NATURE AND CLIMATE NEXUS

Nature-Based Solutions for Urban and Rural Landscapes

Lecture Series + Project Design Clinic
17–19 September 2024 • ADB Multifunction Halls 2 and 3 • Hybrid

This training is organized by **the ADB Environment Group** together with the **Water and Urban Development Sector Group,** and the **Agriculture, Food, Nature, and Rural Development Sector Office.**

ROI Evaluation for NBS

Speakers:

Erik Spirro-Larrea and Ben Furmage

SECTION/CHAPTER 1

NBS Benefit – Cost analyses, and Return-on-Investment

Structure of this session

- The “what and why” of CBA and ROI
- Cape Town example – ROI
  - Teaser: WaterProof tool
- RUCaS case study – CBA
  - Teaser: INFEWS tool
- Recap and common mistakes

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Defining CBA and ROI

What do the terms “return-on-investment” and “cost-benefit analysis” mean to you?

Defining CBA and ROI

CBA and ROI are different ways to analyse and express the costs and benefits associated with a program or an investment. ROI is narrower, and CBA broader.

Return-on-investment

- What are the tangible financial benefits that I can expect from this project?
- How do they compare to the costs I expect to incur from doing the project?
- How do those financial flows materialize over time?

Most useful for: defining "returns" for a specific audience

Cost-benefit analysis

- What is the long list of costs and benefits of the program, including those which are not tangible "financial flows"?
- Who do these costs and benefits arrive to, and how?
- How do those appear over time?

Most useful for: exploring the broader rationale for a project

Key CBA/ROI questions

CBA and ROI analyses allow us to answer some key questions about NBS programs.

Return-on-investment

Defining "returns" for a specific audience

+

Cost-benefit analysis

Exploring the broader rationale for a project

What key questions might you answer with CBA/ROI?

- ✓ How **cost-effective** is/are NBS options at addressing my key challenges, including compared to alternative investments?
- ✓ How do the **costs and benefits of my NBS arrive over time, and to whom**? What does this mean for **project funding, governance, and delivery**?
- ✓ Is a **portfolio** of different NBS the best approach?
- ✓ What are the **key co-benefits** my NBS will deliver?
- ✓ **Who do I need to involve in my project and why**? Who are the main winners, and are there any losers?
- ✓ What/where is the **optimum investment plan**?

Why is this important

Answering these questions is key to determining your project strategy and unlocking support.

What key questions might you answer?

- ✓ How **cost-effective** is/are NBS options at addressing my key challenges, including compared to alternative investments?
- ✓ How do the **costs and benefits of my NBS arrive over time, and to whom**? What does this mean for **project funding, governance, and delivery**?
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- ✓ **Who do I need to involve in my project and why**? Who are the main winners, and are there any losers?

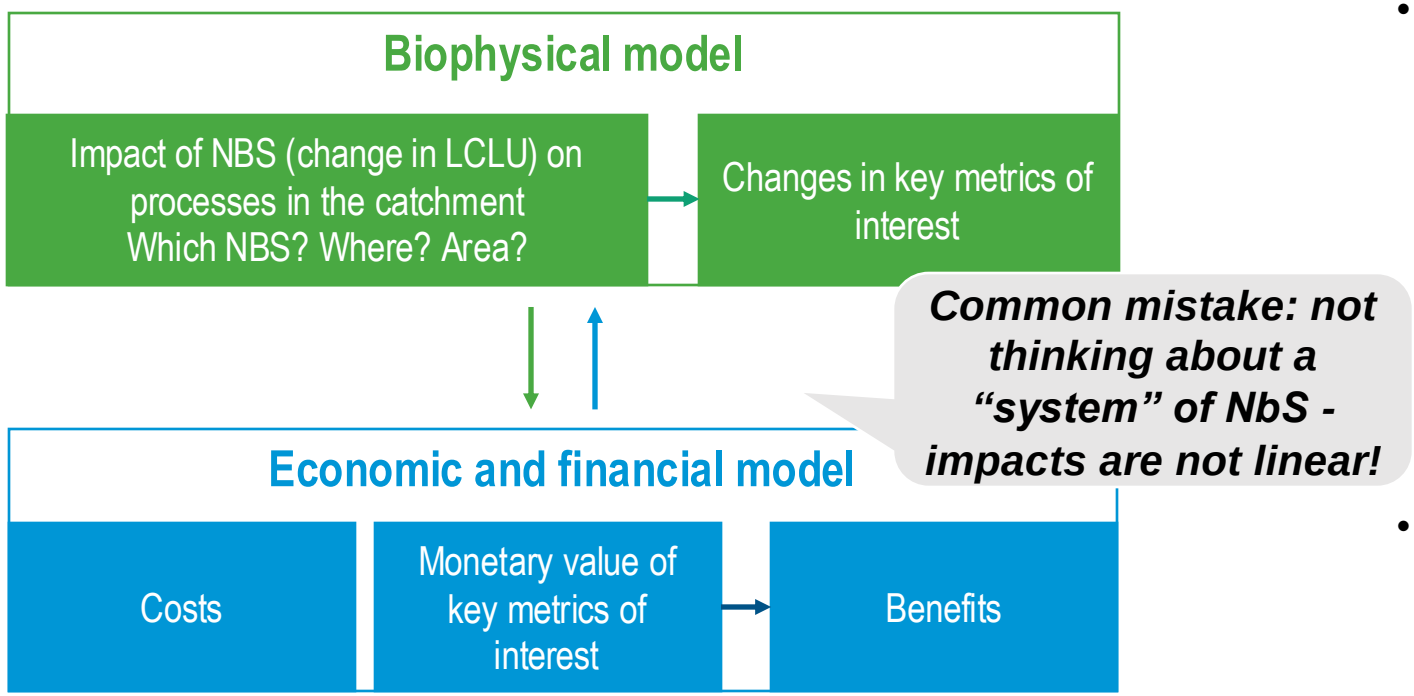
Why do these questions matter?

- ✓ Determining strategy
- ✓ Justifying activities
- ✓ Unlocking support
- ✓ Motivating funding
- ✓ Changing Policy
- ✓ Deciding who to involve, and when

Key aspects of the analysis

CBA/ROI should not be conducted in a vacuum. It must integrate with other analyses and be designed with a purpose.

Intertwining economic and biophysical analyses



Clearly defining the purpose of the analysis

- The CBA/ROI should be designed with a purpose in mind. That purpose is determined by:
  - Who cares?
  - What do they care about?
  - What do they need to 'see' for decision-making, and what is their burden of proof?
  - What data are available?
- The purpose may evolve over time – but **starting without defined goals is a recipe for both "analysis paralysis" and wasted time!**

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Economic & financial analysis building blocks

1. Determine beneficiary(s), Water security issue & Unit of measurement
2. Connect Ecosystem Services to NBS Interventions & Define the Interventions
3. Determine your Baseline Scenario
4. Target Interventions Based on Model Outputs
5. Identify Program Costs
6. Monetize Improvement in Ecosystem Services
7. Calculate Economic & Financial Indicators

Greater Cape Town Water Fund

Common mistake: not properly defining & involving beneficiaries

1 Determine beneficiary, Water security issue & Unit of Measurement

- *Who* is the target beneficiary(s)?
- *What* water security issue do they care about?
- *What* specific metric(s) define success?
- *What* co-benefits should also be estimated?

Based on what you heard earlier today, who do you think are the main beneficiaries of the program? What do they care about?

Primary Metric for ROI

Yield to water supply system (@ 50 year assurance of supply level)

Priority Co-benefits

Sustainable livelihoods

Biodiversity outcomes

Greater Cape Town Water Fund

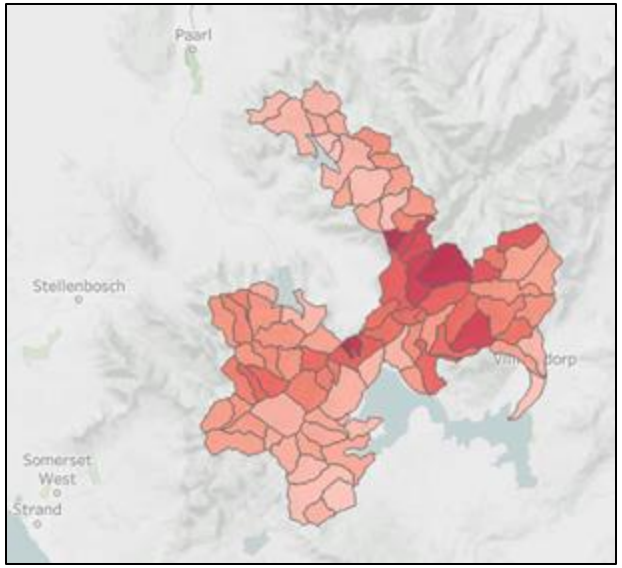
2 Connect Ecosystem Services to NBS Interventions & Define the Interventions

- *Which* ecosystem services need to be improved?
- *Which* NBS interventions can improve those ecosystem services?

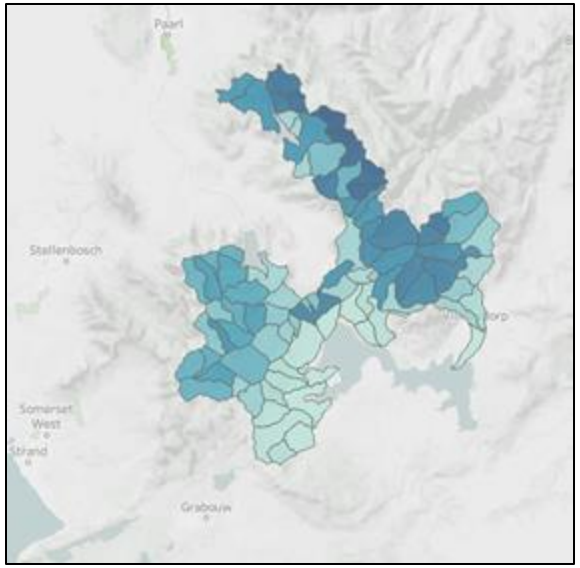
Priority interventions

Mechanical clearing of invasive alien plants (IAP)

