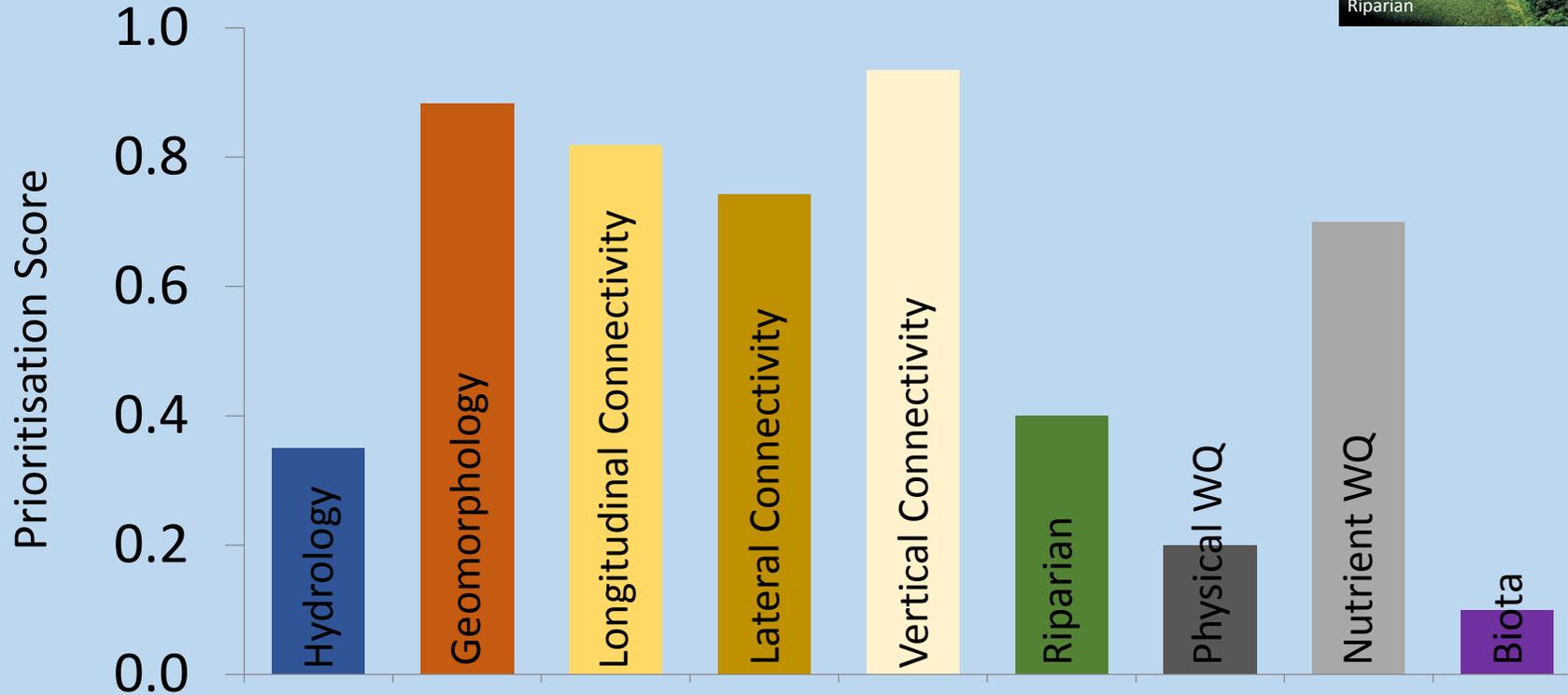
Are there barriers upstream or downstream preventing the ingress of important species (e.g. native fish) ? 💡

## Answer (select)

10-30%	^ v
<5km <sup>2</sup>	^ v
Stormwater piped to drainage lines	^ v
0.41 – 0.89 km km <sup>2</sup>	^ v
75-100%	^ v
Highly unlikely	^ v
No	^ v
NA	^ v
unknown	^ v
yes, > 10 road crossings	^ v
yes, 10-50% is piped	^ v
no	^ v
Yes, effect on fish unclear	^ v



