A DECISION FRAMEWORK FOR INTEGRATED GREEN GREY INFRASTRUCTURE (IGGIFRAME)

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Hashtag: #greeningthegrey
TALK OUTLINE

1. What do we mean by green into grey/green grey?
2. Why is it needed?
3. How can we green grey?
4. The NERC IGGI project
   - Decision Framework
   - Business case
   - Case studies
   - ‘Art of the Possible’

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WHAT IS INTEGRATED GREEN GREY INFRASTRUCTURE (IGGI)?

“seeks to improve the multifunctionality of hard, non-building grey infrastructure assets in towns and cities by greening the parts of our cities that must remain grey”

Naylor et al. 2014
A. Grey infrastructure (e.g. flood defences, roads, walls)

B. Integrated green grey infrastructure (e.g. green roofs, walls)

C. Green/Blue-green infrastructure (e.g. wetlands, green spaces)

Hashtag: #greeningthegrey
Ways of enhancing to create IGGI

- **Temporary** features to improve ecosystem service provision during construction
- **Retrofitting** features onto pre-existing grey assets
- **Designing in** as part of new schemes
- **Strategic** as part of strategic planning
Why do it? Enhancing for ecological goals

- Enhance to improve biodiversity (most common)
- To target specific species of concern
- To comply with legislation

**How:**
- Active enhancement making textures or adding vegetation to attract species
- Passive enhancement Material choice
Why do it? Enhancing for asset resilience

- **Deterioration:** is one of the leading causes of decay of coastal structures and historic ruins; maintenance is expensive.

- **Tools to improve durability:** conventional methods are expensive or fail rapidly

- **Policy Push:** Improve asset sustainability & resilience
The IGGIframe project: overall goals

- The key objective of this project is to incorporate our innovative green grey work to:
  - broaden the range of GI tools available for practitioners,
  - provide evidence-based case studies and
  - a simple framework to enable users to better incorporate IGGI on existing or new hard assets in urban areas, estuaries and along coastlines.

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Responding to User Needs

What do you need to move from innovation to widespread application?

- Guidance: 90.0%
- Evidence of asset resilience: 80.0%
- Comparison tools: 60.0%
- Cost: 80.0%
- Business Case: 40.0%
- Other: 10.0%
How did we do it? Co-production


- **Project Supporters:** Natural Resources Wales, Isle of Wight Council, Highways England, Historic England, Spectrum Housing.

- **Advisory Board:** Glasgow City Council, SEPA, NYC Parks Dept, Southampton City Council, Arup, Dr. Rob Fish, Prof. John McCarter, Dr. Jasper Kenter, Dr. Elsa João.

- **Subconsultants:** HR Wallingford, Environmental Policy Consultants and CIRIA
Project outputs

- **Decision Support Framework** tested using the case studies
- **Method** to assess your own IGGI vs business-as-usual
- **Case Studies** > 16 case studies showing breadth of IGGI
- **Art of the possible** > 23 signposting ideas
What environments are covered?

- Coastal and Estuarine
- Mowing for pollinators
- Historic
- Urban
What range of IGGI measures are included?

Non-building grey assets that need to remain grey for their primary function

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Examples that have multifunctional benefits

- **Air pollution:** Green screens, CityTree, Trees for Health
- **Biodiversity:** Bee walls, bee benches, bee bricks, mowing for wildlife, green bridge, all coastal examples
- **Water attenuation:** green tramway, Sheffield grey to green, coastal saltmarshes
- **Asset Resilience:** Soft capping and ivy on historic walls
Critical Success Factors

- **Motivation**: Why green?
- **Cost**: How do the costs compare to business as usual (BAU)?
- **Engineering**: does greening affect performance?
- **Social**: What are the amenity & reputation benefits?
- **Ecosystem services**: which ones are provided?
- **Asset Resilience**: effect of greening on resilience?
Decision Framework

- Developed using case study data & expert judgment
- Criteria were set to:
  - Differentiate between case studies and ‘Art of the Possible’
  - To assess each critical success factor against business-as-usual (BAU)
  - To assess cost benefits compared to BAU
A step-by-step guide

**Benefit:** expert judgment assessment of the benefits vs costs/dis-benefits, to assess the net value of the IGGI approach.
- Qualitative to semi-quantitative
- Overall assessment of critical success factors

**Engineering:** Operational assessment and/or expert judgment (EJ) assessment of positive or negative effects on asset performance, inspection and maintenance; includes asset resilience.
- No IGGI measures appear to adversely affect performance, inspection or maintenance; some improve asset resilience
Ecosystem services: combination of ecology and social data. Ecosystem services benefits are calculated based on data comparing IGGI values against BAU.