HMU % IAP Invasion Level



HMU Person Day Cost Map

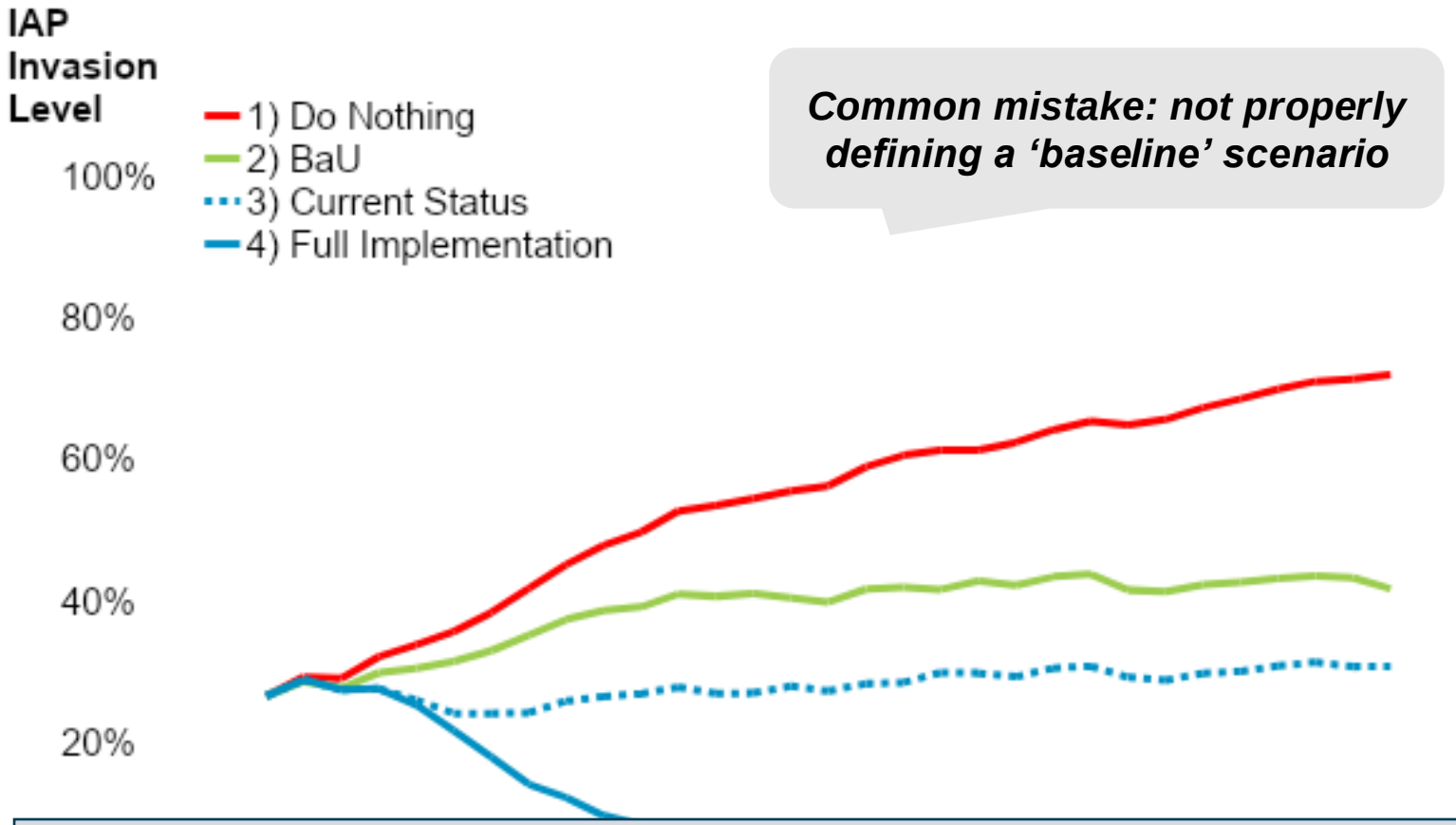


What factors do you think might make costs for IAP clearing be different in different areas?

Greater Cape Town Water Fund

3 Determine your Business-as-Usual Scenario

- *What* happens if your NBS program isn't implemented?



Common mistake: not properly defining a 'baseline' scenario

Why do you think this "Do Nothing" line is going upwards? What might that mean for the NBS program?

Greater Cape Town Water Fund

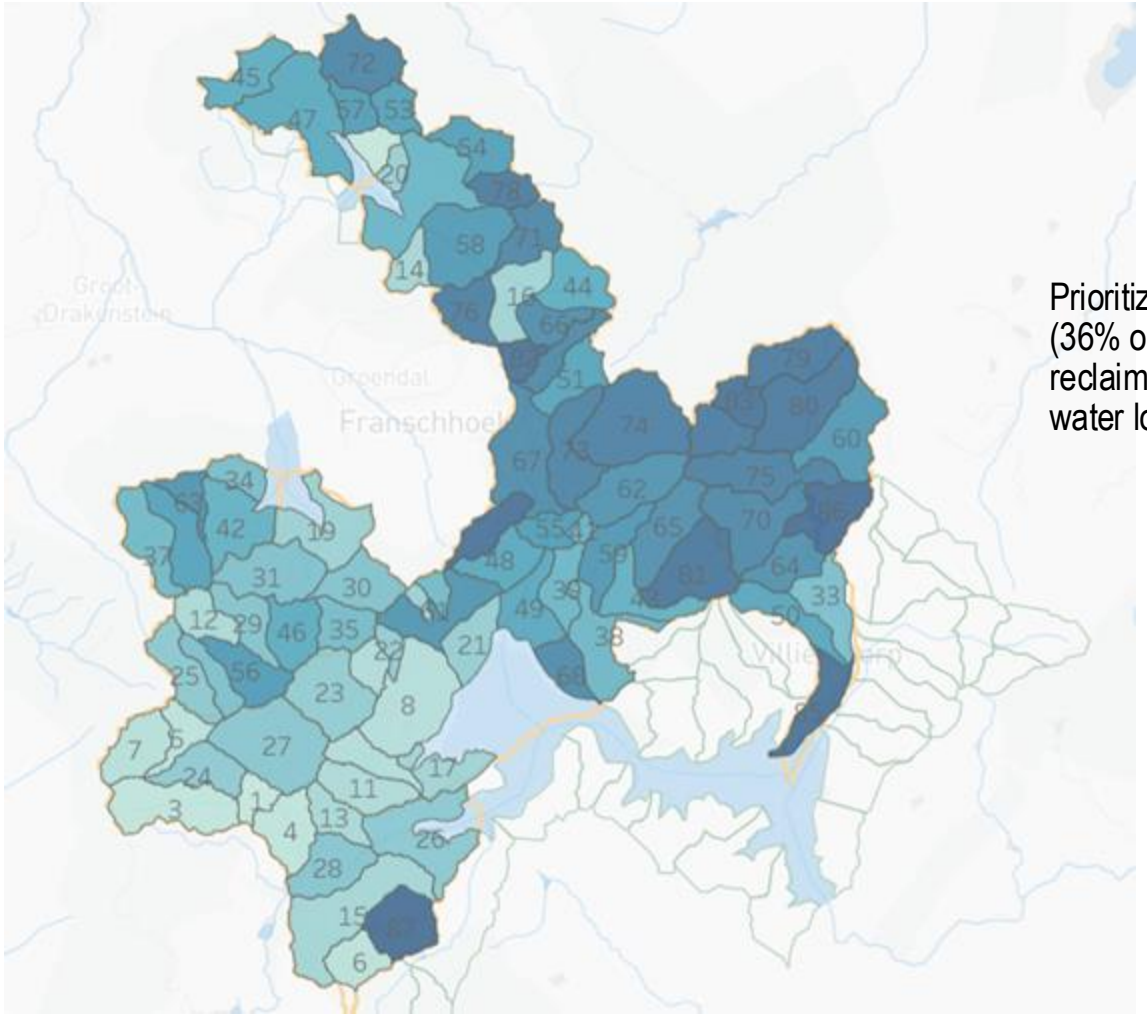
3 Determine your Business-as-Usual Scenario

- *What* happens if your NBS program isn't implemented?

4 Target Interventions Based on Model Outputs

- *Where* would NBS yield the highest improvement in ecosystem services per unit cost?

Prioritization of the HMU's



Prioritizing 7 of the catchments (36% of the WCWSS) allows for the reclaiming of 74% of the current water losses

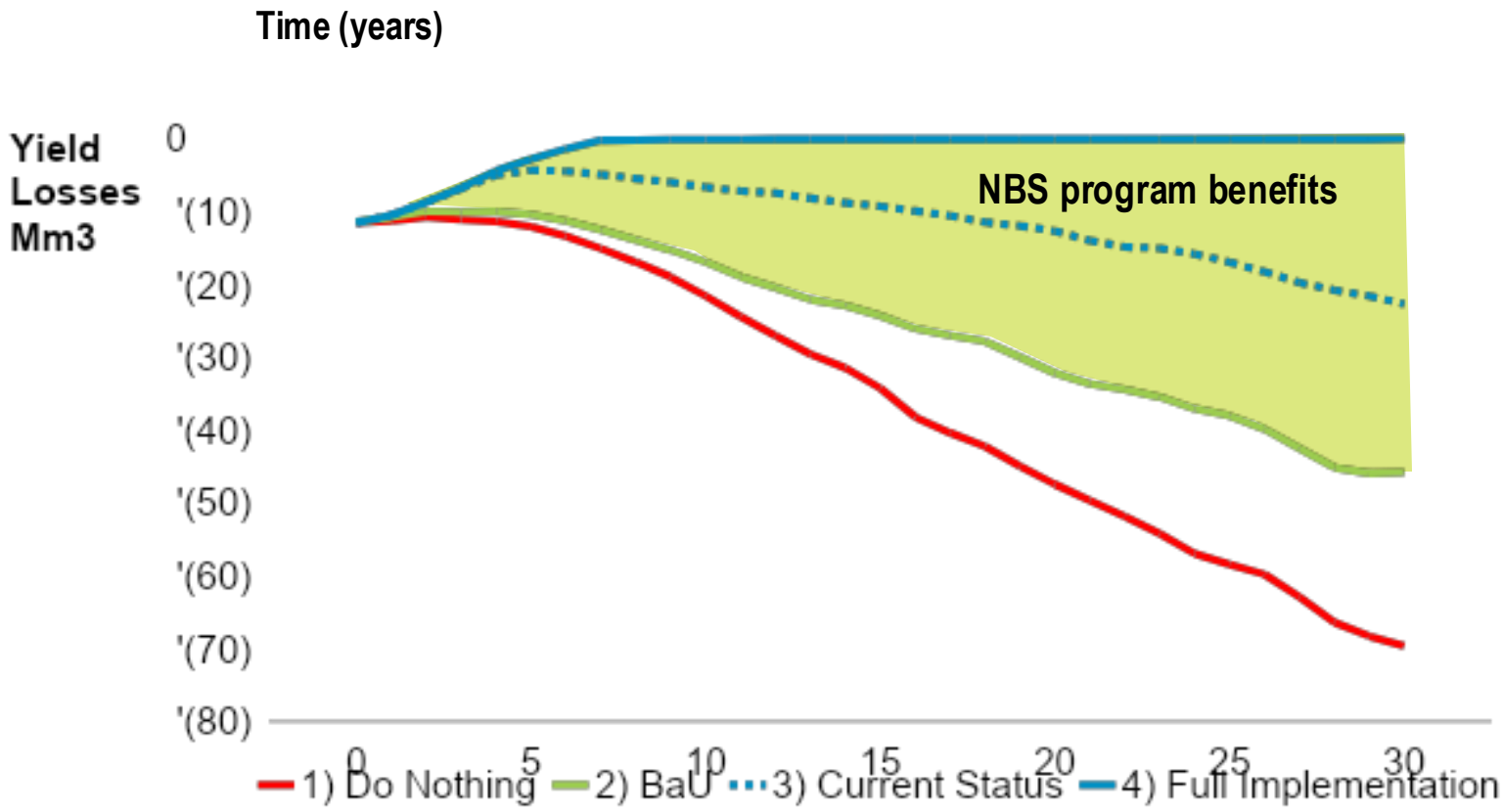
Greater Cape Town Water Fund

3 Determine your Business-as-Usual Scenario

- *What* happens if your NBS program isn't implemented?