# Prioritisation output...



*The natural ecosystem components prioritised for repair at your restoration site*

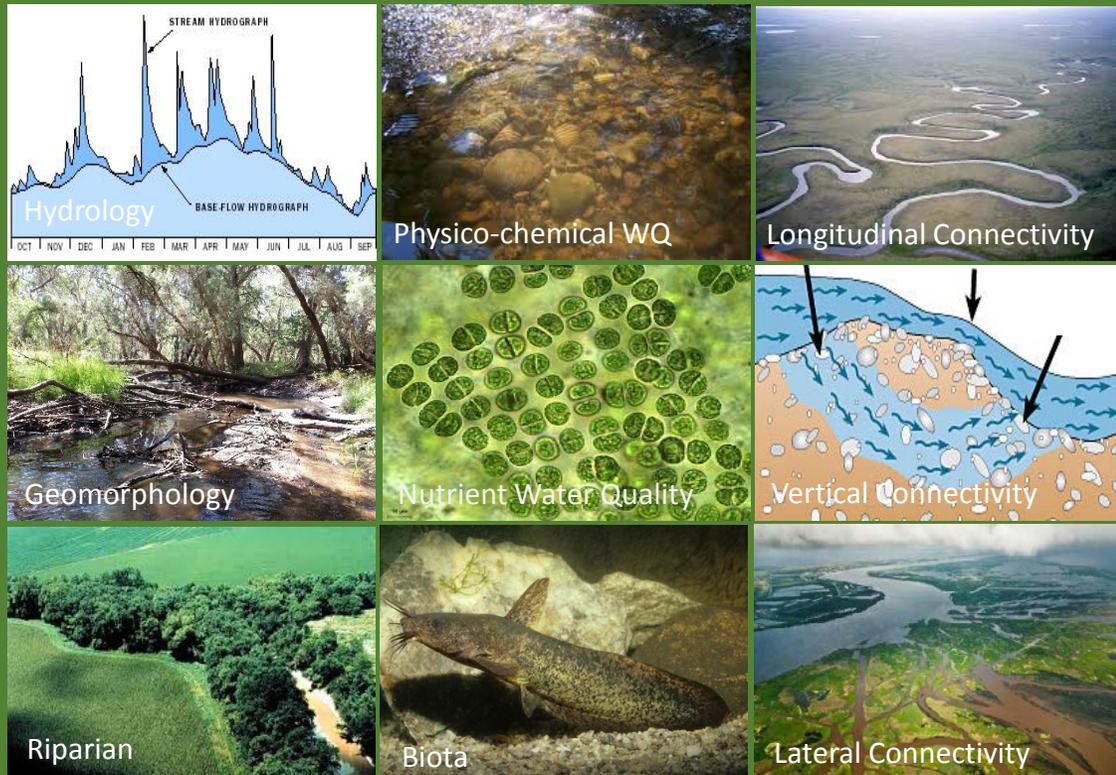
# Management priorities...

? More information about the question

Using the output of RESTORE, provide information about the ecosystem components for management attention.

## Question

Which ecosystem components are considered to be a management priority for your site? List in descending order of importance. ?



## Answer (select)

Hydrology (flow)	^ v	Priority 1
Nutrients, Water Quality	^ v	Priority 2
Riparian	^ v	Priority 3
Vertical Connectivity	^ v	Priority 4
Physico-chemical, Water Quality	^ v	Priority 5
Geomorphology	^ v	Priority 6
Lateral Connectivity	^ v	Priority 7
Longitudinal Connectivity	^ v	Priority 8
Biota	^ v	Priority 9

Go to next step

# Ecological elements for repair or protection...

Of your priority ecosystem components, choose elements are you interested in repairing, protecting or creating?