- Most studies only measure some services (supporting, provisioning)
- There are data gaps (regulating, cultural)

Costs: Capex cost of IGGI compared to business as usual (BAU); summarised as ‘less’, ‘the same’, ‘more’, with ££ detailed as common metrics that are used to cost (e.g. ££/km of seawall).

- Where possible, IGGI costs are compared per unit using standard costs
- If unit costs are not possible, the cost of IGGI is also related to overall project cost
A step-by-step guide

**Social:** data on other social benefits such as job creation, public engagement and improved cohesion
- Data for this metric varies

**Reputation:** what this a motivation or a benefit of the work?
- Many examples are award winning

**Policy:** what this a motivation for the work?
- Several IGGI measures were used to comply with required mitigation or helped meet corporate policy targets.
Data Quality: what is the quality of the data assessed?

- Cost, engineering and ecosystem services are evaluated

<table>
<thead>
<tr>
<th>DATA TYPE</th>
<th>DATA QUALITY / QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Scheme specific information</td>
</tr>
<tr>
<td>No Data</td>
<td>Limited reported sources</td>
</tr>
<tr>
<td>COST</td>
<td></td>
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<tr>
<td>ENGINEERING</td>
<td></td>
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<tr>
<td>ENVIRONMENTAL</td>
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</table>
Project outputs ‘bundle’ for each topic

- **Business case** high level business case per topic
- **Case studies** specific examples for each topic
- **Art of the possible** ideas for each topic
Business Case for ‘Mowing for Pollinators’ as an Integrated Green Grey Infrastructure (IGGI) Measure

Purpose
To create an evidence-based case to aid wider implementation of ‘mowing for biodiversity’.

This business case aims to reduce uncertainties associated with GIG innovation including:
- Will it work?
- Will it cost more?
- What examples are there we can draw on?
- Are the benefits worth it?
- What are the benefits?
- How can we get this approved in our own scheme?

What is it / Greening innovation
Change of maintenance regimes to reduce cost and improve ecosystem services without any engineering impacts. Key drivers have been to save money, to improve biodiversity and amenity value.

What types of infrastructure have been greened using this technique?
A range of linear and urban assets including: earth embankment, flood defences, road verges, central reservations and industrial estates.

When in the design/life of an asset can this be applied?
As a strategic design goal (mowing for biodiversity) and as part of routine maintenance practice and/or as a cost saving measure. Mowing for pollinators is a cross-cutting measure that can be applied in a range of contexts. This includes any vegetated verge, bank or backstop of an existing asset that has an existing mowing regime. This way, the measure can be used alongside other GIGI measures to achieve additional benefits in urban, coastal, estuarine and historic contexts.

Where has this innovation been tested or applied?

- Middlesbrough
- Sheffield
- Oxfordshire
- Essex
- Kent

Mowing bundle
- Fluvial / Coastal

Evidence Summary
The evidence summary and benefits assessment are a summary of the critical success factors evaluated for all of the coastal case studies and ‘Art of the Possible’ examples. It is replicated across the four business cases to enable comparison between environmental contexts.

<table>
<thead>
<tr>
<th>Costs</th>
<th>Ecosystem Services</th>
<th>Engineering</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>What do they cost compared to business-as-usual?</td>
<td>What evidence do we have that they deliver ecological benefits?</td>
<td>Are there any risks to design life, construction or maintenance regimes?</td>
<td>How does it relate to policy and guidance?</td>
</tr>
<tr>
<td>Reduced frequency of mowing gives overall reduction in costs (e.g. usage time and fuel.)</td>
<td>Biodiversity is enhanced by providing grassland and wildflower meadows. This has significant benefits for pollinator species.</td>
<td>No risk to design life, possible small changes to asset inspection (i.e. timing.)</td>
<td>Can help meet national pollinator strategic objectives and/or local biodiversity Action Plan targets for bees.</td>
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LESS
POSITIVE
NEUTRAL
ACHIEVED