4 Target Interventions Based on Model Outputs

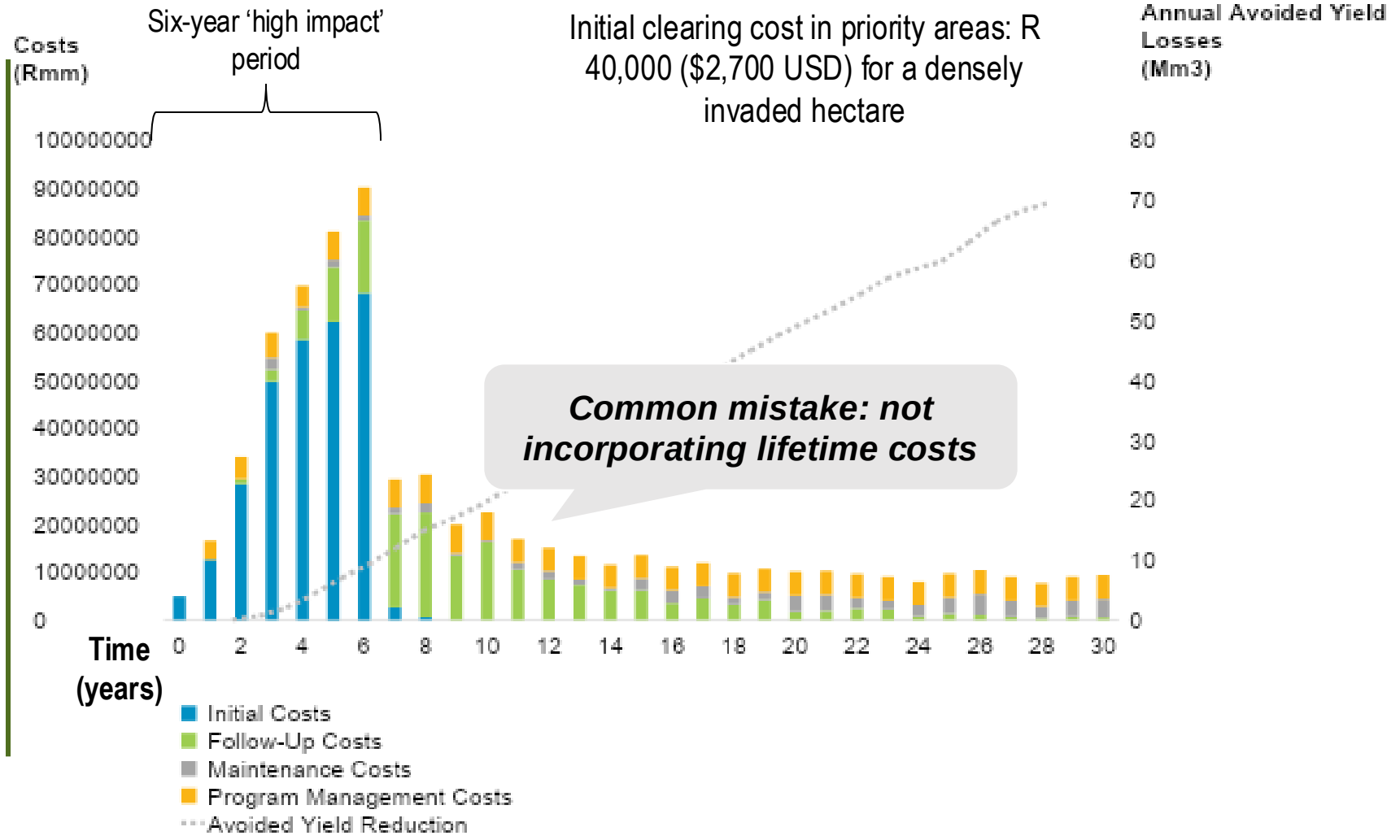
- *Where* would NBS yield the highest improvement in ecosystem services per unit cost?
- *How much* will the NBS program impact the benefits you care about?



Greater Cape Town Water Fund

5 Identify Program Costs

- *How much* will the implementation, maintenance and management of the NBS program cost?



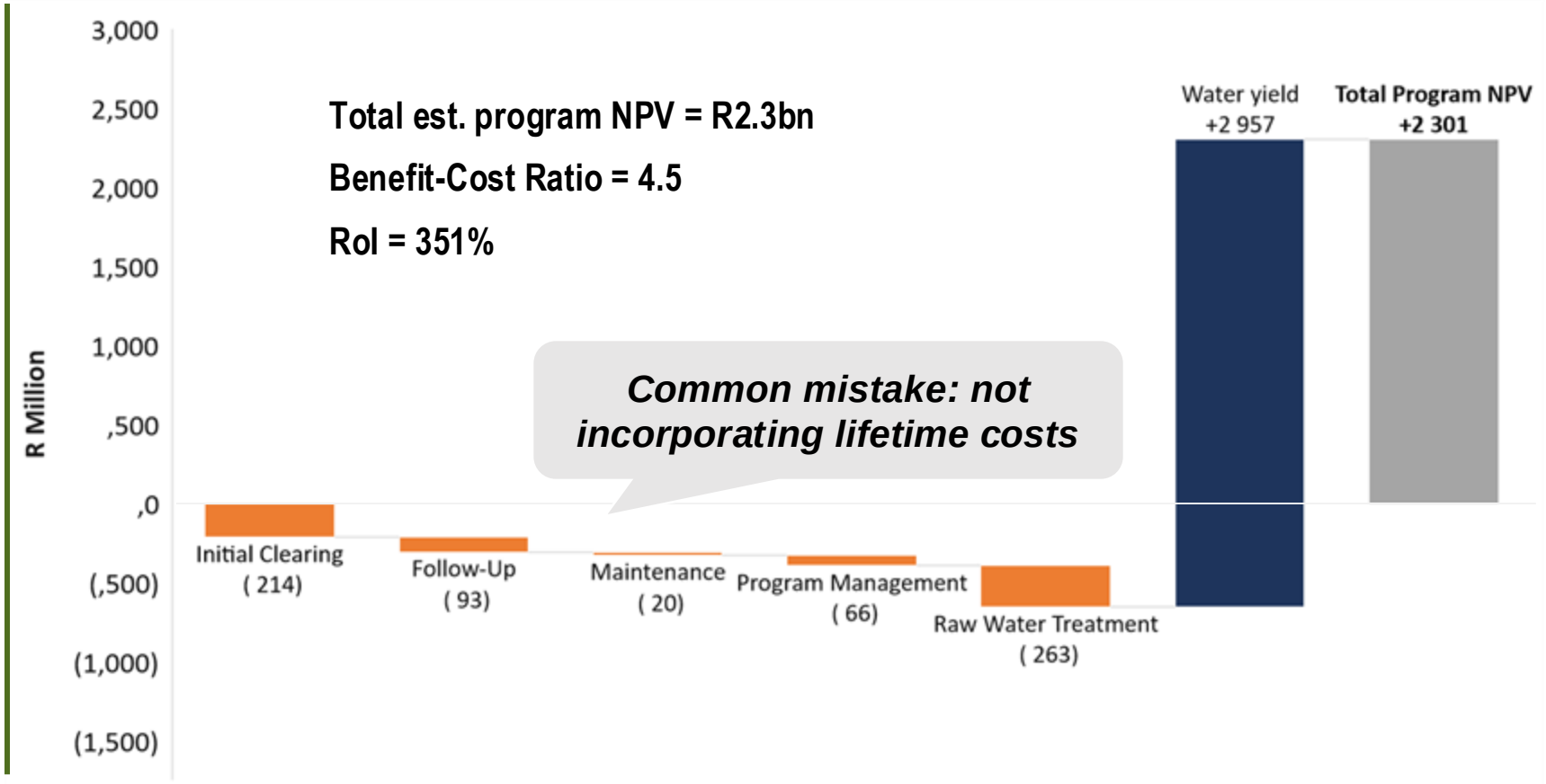
Greater Cape Town Water Fund

5 Identify Program Costs

- *How much* will the implementation, maintenance and management of the NBS program cost?

6 Monetize Improvement in Ecosystem Services

- *How* does the improvement in ecosystem services bring value to your beneficiaries?



Greater Cape Town Water Fund

7 Calculate Economic & Financial Indicators

- *Which* economic and financial indicators are important to beneficiaries?
- **Is the NBS program a viable investment?**

How might you want to communicate these outputs of your analyses? What might you want to compare NBS against?

