

Going Green – Costs and Benefits of Living Roofs on Bus Shelters in Auckland

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Auckland Transport Living Roof Trial Objectives

The goal of the pilot project is to design extensive living roofs which can be retrofitted, easily maintained, and which maximise four prioritised benefits:

- ❖ To contribute to the well-being of Aucklanders by providing bus stops which filter air pollutants, reduce the urban heat island effect and provide some aesthetic benefits;
- ❖ To contribute to local native biodiversity and/or pollinator pathways, increasing 'nature' in the roadside environment;
- ❖ To reduce impervious surfaces within the city and provide stormwater quantity reduction benefits; and
- ❖ Provide an opportunity to understand a climate change adaptation option.

International Bus Shelter Living Roofs



Living roof, green screen and planter box installation – Bialystok, Poland



Living roof and greenwall installation – Wetering circuit at Vijzelgracht, Amsterdam

International Bus Shelter Living Roofs



Living roof – Philadelphia, USA



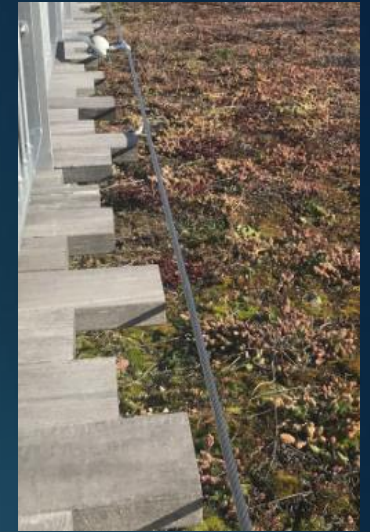
Jurong Smart Bus Shelter - Singapore



Living roof with solar panel – Buffalo, USA

Design Considerations

- Structural Loading – for safety. Retrofitting requires structural assessment. Design weights 60-150 kg/m² for standard low-profile (sedum) roof
- Waterproofing?
- Irrigation?
- Safety in Design for construction and maintenance: access, fall protection, structural integrity, vandal-resistance.
- Building Consent Requirements.
- Plant Choice complements site exposure, irrigation / water stress, maintenance.
- Complementary features – Solar panels, mirrors, sculptures, habitat structures.
- Maintenance – frequency and aims



Panmure Eastbound Long Canopy Bus Shelter - Before



Panmure Eastbound Long Canopy Bus Shelter - After



Diorella Drive / Redoubt North School Bus Shelter



Diorella Drive / Redoubt North School as built



Stakeholder engagement



Implementation and Maintenance

- Roofs 18 months post-installation, maintained by the installer.
- Quarterly site audits/ inspections
- 10-12 annual maintenance visits: weeding, pruning. Fertilised twice a year.
- Can probably be reduced to 6 to 8 now established.
- Maintenance requires scissor lift at Panmure and ladder at Redoubt North
- Vandalism of green walls at Panmure required substantial replanting.
- Two biggest learnings :
 - Planting time and lead in to planting for investigations and growing
 - Cost of access for maintenance at Panmure