	<b>Ecosystem Components</b>	<b>Element 1</b>	<b>Element 2</b>	<b>Element 3</b>	<b>Element 4</b>
Priority 1	Hydrology (flow)	Flow volume	Flow velocity	Flow permanence	Rate of rise and fall
Priority 2	Nutrients, Water Quality	Nitrate	Phosphorus	Organic nitrogen	select
Priority 3	Riparian	Stream shading	Instream habitat creat...	Vegetation nativeness	Upstream continuity
Priority 4	Vertical Connectivity	Baseflow	Channel unit complexity	Bed material porosity	select
Priority 5	Physico-chemical, Water Quality	Temperature	Salinity	Heavy metals	select
Priority 6	Geomorphology	Channel unit complexity	Bank stability	select	select
Priority 7	Lateral Connectivity	select	select	select	select
Priority 8	Longitudinal Connectivity	select	select	select	select
Priority 9	Biota	Native species richness	select	select	select

! Element selection should reflect ecosystem component priorities. That is, you should select more elements for the ecosystem components considered to be a priority. The exception may be biota, which itself may not exert a marked influence on general stream function, it can provide a holistic description of stream condition (i.e. biota can synthesise improvement in multiple physical factors).

[Go to next step](#)

# Ecological indicators...

[? More information](#)

For each of your priority elements, the tool automatically generates a list of potential ecological indicators. Select the ecological indicators that are relevant to your urban region.

Priority Elements	Ecological indicator
Flow volume	Discharge (ML/d, ML/yr)
Flow permanence	# days no flow per year
Flow velocity	select
Rate of rise and fall	select
Nitrate	NOX
Phosphorus	Soluble Reactive P
Organic nitrogen	Total organic N (mg/L)
Stream shading	select
Instream habitat creat...	select
Vegetation nativeness	select
Upstream continuity	select
Baseflow	Baseflow index
...	
Biodiversity	SIGNAL

### Biodiversity ecological indicators

#### Macroinvertebrates

SIGNAL. Suitable for south-eastern Australia, but not WA.  
Macroinvertebrate family richness, suitable for all states.

#### Fish

Total native species richness. Suitable for all states.

# Aspirational condition...

? [More information about the question](#)

If your goal is to Protect the health of a waterway not improve it skip to step 6. [Go to step 6](#)

If your goal is to create a novel living stream, e.g. a stream in an area where there has never been one (new development) skip to step 7. [Go to step 7](#)

For each of your ecological indicators use the site-specific **Historical Condition Applications**, **Reference Typology** or **other tools** to determine your aspirational condition, and use field measurements to describe current condition. Models (i.e. apps) generating predictions that are site-specific should be used in preference to generic typologies where data permits.

## Ecological indicator

## Tool

## Aspirational condition

Discharge (ML/d, ML/yr)	^ v	Reference typology	enter	^ v
# days no flow per year	^ v	Reference typology	enter	^ v
select	^ v	Reference typology	enter	^ v
select	^ v	Reference typology	enter	^ v
Nitrate, Nitrite (NOX)	^ v	Historical condition application	enter	^ v
Soluble Reactive P	^ v	Historical condition application	enter	^ v
Total organic N (mg/L)	^ v	Historical condition application	enter	^ v
select	^ v	Historical condition application	enter	^ v
select	^ v	Historical condition application	enter	^ v
select	^ v	Historical condition application	enter	^ v
select	^ v	Historical condition application	enter	^ v
Baseflow index	^ v	Bhaskar et al. 2016 tool	enter	^ v
Native fish sp richness	^ v	Historical condition application	enter	^ v

[Go to next step](#)

# Current condition...

Next, you need to determine the current condition of the ecological indicators at your site. This can be achieved by field measurements or data recently collected from your site. Once the current condition is entered, the departure from reference will be automatically generated. NB. Departure from Aspiration will only be generated if your goal is rehabilitation.