Primary Critical Success Factors

<table>
<thead>
<tr>
<th>Data Quality</th>
<th>Social</th>
<th>Reputation</th>
<th>Asset Resilience</th>
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<tbody>
<tr>
<td>What is the quality of the data underpinning this bundle?</td>
<td>What are the potential additional social benefits - jobs, cohesion, education etc.?</td>
<td>How have the schemes helped improve public perceptions?</td>
<td>Is asset resilience affected, neutral or improved?</td>
</tr>
<tr>
<td>Improved amenity value, improved community cohesion (some of the schemes have involved corporate-community partnerships) and new jobs have been created (Westhorpe scheme)</td>
<td>Led to improvements in corporate reputation, gained public support for changes in management and won awards (AP-M1). Local authority cuts and reduced service provision has been offset by wildflower meadows that have high public approval.</td>
<td>Changes mowing practice has little adverse effect or benefit an structural integrity of earth embankments or verges.</td>
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Benefits Assessment

The evidence summary presented above is derived from the examples contained in this bundle, each of which have been assessed using the Critical Success Factors guidance developed by this project. The benefits showcase the benefits of each critical success factor relative to each other. They are a combination of ecosystem services and other important considerations necessary to evaluate IGGI measures compared to business as usual. More detailed breakdown of each element of each can be found below.

Cost benefit
Reduced frequency of mowing reducing labour and fuel costs, although this is offset partly by possible increased costs of machinery maintenance due to cutting longer grass. Overall costs are considered neutral or slightly reduced compared to business-as-usual.

Engineering value
Mowing regimes have very little impact upon engineering performance. Whereas mowing frequency is reduced, grass is still cut during the year and so there is no concern with vegetation becoming unmanaged or possibly compromising engineering performance.

Cultural services
Reduced mowing supports semi-natural grassland habitats. These are rich habitats that often support wildlife of local communities. This includes opportunities for learning, aesthetic value, recreational and reflective experiences.

Regulating services
Grassland habitats provide some carbon sequestration.

Supporting services
Grassland habitats host valued pollinator species, important for supporting resilience ecosystems and agriculture. Examples show that reduced mowing can increase the number of native needs, including rare species.

IGGI Measures

This bundle contains three IGGI measures:

<table>
<thead>
<tr>
<th>Aim of the IGGI</th>
<th>Label</th>
<th>Title</th>
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<tbody>
<tr>
<td>Reduced maintenance</td>
<td>CS-M1</td>
<td>Embankment mowing for bees</td>
</tr>
<tr>
<td>Replacing grass verges on railway estate with wildflower meadows</td>
<td>CS-M2</td>
<td>Embankment for wildlife gains</td>
</tr>
<tr>
<td>Replacing grass verges on road estate land with flower meadows</td>
<td>AP-M1</td>
<td>Flower meadow verges</td>
</tr>
<tr>
<td>Improve the local environment for wildlife and people by improving biodiversity onsite and create a native tree</td>
<td>AP-M2</td>
<td>Urban grassland</td>
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IGGI solutions and relevance to other bundles

These IGGI measures can be applied more widely than the examples put forth here, as it can form part of managing of the wider more conventional green infrastructure estate including parks and open spaces. It can also be combined with other IGGI measures such as Mowing for Pollinators (CS-M1) being used on the land-facing side of coastal flood alleviation structures and the other coastal measures being used on the others such as vegetated terraces (26-C1). In an urban context, these measures can be combined with enhancements to building or free-standing wall facades (e.g. AP-U2, AP-U9) and street furniture (AP-U1) to optimise the value for people and pollinators.

How can you get this type of greening approved for your scheme?