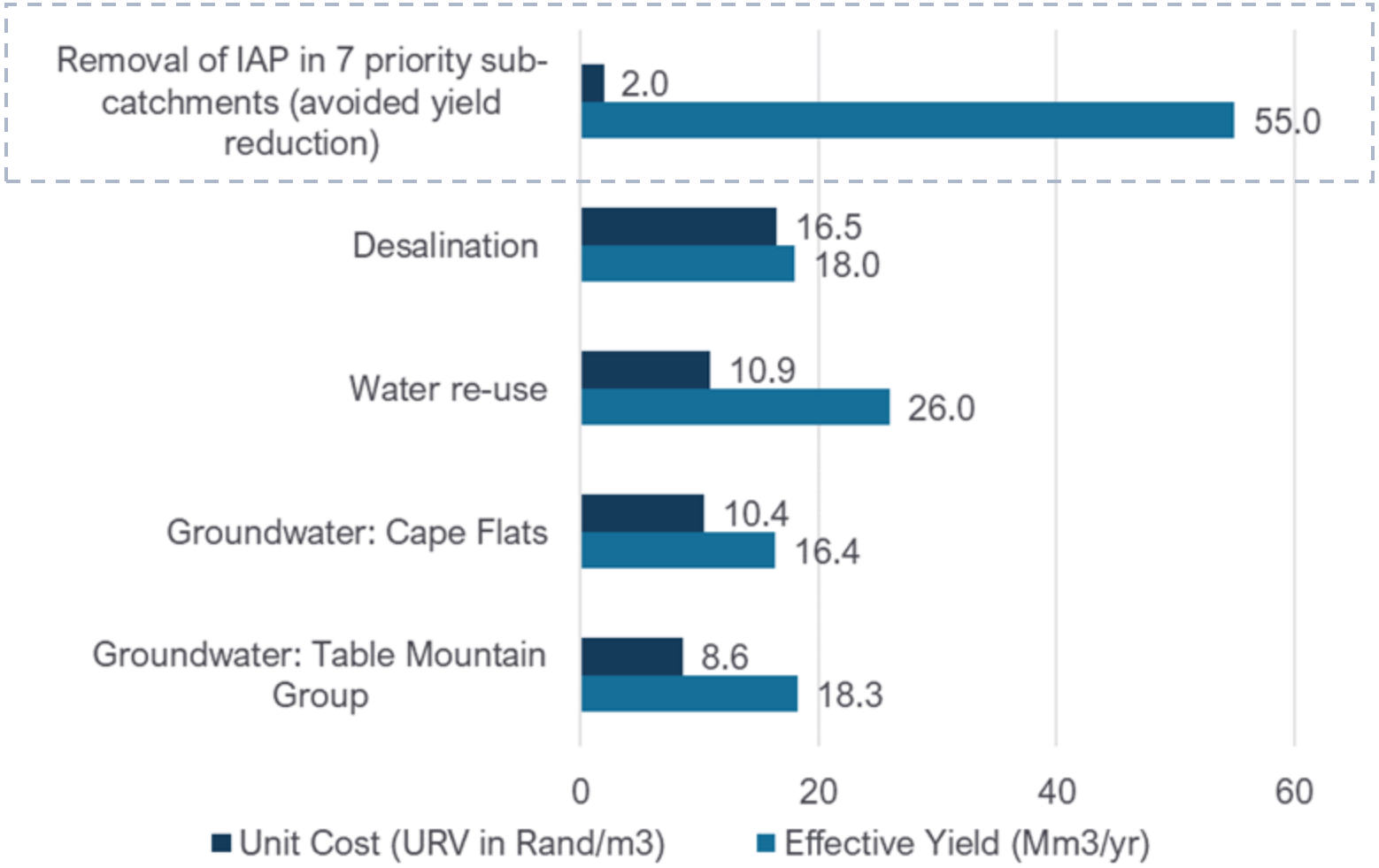
Cost Effectiveness Analysis

- Comparison / Selection of alternative options
- Lowest cost over a project lifetime to achieve a goal (e.g. water supply)
- All costs expressed in monetary terms, at consistent level of detail
- Compare options costs against a specific "unit of outcome" (R/m^3)

ROI Analysis

- Compare value benefits deliver against costs of implementation
- Compare scenarios with and without interventions
- Outputs: NPV, BCR, IRR
- Time variance accounted for by using a "present value", using a discount rate (which reflects society's time preference and the opportunity cost of capital)

Greater Cape Town Water Fund



IAP removal compares favorably to the other supply options at roughly 1/8th the full-cycle cost of 'grey' alternatives like desalination.

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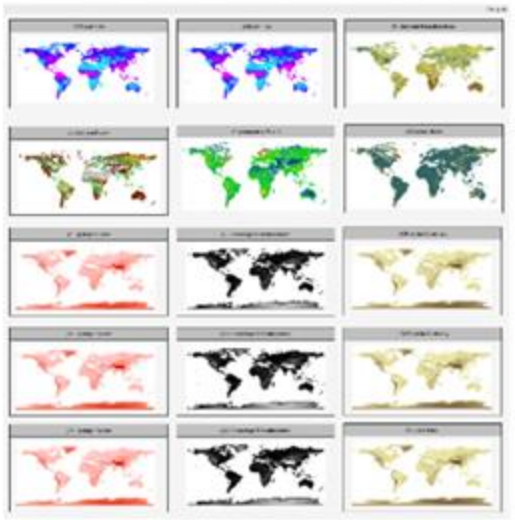
WaterProof

TNC has developed a free online tool called WaterProof which performs rapid analyses of NBS opportunities and potential WTP ROI around the world.

Global datasets

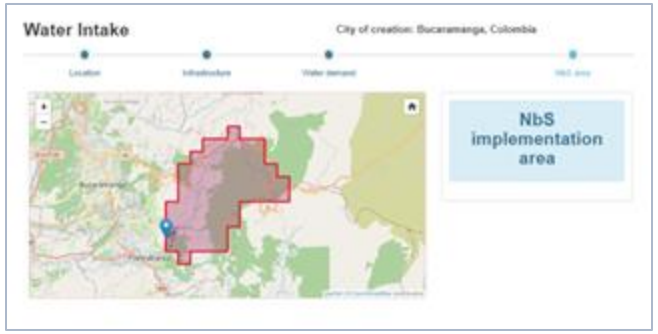


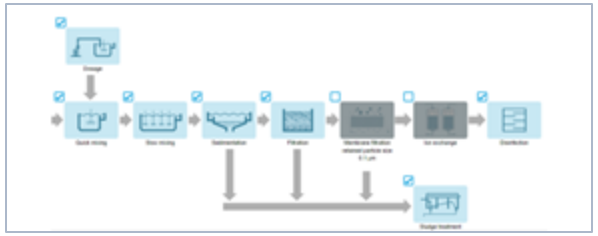
Ecosystem services benefits

InVEST
integrated valuation of ecosystem services and tradeoffs

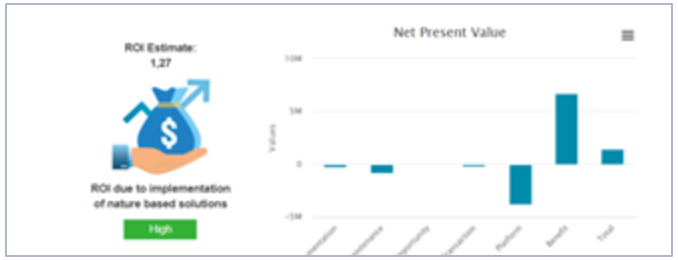
RIOS

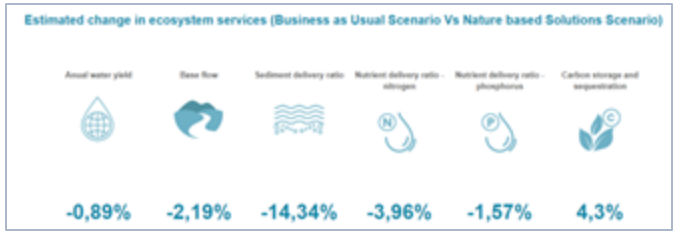
Standard or custom cost functions





ROI calculation





WaterProof

- Find your city
- Select or create your NBS
- Configure water intakes
- Define infrastructure
- Create a case study
- Analyze outputs

Protection

Passive Restoration

Active Restoration

Agricultural NBS

WaterProof

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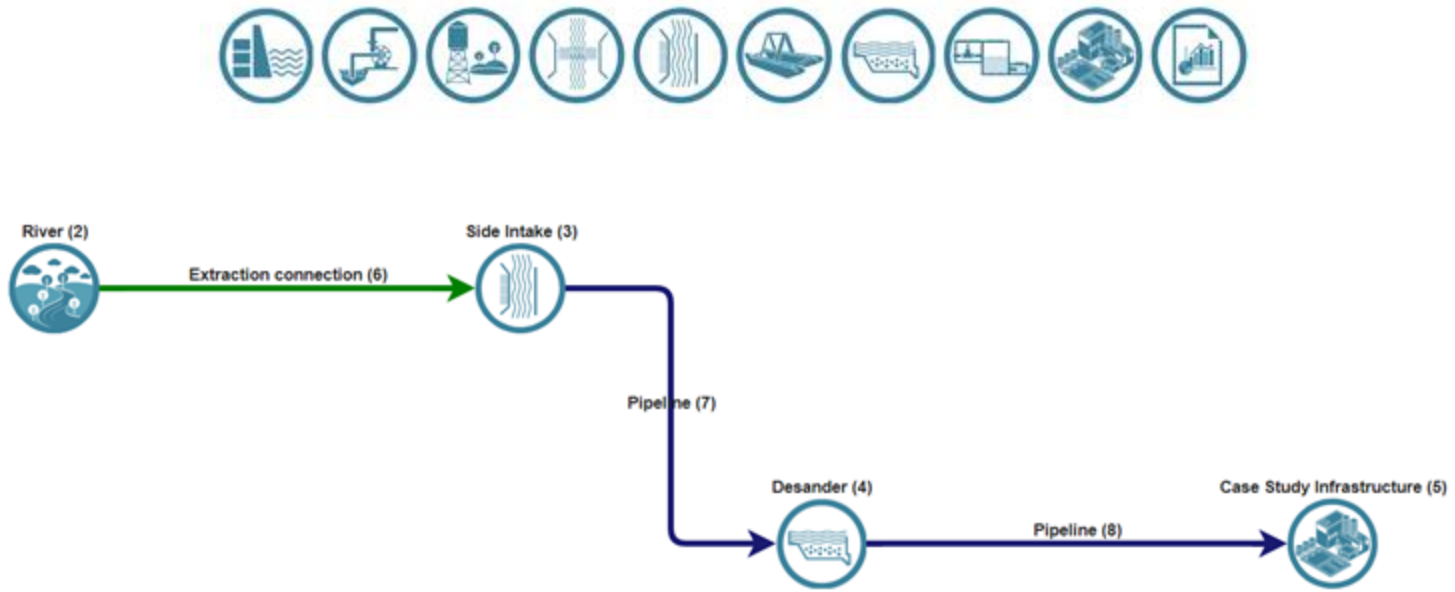