### Ecological indicator

### Current condition

### Departure from Aspiration

Discharge (ML/d, ML/yr)	enter	To be generated
# days no flow per year	enter	To be generated
	enter	To be generated
	enter	To be generated
Nitrate, Nitrite (NOX)	enter	To be generated
Soluble Reactive P	enter	To be generated
Total organic N (mg/L)	enter	To be generated
	enter	To be generated
Baseflow index	enter	To be generated
Native fish sp richness	enter	To be generated

Example 1  
Large increase



Example 2  
Little change



Consider removing this parameter from your ecological indicator list unless future development is likely to cause stress to base flow.

Go to next step

# Set realistic targets...



*Next, you need to set realistic targets for each of your ecological indicators. These should be values you believe are attainable given your management interventions. Mathematical models may be able to assist you in creating realistic targets.*

There are several factors you should consider when setting your target.

## 1. Whether the ecological indicator is shaped by small (e.g., site) or large (e.g., catchment) scale ecological processes

If small-scale processes are dominant, large improvements in the indicator can be achieved by on-ground actions at the site (e.g., stream shading) and targets can be ambitious. If large-scale processes are dominant, large improvements in the indicator are only possible if on-ground actions occur across the catchment. This may be very difficult to achieve, unless the catchment is very small. Consequently, targets for these indicators (e.g., flow) should be more conservative.

## 2. The scale of management intervention

If a management intervention is controlled by large-scale processes (e.g. catchment) then the greater the spatial scale of the intervention the more ambitious the target can be. Note that exceptions occur. For example, if an upstream weir can be controlled to manage flow to the stream site, then an ambitious target for flow could be set even though the spatial scale of influence is small (e.g. the weir).

## 3. The type of management intervention

Not all management interventions have the same capacity to deliver ecosystem improvements. If interventions are likely to have a strong direct effect on the indicator then targets can be ambitious, if interventions are likely to have a weak or indirect effect on the indicator then targets should be conservative.

## 4. Temporal aspects of recovery

Most ecological components are interdependent, and some are dominant, e.g., flow strongly affects geomorphology. Thus it may not be appropriate to set an ambitious target for certain indicators if influential components of the stream ecosystem have not already been repaired.

## 5. Future urban development

Future development within a restoration site's catchment will increase stress to many ecological indicators, particularly if they are related to catchment-scale processes (e.g. flow). In such instances a target of 'maintaining current condition' may be more appropriate than an 'improvement in condition'.

## 6. Legacies

Past land use change can leave long-lasting effects on stream ecosystems, which can make certain targets difficult to achieve. For example, agriculture can cause nutrient levels in soils and streams to remain elevated for decades. In such instances, targets must be adjusted down or the time-frame of achievement needs to be extended.

# Create a list of suitable on-ground actions...



References recommending action



Guidelines for implementation

Next, you need to create a list of the management actions that can repair your ecological indicators (ecological elements). Use the dropdown menu to identify the ecosystem component and ecological element that describe each ecological indicator. A list of management actions will appear. You must then choose the management actions that can be implemented given fiscal and urban constraints. Drag and drop your list of on-ground actions to your cart.

## Ecosystem Component

Nutrient Water Quality



## Priority Element

Nitrate



## Management objective

Reduction



## Management strategies

Reduce nutrient input by people

Reduce the volume of stormwater

Clean stormwater prior to it reaching the stream network

Slow and reduce the transport of nutrient-rich groundwater

Increase nutrient processing and uptake in the riparian zone

Increase nutrient processing and uptake instream

## Management action cart

Drag and drop actions in here...

raingardens

wetland  
biofiltersPlant native deep-rooted  
vegetation in  
riparian zone

On-ground action	Scale	Mechanism	Maintenance
Construct rain gardens  	Street	Nutrients are reduced by filtering and trapping stormwater in sediment and plant media.	High – sediment and vegetation need to...
Construct vegetated swales  	Street	Nutrients are reduced by reduced by trapping stormwater.	High – sediment and vegetation need to...
Construct wetland biofilters  	Precinct	Nutrient uptake is enhanced by slowing the flow of water and creating areas rich in macrophytes.	High – sediment and vegetation need to...