Vandalism of Panmure green walls

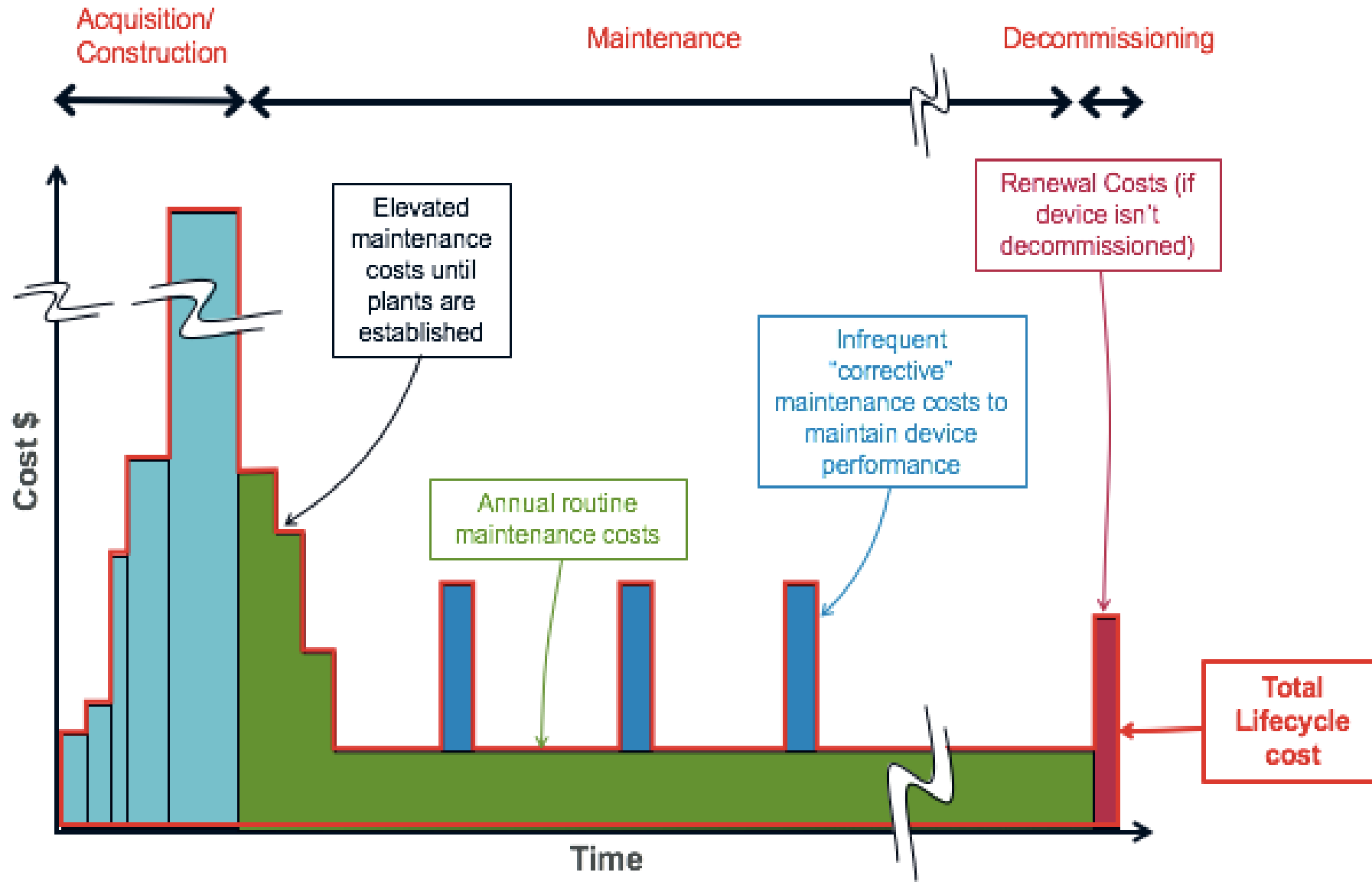


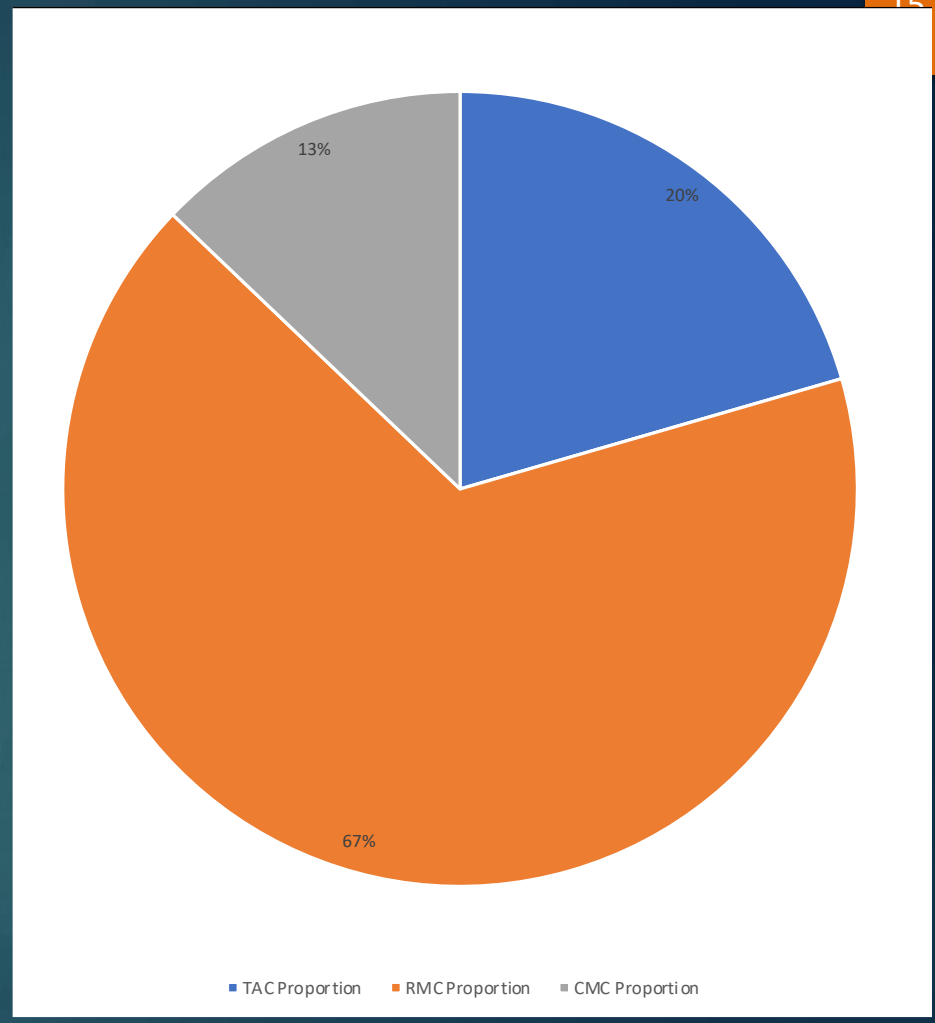