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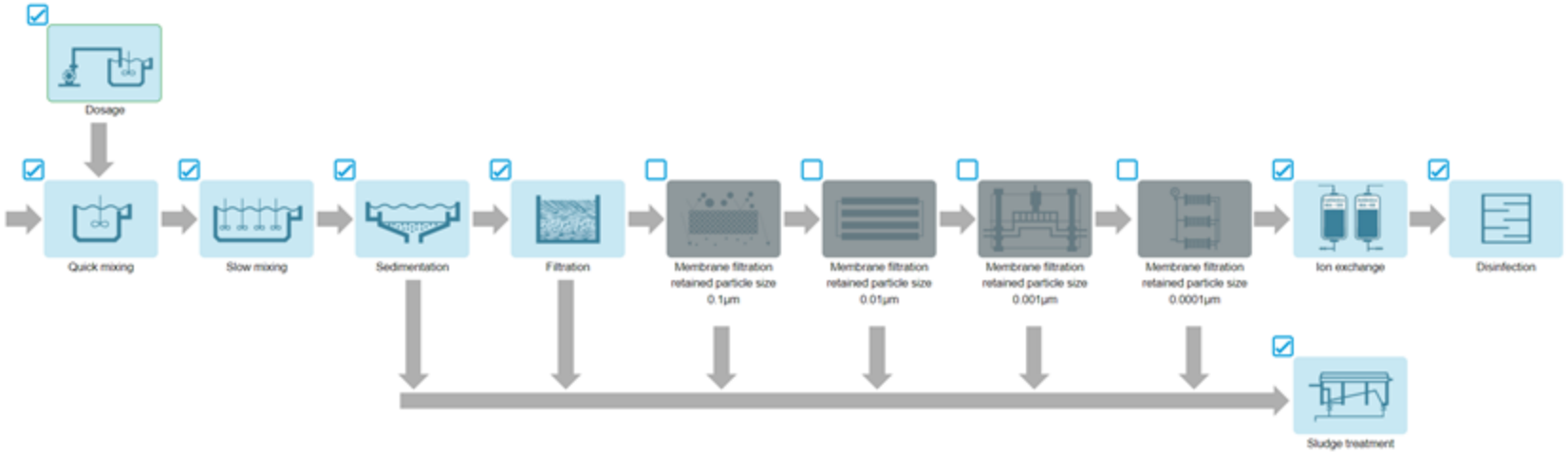

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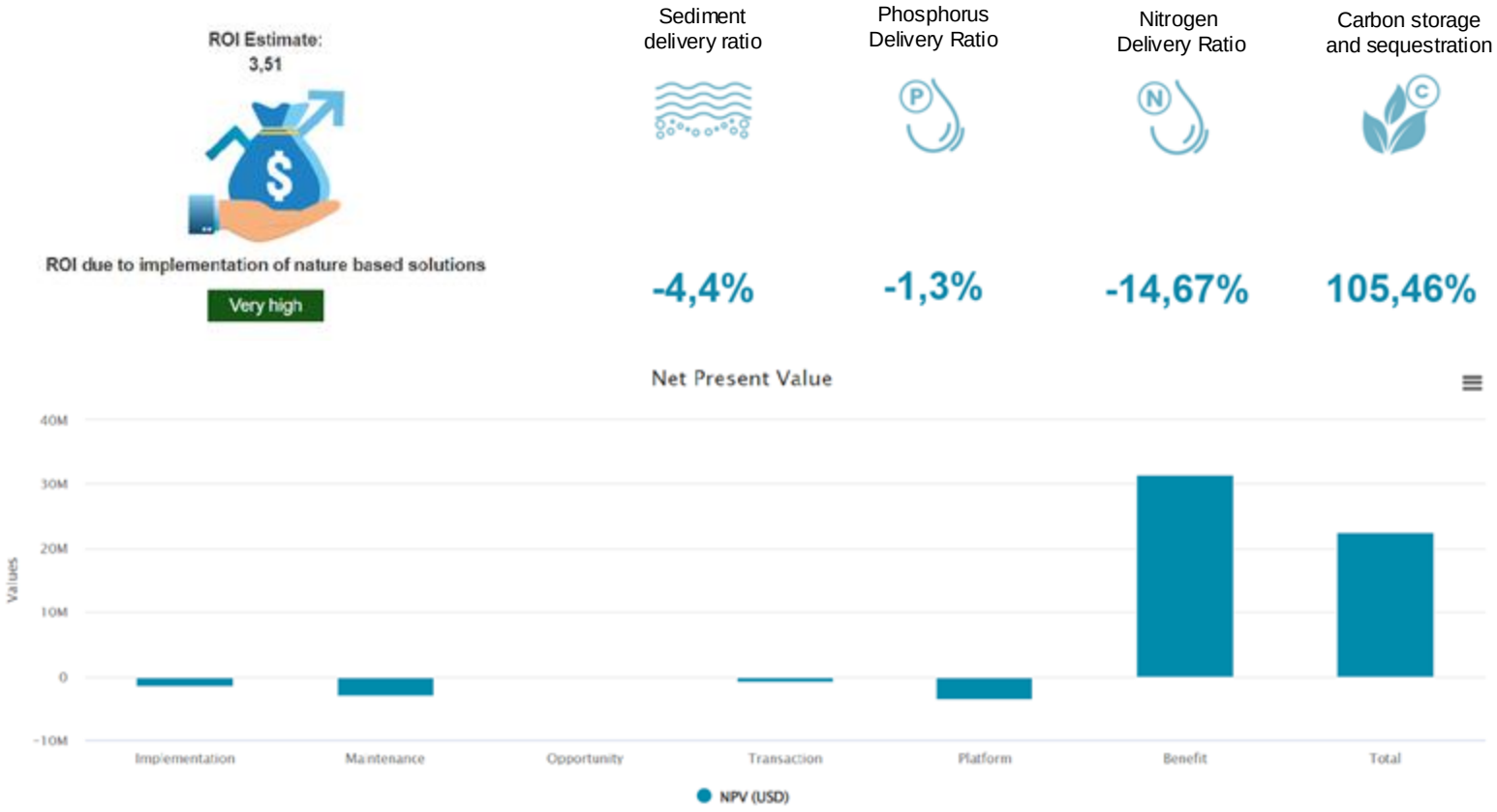

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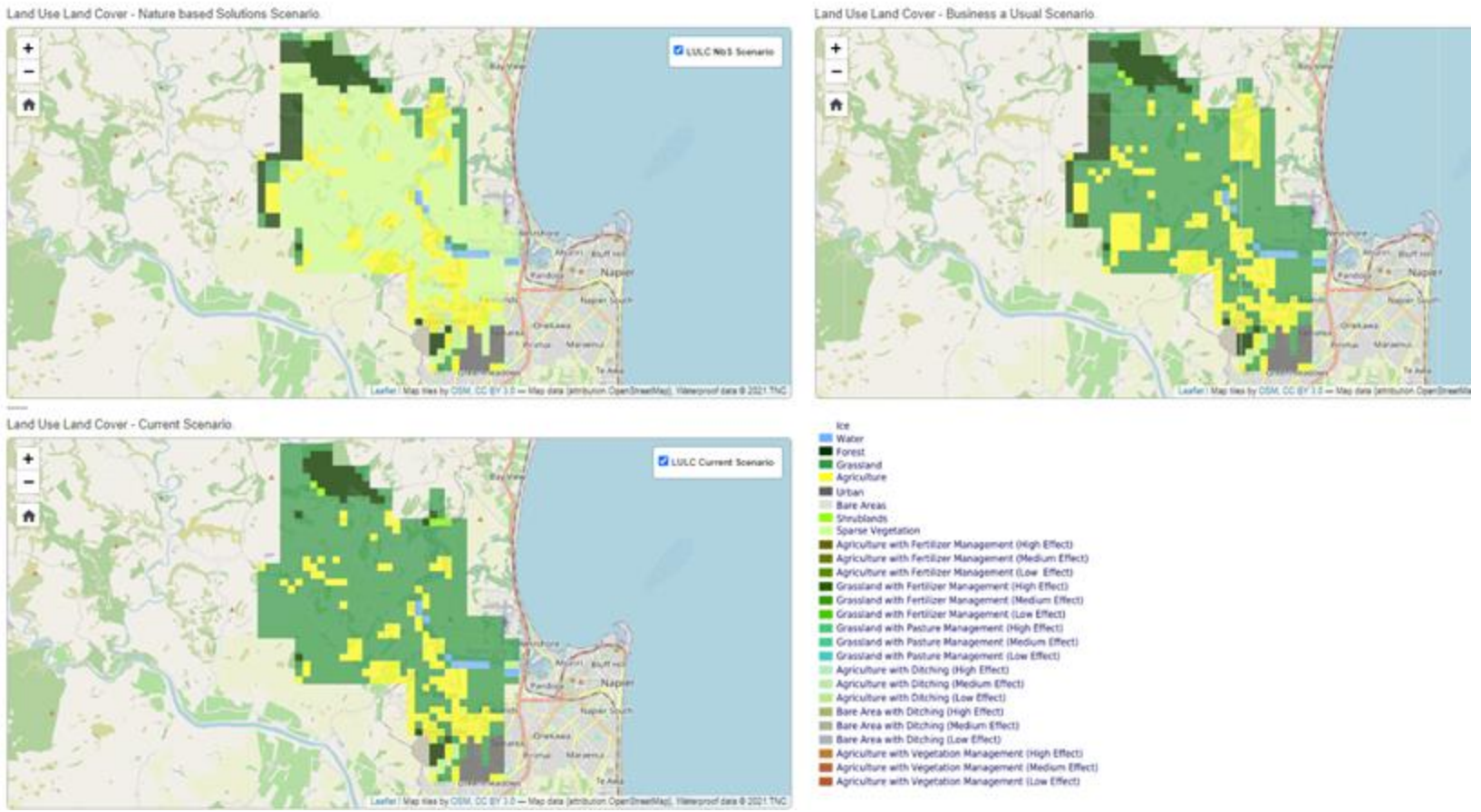


WaterProof

WaterProof

- ✓ Peer-reviewed
- ✓ Free and available online at https://water-proof.org/
- ✓ Takes <30 minutes to run with preset variables
- ✓ Customisable with improved information
- ✓ Being regularly improved/expanded (e.g. next with a flooding module)
- ✓ Information and guidance available online

- ○ *Note: WaterProof is for "pre-feasibility" stage*

Please reach out to us for further detail on WaterProof and guidance on how to run it for your catchment!