On-ground action	Scale	Mechanism	Maintenance
Increase stormwater infiltration by various mechanisms. <a href="#">LINK TO STORMWATER INFILTRATION</a>	Catchment	Increasing stormwater infiltration raises the water table which creates more anoxic soil in the riparian zone and improves denitrification.	See STORMWATER INFILTRATION
Plant native deep-rooted vegetation in riparian zone  	Site	Deep-rooted vegetation increases the carbon content of riparian soils. It also increases the depth of the microbial active zone. Trees/shrubs will also uptake nutrients, particularly if fast growing.	Low – none required
Increase width of riparian buffer  	Site		Low – trees bordering roads and paths...
Create trenches filled with sand	Site	Localised reduction in nitrate on other side of trench.	

# Refine targets given management actions...

Next, revisit your targets for each ecological indicator in light of the management actions you will implement. Targets may need to be refined.



## **Making Targets More Ambitious**

*If this tool has revealed there are management actions that you were not aware of that are highly effective, you may be able to make your targets more ambitious.*

## **Making Targets Less Ambitious**

*If this tool has revealed that management actions you expected to implement are likely to have poor efficiency given your physiographic setting, you may decide not to implement them and may need to make your targets more conservative.*

# *Implement on-ground actions...*

*Next, implement your on-ground management actions.*

BUT before you do... consider if the timing of different actions can improve your chance of success.

## Useful tips

1. channel reconfiguration is more likely to last if flow has already been fixed
2. replanting of native understory vegetation is more likely to be successful if weeds have been removed and overstorey vegetation is present to shade seedlings
3. implement destructive actions (e.g. channel modification) before you implement other actions

Finally, you need to monitor your ecological indicators to evaluate if you have reached your restoration/protection or creation target.

To do this you need to monitor at the appropriate spatio-temporal scale, i.e. in the appropriate locations at the appropriate times.

## Where to sample?

You need to decide if you only need to sample at the site or at other 'control' sites as well. This will depend on how you plan to analyse your data.

[Go to analysis information](#)

You also need to decide how you place your sampling effort at the site. This will be determined by how variable the indicator is over fine scale (i.e. within your site). If the indicator is relatively constant across the site then it can be measured at one location.

[Go to spatio-temporal variation of indicators](#)

## When to sample?

To know when to sample you need to know:

- 1) How much your indicator naturally changes through time unrelated to your management intervention (e.g. seasonally)
- 2) How much time it will take for intervention to cause a change in your indicator

To answer point 1 you need to understand to what extent your indicator changes hourly, daily, monthly, yearly. If change is considerable you need to standardise sampling so that you can control for these changes.