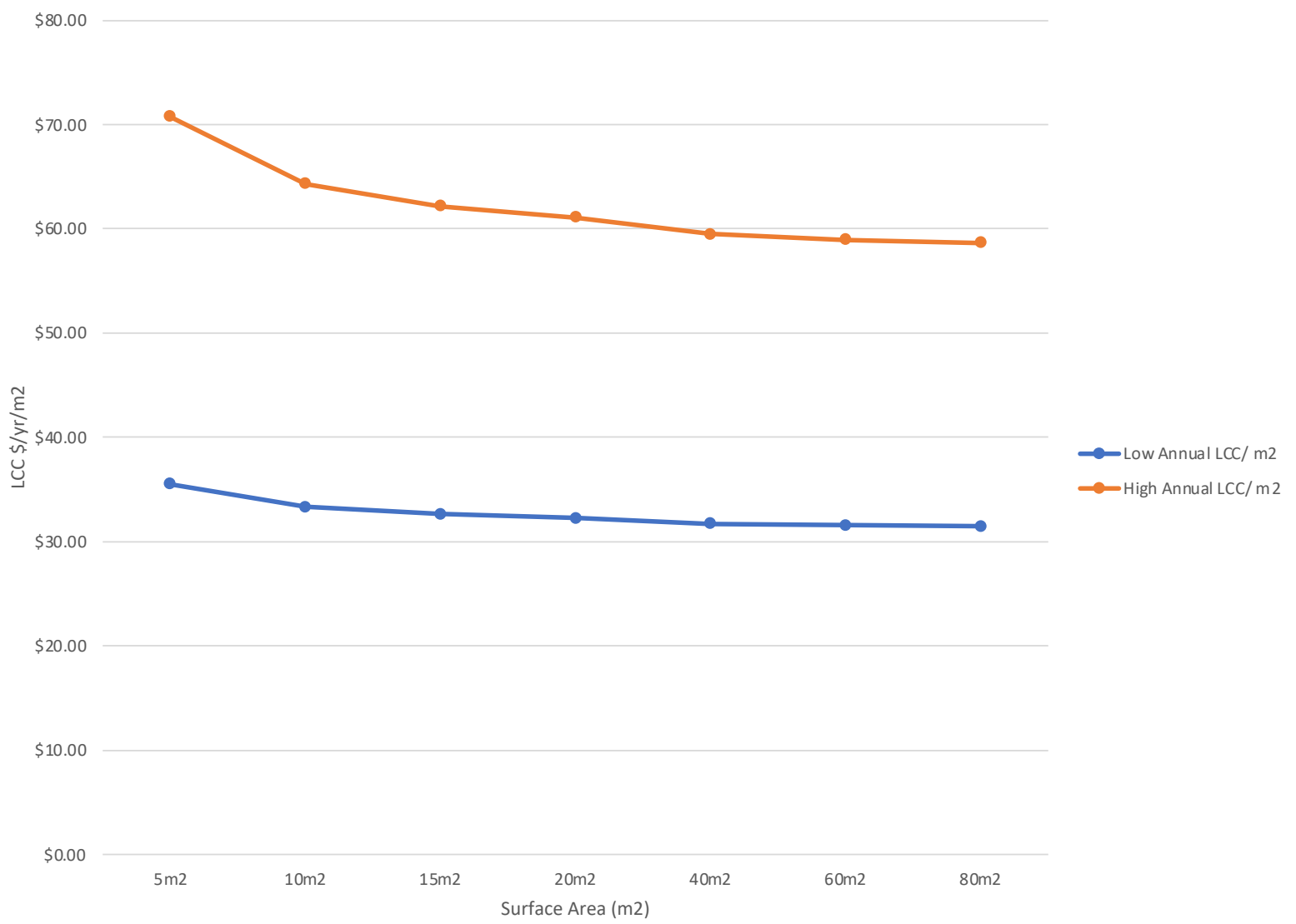
APPENDIX A - Living Roof Operation and Maintenance Checklist