Structure of this session

The "what and why" of CBA and ROI

Cape Town example – ROI

Teaser: WaterProof tool

RUCaS case study – CBA

Teaser: INFEWS tool

Recap and common mistakes

RUCaS case study CBA

Method has been applied widely

1. Define your urban system context
2. Consider full range of options
3. Identify and value benefits and costs
4. Evaluate and compare options
5. Identify financing and funding

On Nut Urban Forest Park
Bangkok, Thailand
Transforming former industrial waste site for brownfield development

Makkasan Zone C Departure Park
Bangkok, Thailand
Using NbS to enhance public green spaces

Can Tho University
Can Tho, Vietnam
Using NbS to advance flood resilience and community activation

Hanoi University of Civil Engineering
Hanoi, Vietnam
Using NbS to refurbish existing buildings in a built-up area to mitigate heat and improve amenity

Nong Loup Ian Marsh
Vientiane, Lao PDR
Enhancing NbS functions for communities, environment, and wider city benefits

Ban Mano Wetland
Luang Prabang, Lao PDR
Preserving wetlands' heritage for households and economic growth

A cool green Street 2
Battambang, Cambodia
Integrating NbS in city street for cooling and economy

Akreiy Ksatr wetland living
Phnom Penh, Cambodia
Using NbS to protect wetlands amid urban development

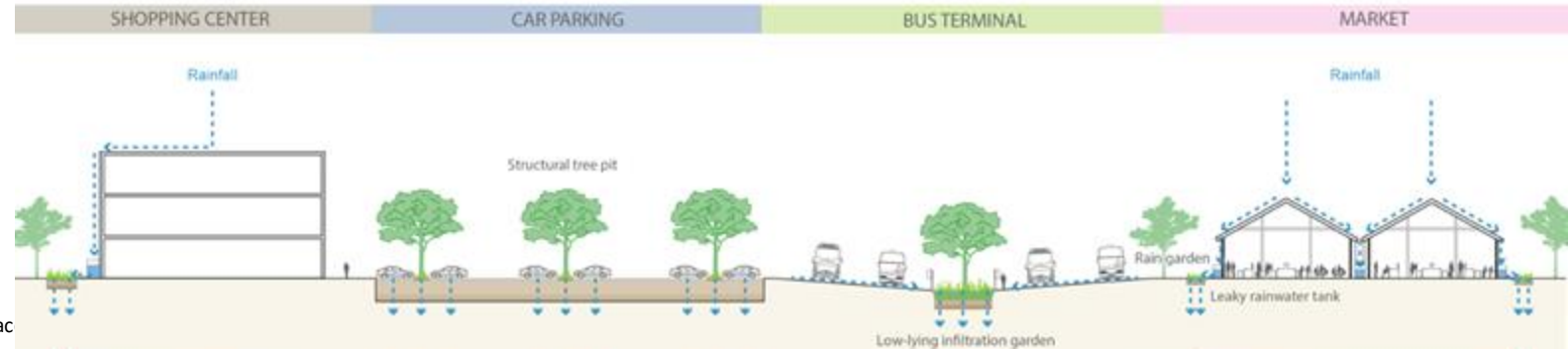
RUCaS case study CBA

An example: Rayong Cool Green CBD for Rayong, Thailand

RUCaS case study CBA

An example: Rayong Cool Green CBD for Rayong, Thailand

1. **Water sensitive urban design on primary roads** to improve flood management and increase property values
2. **Urban canyons** on key commercial/ neighborhood streets to support urban cooling and improve human thermal comfort
3. **Green cool shopping hub:** 'Leaky' rainwater tanks for large development roofs to mitigate local floods and reduce combined sewer
4. **Green cool transport hub and low lying public open space:** Infiltration rain garden with trees to reduce floods, increase canopy as a cooling shelter
5. **Establish Rayong 'Cool Lines' smart platform** to improve wellbeing and enhance community and tourism experience



RUCaS case study CBA

An example: Rayong Cool Green CBD for Rayong, Thailand

RUCaS case study CBA

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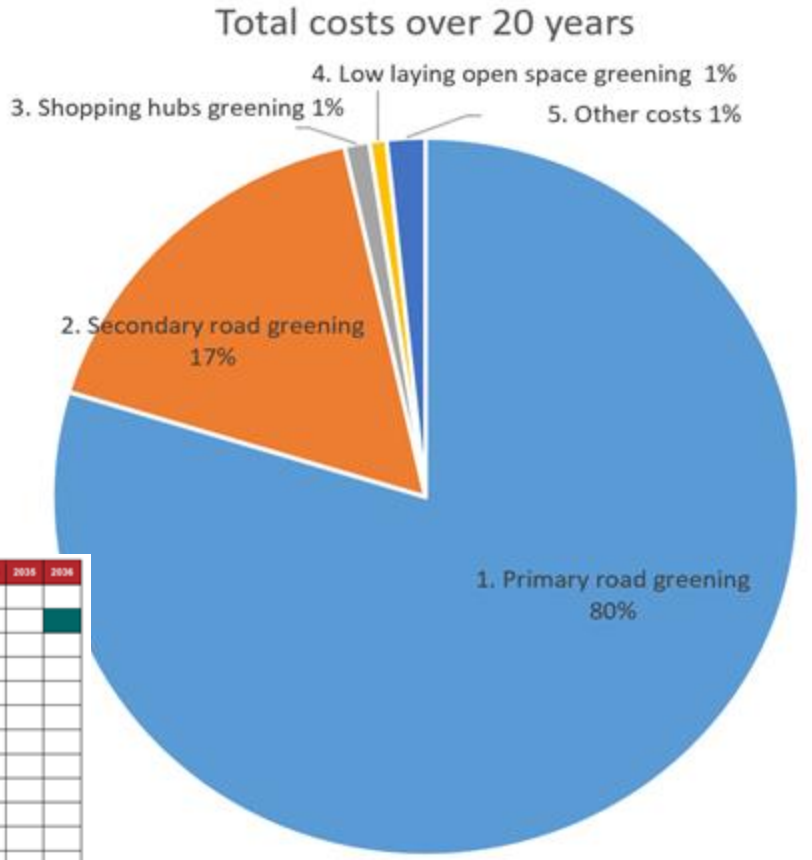


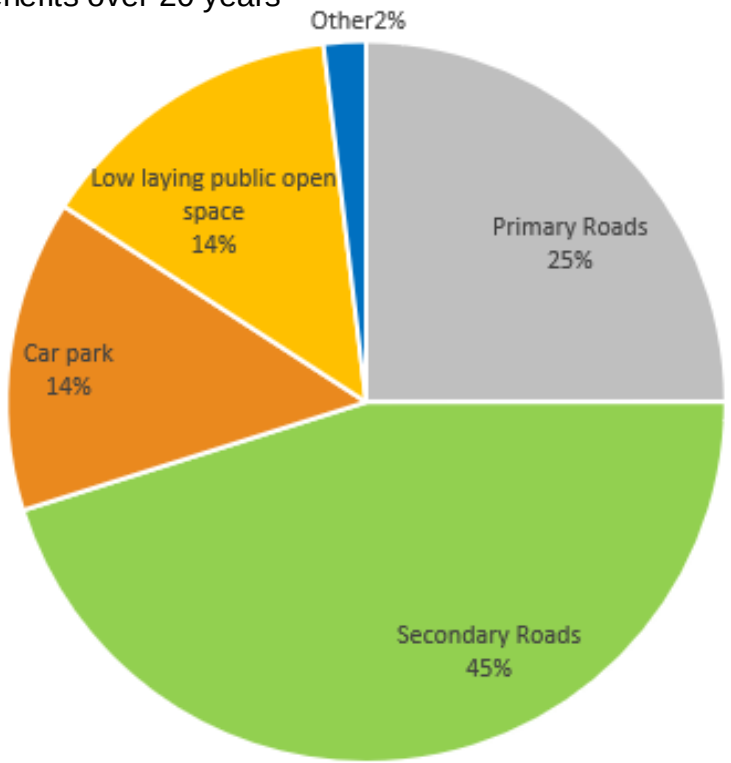
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Primary roads															
1.1 Sukhumvit Road															■
1.2 Ratchumphon Road										■					
1.3 Chanudom Road					■										
Secondary roads as urban canyons															
2.1 Phase #1	■														
2.2 Phase #2		■													
2.3 Phase #3			■												
2.4 Phase #4				■											
3. Green, cool shopping hubs	■														
4. Raingardens in low-lying public space		■													
5. 'Cool Lines' smart platform		■													

Table 1: Staging of interventions.
Source: Project team.

RUCaS case study CBA

An example: Rayong Cool Green CBD for Rayong, Thailand

Benefits over 20 years



RUCaS case study CBA

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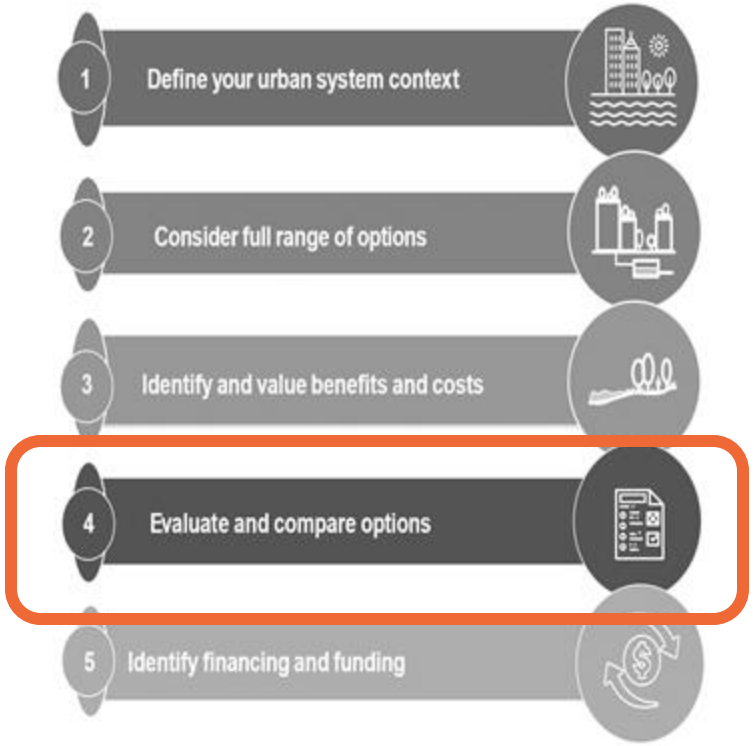
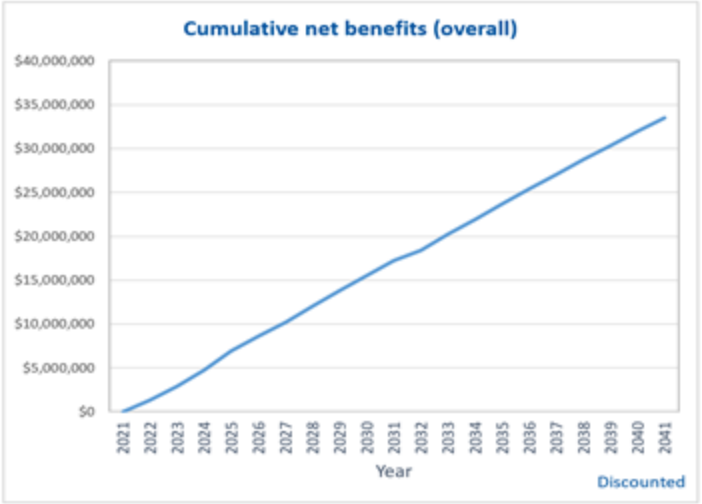
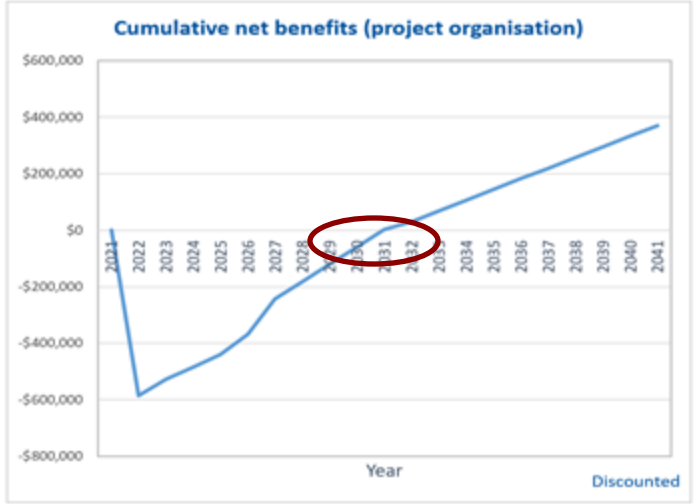