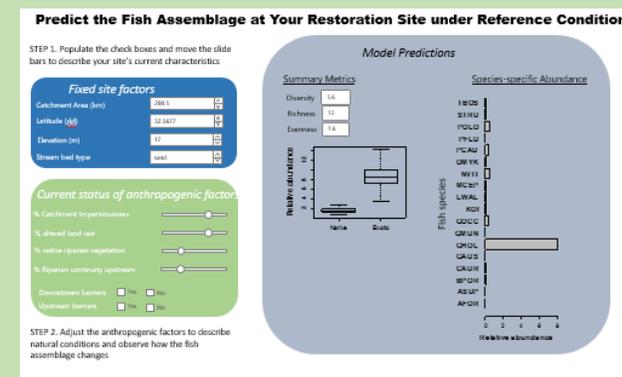
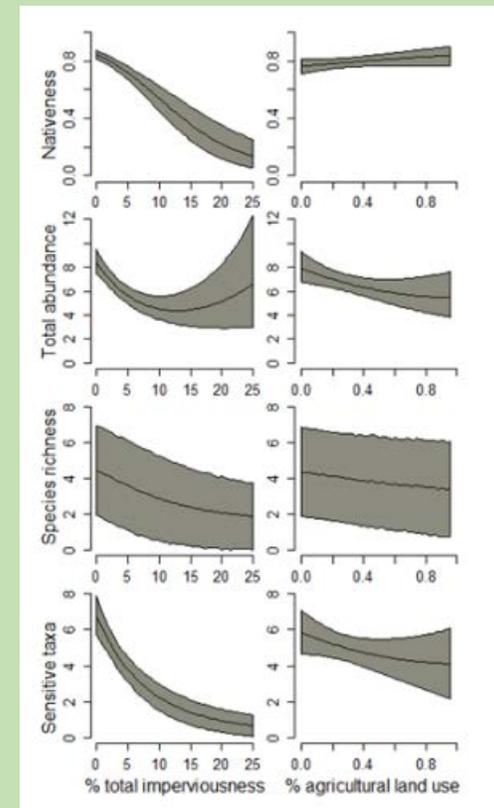
To answer point 2 you need to have some understanding of how long recovery will take. Some indicators may change relatively quickly (e.g. days to months), whereas others may take years or decades to recover. Resources should not be wasted measuring indicators that have not had sufficient time to respond.

[Temporal response of indicators](#)

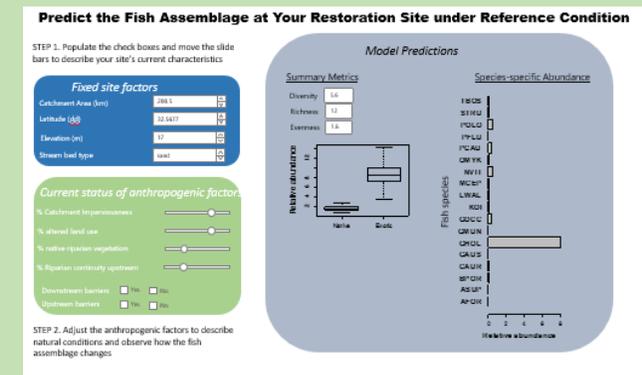
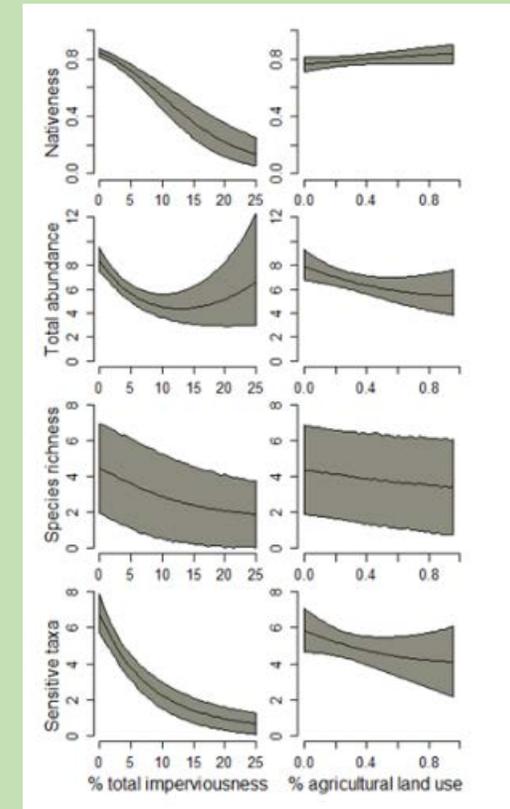
B2.23 developed a urban water restoration framework that guides managers through the system assessment and prioritisation process when developing a River Action Plan, with tools and guidelines along the way.

These supporting tools include:

- (i) 'RESTORE' - a tool that synthesizes multi-disciplinary current state of knowledge to guide the prioritisation of important drivers and on-ground management actions,
- (ii) the determination of multiple Biotic indicators of stream condition to help managers evaluate the state of urban waterways and restoration success,
- (iii) an analytical framework that allow site-specific reference condition to be predicted for biotic indicators, and
- (iv) guidelines for determining appropriate riparian buffers.