| | | |
|--|-------|--------------------------|
| Living Roof Address: | | Bus Shelter ID: |
| Date: | Time: | Date of Last Inspection: |
| Weather (including rain in last 48 hours): | | |
| Irrigation system: | | |
| As-builts available: | | |
| Maintenance Operator/ Inspector Name: | | |

| Inspection item | Comment | Action needed |
|---|---|---|
| Plants | | |
| Plants appear to be healthy: - no signs of wilting, discoloration, dying due to disease, pests or stress | <input type="checkbox"/> Yes; <input type="checkbox"/> No; <input type="checkbox"/> N/A | <input type="checkbox"/> Yes; <input type="checkbox"/> No |
| Plants meet coverage expectations – please estimate % coverage | <input type="checkbox"/> Yes; <input type="checkbox"/> No; <input type="checkbox"/> N/A | <input type="checkbox"/> Yes; <input type="checkbox"/> No |
| Weeds have been removed and minimal weed presence | <input type="checkbox"/> Yes; <input type="checkbox"/> No; <input type="checkbox"/> N/A | <input type="checkbox"/> Yes; <input type="checkbox"/> No |
| Growing media and irrigation | | |
| Growing media is even, level and in tact (no signs of rills or erosion) | <input type="checkbox"/> Yes; <input type="checkbox"/> No; <input type="checkbox"/> N/A | <input type="checkbox"/> Yes; <input type="checkbox"/> No |
| Vegetation free zones inspected and cleared of loose growing media/ plants | <input type="checkbox"/> Yes; <input type="checkbox"/> No; <input type="checkbox"/> N/A | <input type="checkbox"/> Yes; <input type="checkbox"/> No |
| Moisture levels checked | | |
| Irrigation system check and working (ensure drip emitters are unclogged) | <input type="checkbox"/> Yes; <input type="checkbox"/> No; <input type="checkbox"/> N/A | <input type="checkbox"/> Yes; <input type="checkbox"/> No |
| Irrigation applied if needed | | |
| Structural components | | |
| Waterproof membrane (where visible) is <u>in tact</u> (no cracks) | <input type="checkbox"/> Yes; <input type="checkbox"/> No; <input type="checkbox"/> N/A | <input type="checkbox"/> Yes; <input type="checkbox"/> No |
| Drains and gutters are free from sediment, vegetation, debris or other obstructions | <input type="checkbox"/> Yes; <input type="checkbox"/> No; <input type="checkbox"/> N/A | <input type="checkbox"/> Yes; <input type="checkbox"/> No |
| General | | |
| Digital photos taken | <input type="checkbox"/> Yes; <input type="checkbox"/> No | |
| Additional notes | | |

Costs of Living Roofs



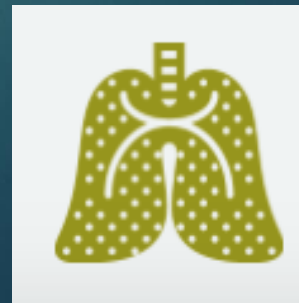


Potential Benefits of Living Roofs

- Provides a rainwater buffer
- Purifies the air (dust)
- Reduces ambient temperatures (urban heat island)
- Extends life span of the roof
- Increases biodiversity/habitat
- Noise reduction
- Increases the feeling of well-being
- Aesthetics/views
- Carbon sequestration