Overall BCA results	Present values
Potential benefits	$49,775,805
Deduction	$12,106,624
Benefits	$37,669,181
Costs	$4,153,396
- Project organisation	$1,335,817
- Other stakeholders	$2,509,920
- Excess burden	$307,659
Net Present Value	$33,515,786
Benefit: Cost Ratio	9.07

Results attributable to project organisation	
Potential benefits	$2,006,707
Deduction	$301,006
Benefits	$1,705,701
Costs	$1,335,817
Net Present Value	$369,884
Benefit: Cost Ratio	1.28





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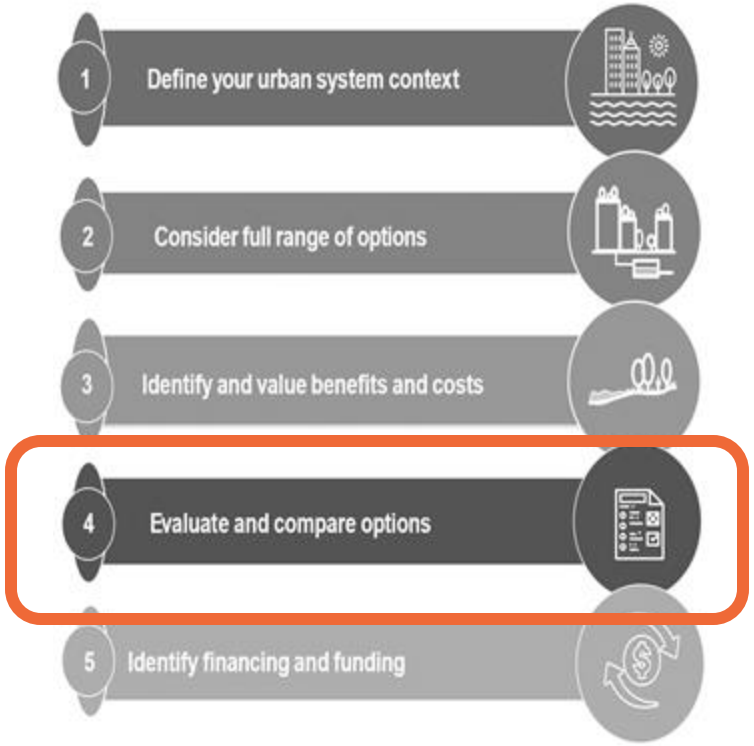

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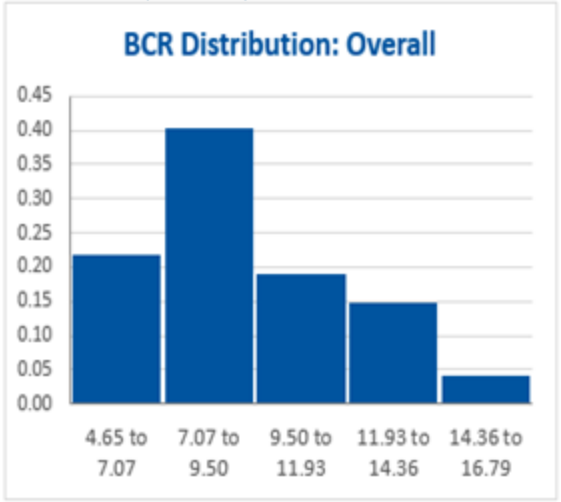
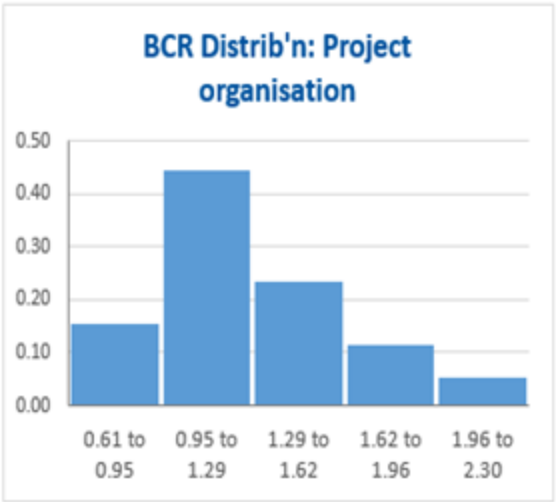
Sensitivity testing across 1000 simulations





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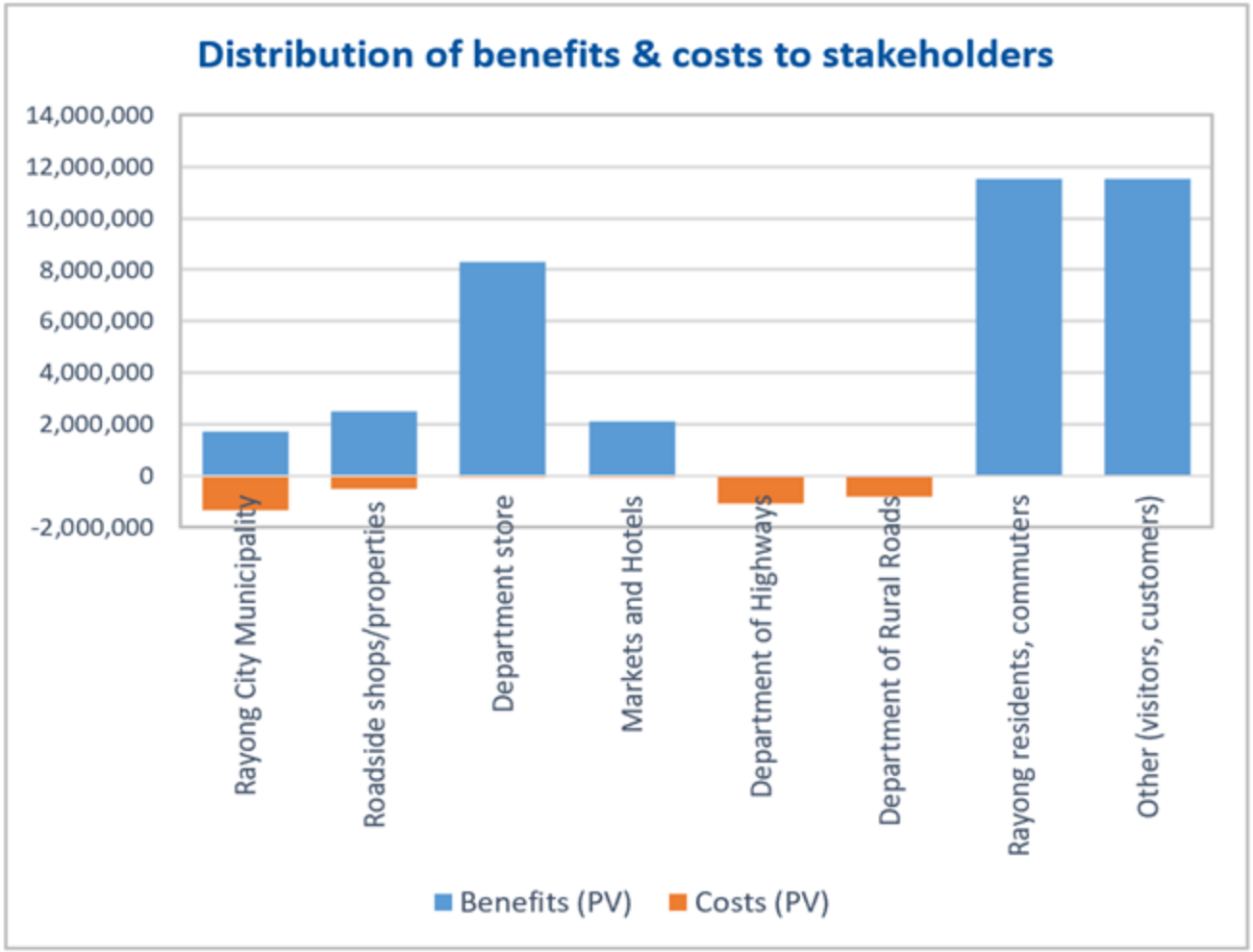