- Through the RESTORE tool, the restoration team can identify the important ecosystem components to repair at a site and optimise on-ground works.
- Monitoring can be optimised by identifying the most appropriate biotic indicators.
- Has the capacity to model reference conditions to support site restoration in areas with little or no data.
- Has guidelines regarding effective design dimensions for riparian buffers.

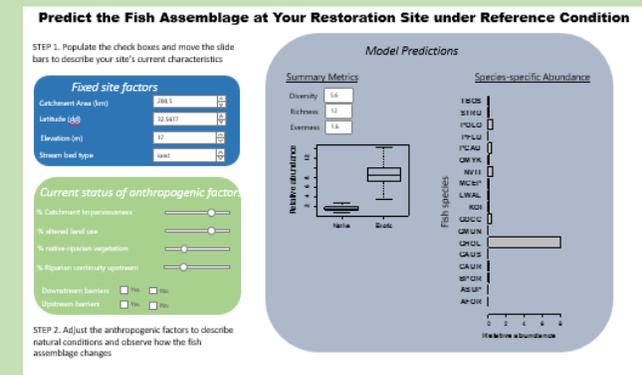
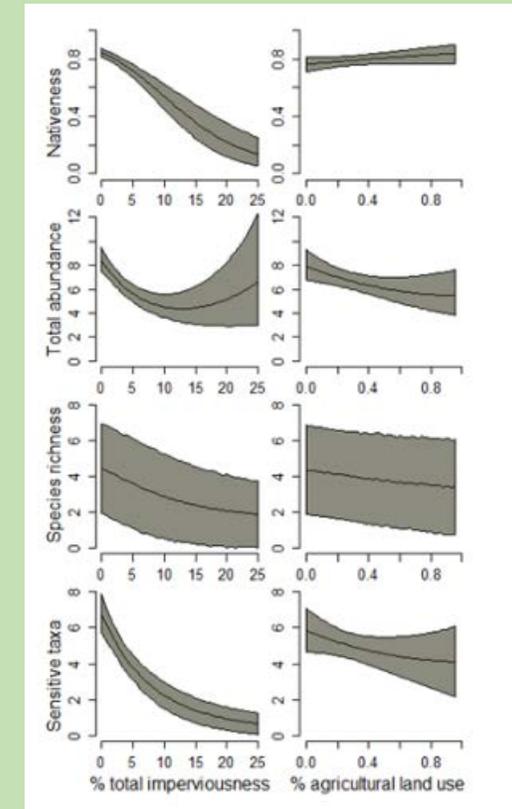


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By December 31 – the framework and the restore tool will be embedded into literature and a suite of paper products. 5 papers to date have been submitted to journals.

The models will be held by Department of Water.

There is still a lot of work to undertake.





Thank you.

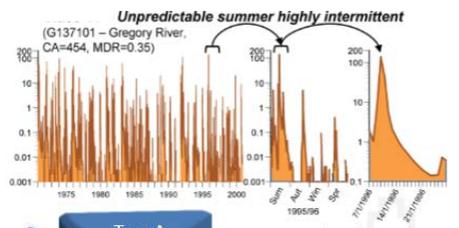
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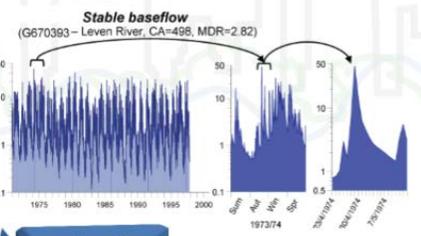
&

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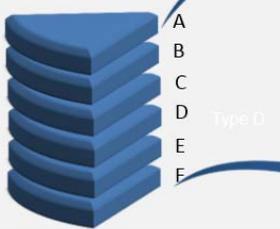


Type A



Type F

Natural types



Type D