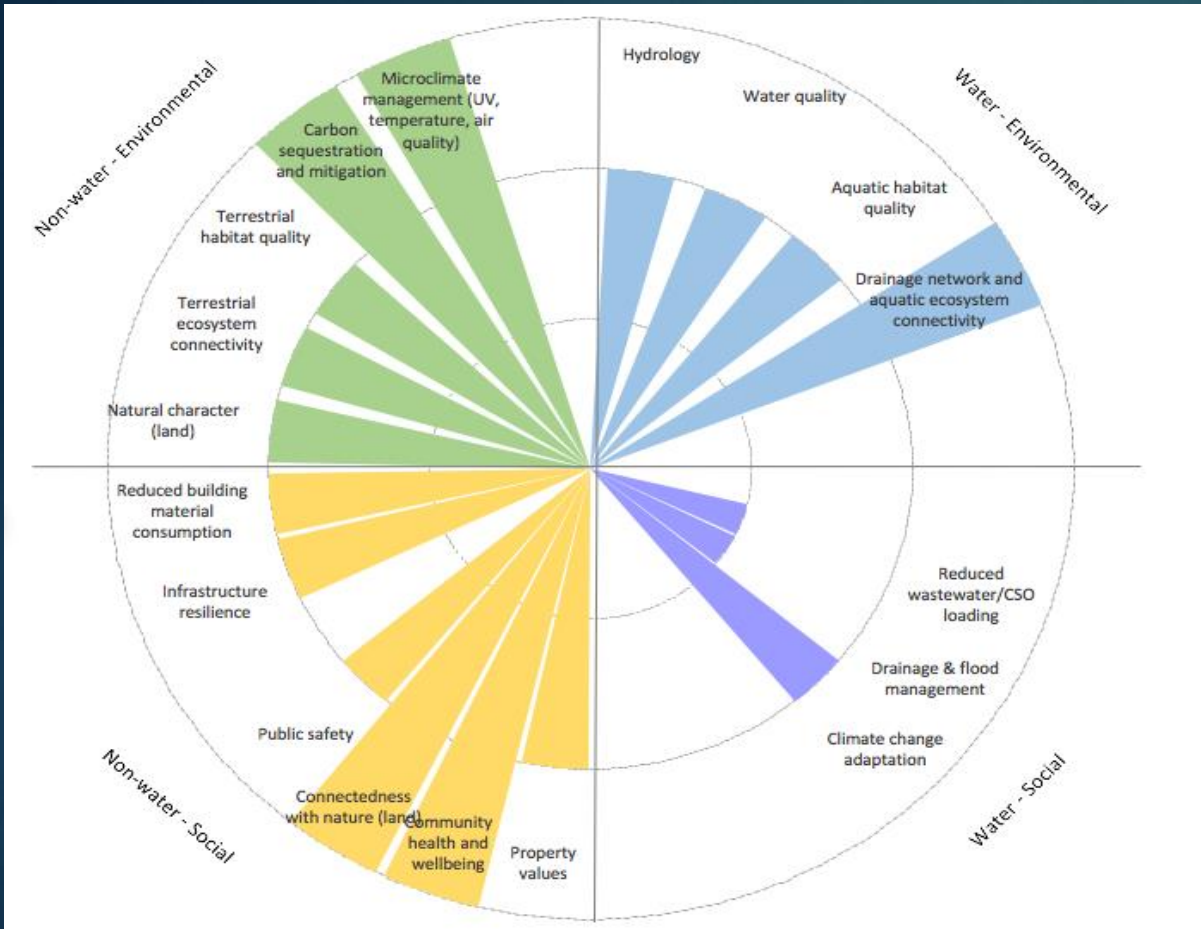
Depends on design, scale, location/visibility, maintenance