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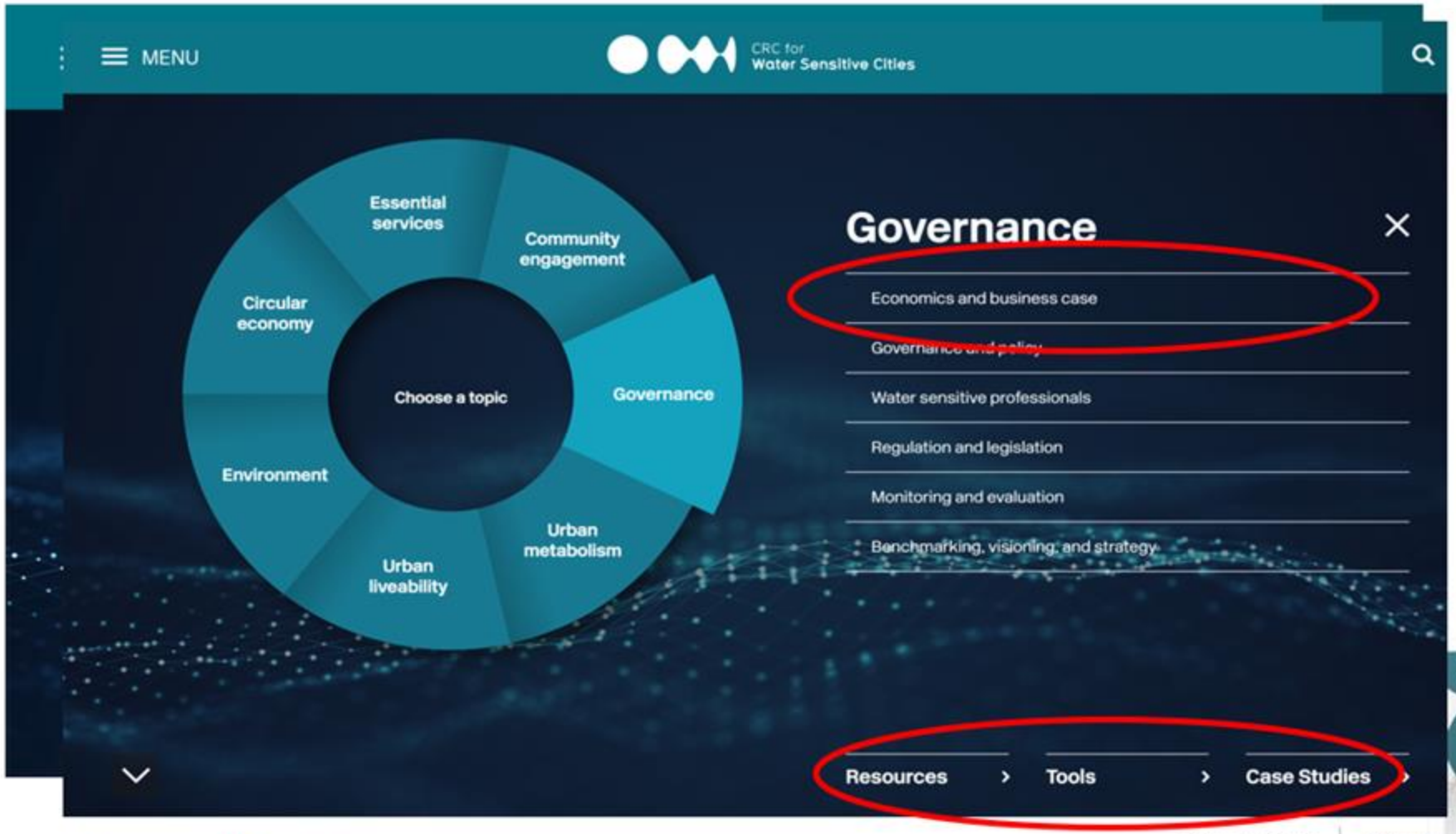
Cooperative Research Centre for Water Sensitive cities

A 9 year $120M research to practice initiative



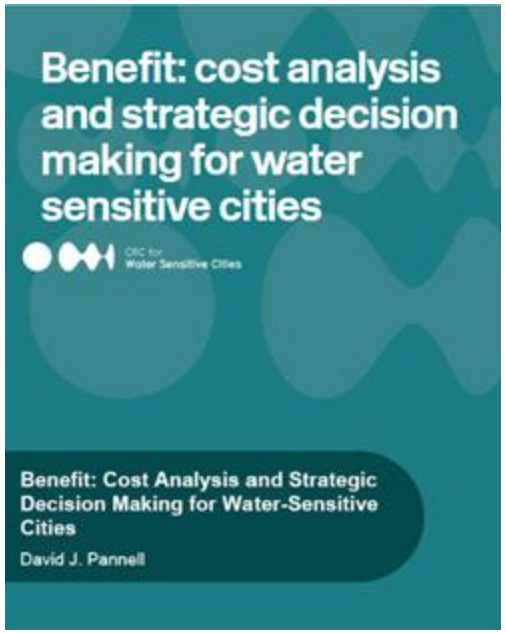
watersensitivecities.org.au

MONASH University

MONASH SUSTAIN DEVELO INSTITU

INFFEWS tools and guidelines

- Costs and benefits relative to what?
  - INFFEWS guideline on **BCA for policy makers**
- How can we identify and value co-benefits
  - INFFEWS **Value** tool
- Which costs?
  - INFFEWS **Lifecycle costs** tool
- Benefits and costs to whom?
  - INFFEWS **BCA** tool



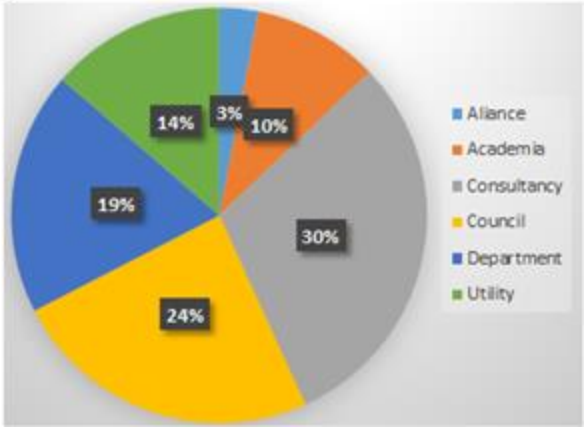
INFFEWS value tool

Estimating NbS co-benefits

	Previous Version	Current Version
No. of studies	192	225
No. of records	2,370	2,812
Record with monetized information	2,095	2,532
Record with non-monetized information	275	280

Adoption of the tools

- The tools have been shared with more than 130 organizations.
- The tools been independently reviewed
- They have been written into many guidelines



	Benefit	Broad benefit group
1	Reduced water consumption	Market
2	Reduced or delayed investment in infrastructure (e.g. water-treatment plant)	Cost savings
3	Reduced recurring costs (e.g. energy for cooling)	Cost savings
4	Improved management of waste-water	Market or cost savings
5	Increased business profits (e.g. from sewer mining)	Market
6	Increased work productivity (e.g. from less extreme heat)	Market
7	Increased tourism	Market and non-market
8	Improved aesthetics	Non-market
9	Improved opportunities for recreation	Market and non-market
10	Reduced crime, increased community cohesion	Market and non-market
11	Reduced mortality (e.g. from reduced extreme heat)	Non-market and market (health system costs)
12	Reduced morbidity, improved health (e.g. from reduced extreme heat)	Non-market and market (health system costs)
13	Reduced greenhouse gas emissions, increased CO_2 sequestration	Market and non-market
14	Groundwater recharge (e.g. for potable extraction or wetland enhancement)	Market and non-market
15	Ecological improvement, biodiversity	Non-market
16	Improved air quality	Non-market
17	Enhancing water quality in a water body	Market and non-market
18	Reduced flood risk	Risk reduction
19	Reduced risk of poor water quality due to fire	Risk reduction
20	Improved security of water supply	Non-market

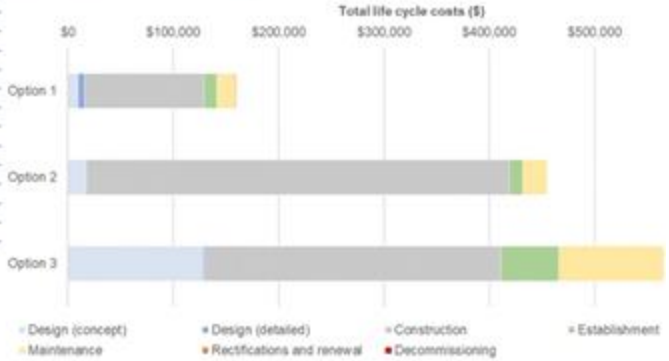
INFFEWS lifecycle costs

Estimating NbS lifecycle costs

Prototype still in development

Contingencies	25%

Life Cycle Costs Summary	Life cycle phase	Option 1	Option 2	Option 3	Notes
	Asset type	Biofilter	Biofilter	Passively irrigated tree	
	Asset subtype	Streetscape biofilter	End-of-line biofilter	Street tree - other	
Capital	Design (concept)	$9,842	$17,353	$127,875	
	Design (detailed)	$5,584	$0	$1,675	
	Construction	$113,551	$401,595	$281,400	
	Establishment	$12,440	$12,814	$54,919	
	Sub-total (excl. contingencies)	$141,417	$431,762	$465,868	
	Total (incl. contingencies)	**$176,772**	**$539,703**	**$582,335**	
Operational	Maintenance	$17,092	$23,260	$99,686	
	Rectifications and renewal	$1,308	$0	$0	
	Decommissioning	$0	$0	$0	
	Sub-total (excl. contingencies)	$18,400	$23,260	$99,686	
	Total (incl. contingencies)	**$23,000**	**$29,075**	**$124,608**	
Present Value Costs	Capital	$176,772	$539,703	$582,335	
	Operational	$23,000	$29,075	$124,608	
	Total (incl. contingencies)	**$199,772**	**$568,778**	**$706,943**	
Inputs to Present Value Analysis	Time period of analysis (years)	25	25	25	
	Discount rate (%)	7.0%	7.0%	7.0%	



Structure of this session

- The “what and why” of CBA and ROI
- Cape Town example – ROI
  - Teaser: WaterProof tool
- RUCaS case study – CBA
  - Teaser: INFEWS tool
- Recap and common mistakes

Summary reflections

BCA/ROI are key analyses to justify and scale-up NbS, and they should be done with care.

Key takeaways…

…and common mistakes

What are your key takeaways from this session?

Summary reflections

BCA/ROI are key analyses to justify and scale-up NbS, and they should be done with care.

Key takeaways…

1. Benefit-cost and return-on-investment analyses are **very important** to determine an **NbS strategy** and **influence decision-makers around funding, policy support, etc**.
2. Analyses **can be narrow or broad**, but in all instances should be **responding to the interests and burden-of-proof of key stakeholders.**
3. High-quality and defensible **input data are necessary**. Often this includes integrating biophysical modelling and costing.
4. "***All models are wrong – but some are useful.***"

…and common mistakes

A. Not properly defining a '**baseline scenario**', and/or assuming it will be static.

B. Not properly involving key stakeholders (early) enough, such that they do not **trust** the output.

C. Not understanding, and planning for, **lifetime costs** including monitoring, adaptive management, and break-fix.

D. Not ensuring there is an **appropriate and legitimate long-term program / delivery unit** to manage the NbS.

E. Not thinking about the **distribution of benefits** (e.g. where, how much, and to whom).

Questions and discussion


LUNCH

THANK YOU