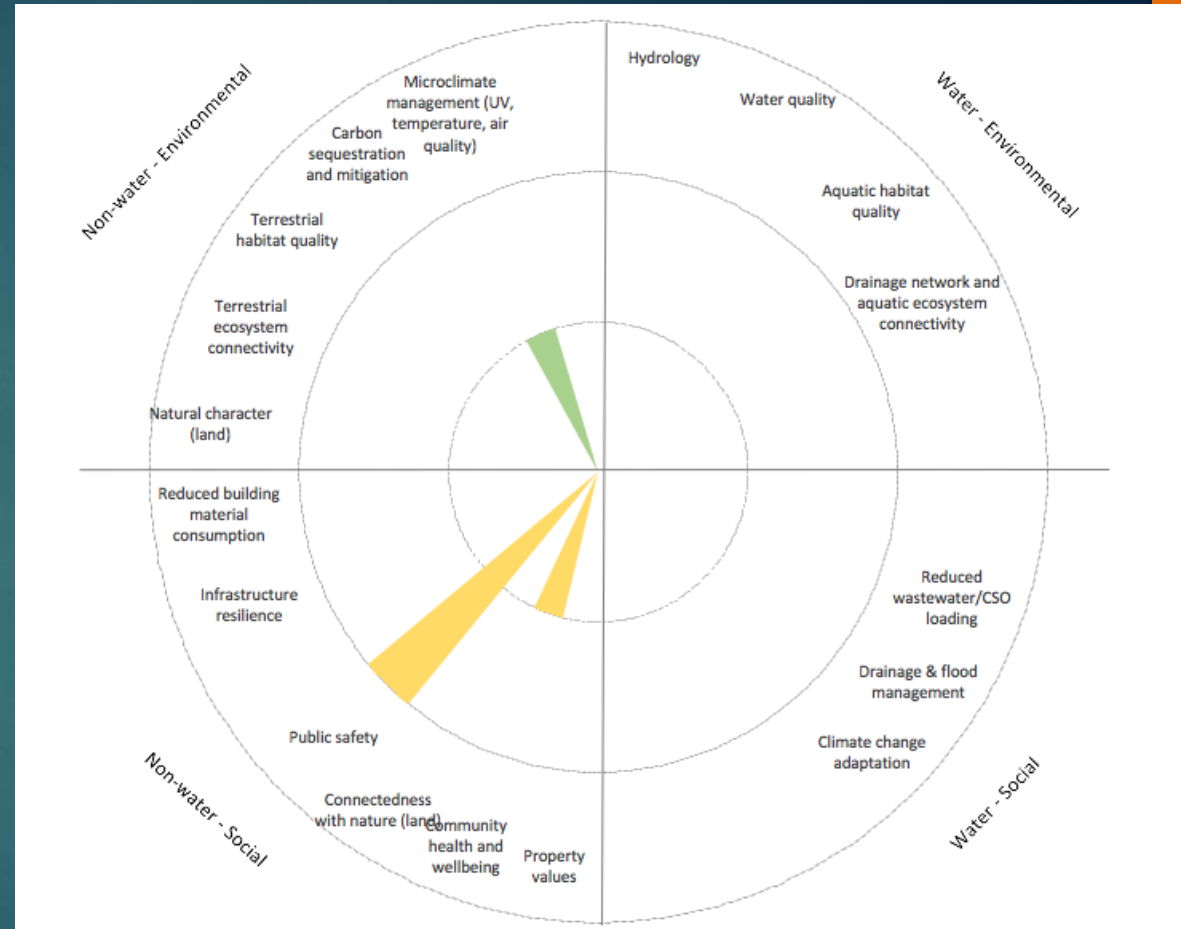
MORE THAN WATER - WSUD Benefits Assessment

| | | <u>Benefit</u> | <u>Level</u> |
|-----------|---------------|--|--------------|
| Water | Environmental | Hydrology | Med |
| | | Water quality | Med |
| | | Aquatic habitat quality | Med |
| | | Drainage network and aquatic ecosystem connectivity | High |
| | | Natural character (water bodies) | N/A |
| | Social | Supplementary water supply | N/A |
| | | Reduced wastewater/CSO loading | Low |
| | | Drainage & flood management | Low |
| | | Climate change adaptation | Med |
| | | Recreation | N/A |
| | | Provisioning (e.g. fishing) | N/A |
| | | Connectedness with nature (water bodies) | N/A |
| Non-water | Environmental | Preservation of natural soils | N/A |
| | | Microclimate management (UV, temperature, air quality) | High |
| | | Carbon sequestration and mitigation | High |
| | | Terrestrial habitat quality | Med |
| | | Terrestrial ecosystem connectivity | Med |
| | | Natural character (land) | Med |
| | Social | Reduced building material consumption | Med |
| | | Infrastructure resilience | Med |
| | | Food & fibre production | N/A |
| | | Public safety | Med |
| | | Connectedness with nature (land) | High |
| | | Community health and wellbeing | High |
| | | Property values | Med |

More Than Water Assessment



Bus shelters with light-weight (short) green roofs



Bus shelters without green roofs

Conclusions

- Pilot project investigated the potential for retrofitting extensive living roofs which can be easily maintained on bus shelters.
- Key learnings:
 - Structural considerations
 - Plant choice/ location
 - Local community involvement
 - Irrigation and complementary design features
 - Ease of maintenance
- More expensive than conventional roofs
- More Than Water assessment highlights the wider non-water benefits (health and wellbeing within the road corridor).
- Greater benefits with community interaction (Redoubt School) and more visible plants.