The case study, art of the possible examples and policy links provided here can be used to demonstrate the economic, environmental and social benefits that can be gained from this type of IGGI innovation. What is also required is a willingness to innovate where testing or application of these innovations often requires changes in behaviour or practice. For example, austerity was a key driver of innovation for AP-M1 where the need to make substantive savings to maintenance budgets for road networks and parks led to an innovative, low cost solution.
Known limitations or risks associated with these IGGI approaches

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Description and Risk Reduction Strategies</th>
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<tr>
<td>Ecosystem service provision</td>
<td>Different altered mowing and planting regimes can cater to specific species or overall biodiversity, but not necessarily both at the same time. Clear biodiversity goals need to be agreed at the outset and other forms of vegetation may also be more suitable than flower meadows.</td>
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<tr>
<td>Ecological connectivity</td>
<td>The potential wider benefits of improved habitat connectivity using these IGGI approaches is high, but it has not been measured by these examples so the precise benefits are currently unknown.</td>
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<tr>
<td>Geography</td>
<td>There can be a wide application across the rural and urban landscape. Where used in dense urban areas, it is recommended that additional habitat features are provided for key species such as solitary wasp bees. Examples in the urban bundle can be used to provide these habitat alongside those in the mowing bundle to achieve this.</td>
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<tr>
<td>Machinery</td>
<td>Mowing late in the season may put additional pressure on equipment in terms of wear and tear (e.g. vegetation will be thicker but machines used less often) and also availability of machinery for cutting. Careful planning is needed to optimise ecological gains within operational constraints of limited numbers of mowers.</td>
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<tr>
<td>Maintenance</td>
<td>Although maintenance is typically less than for grass-managed features, there is still a critical need for a maintenance operational plan to be made and followed over time. Annual maintenance is critical for flood alleviation improvements and to retain their engineering design performance criteria.</td>
</tr>
<tr>
<td>Scale</td>
<td>There is potential for widespread application of these IGGI approaches; limits are the availability of machinery for late season mowing.</td>
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Where to learn more

Case study: CS-M1 and references therein

Art of the Possible: AP-M1 and AP-M2


A related technique involves greening stalling brownfield sites using wildflowers to attract pollinators, e.g. Buglife’s ‘Managing brownfield sites for scarce bumblebees’ https://www.buglife.org.uk/sites/default/files/Managing_brownfield_sites_for_scarce_bumblebees_0.pdf [Accessed August 2017].

Planteen also has guidance on ‘Good Verge’ which may also be applicable: http://www.planteen.org.uk/uk/urban-workplace/good-verge-guide-different-approach-managing-our-waysides-and-verges [Accessed August 2017].


Urban grassland: Greening a light industrial estate

What is the measure?

A novel social enterprise greening and growing scheme on an acre of previously underused land and paving around 11 industrial units on a trading estate between Sheffield and Worksop, Derbyshire. Greening involved a change in habitat from mown grass to urban grassland.

Primary driver

Light industrial areas are often some of the greenest areas of our cities and towns, with little ecological value. This project aimed to improve the local environment for wildlife and people by enhancing biodiversity onsite and creating a native tree nursery for community projects.

Benefit

Savings of £5.5K/annum estate maintenance

This initiative improved biodiversity in an urban area (light industrial estate) typically devoid of green infrastructure and through the plant nursery created jobs and yields an annual cost saving compared to business as usual. It also reduced waste to landfill (through re-use) and delivered a carbon sequestration gain.

Cost

Savings of £5.5K/annum/acre in estate maintenance costs to the industrial estate, net positive as space was re-purposed to create a successful plant nursery business.

Engineering

There are no engineering impacts from this change in use.

Ecosystem services

Supporting services were measured. The existing heavily manicured lawn and hedge provided little habitat value with no nesting birds, no amphibians, and limited invertebrates. Post-greening the area now hosts a diverse bird population and frogs, toads, newts, grass snakes, dragonflies and dams of fly fis, all the bees, more than 10 different butterflies, an array of moths, shield bugs, cinnipeds, gau wasps, burrowing solitary bees and other invertebrates are found across the microhabitats created. The flora includes over 40 species of native and naturalised trees and a profusion of meadow grasses and flower species. The scheme also provided regulatory services to the tree nursery and associated planting has improved local carbon sequestration. Change of habitat from mown grass to urban grassland may also improve rainwater attenuation. Cultural services were assessed (see social).

Social

The project has employed local people and volunteers in growing a range of plants and products cooperatively, the trees are used for social growing projects on similarly underused or derelict sites. Profit from the nursery reduce annual maintenance costs for the landowner and well-being is improved.

Reputation

The project has won a Gold Green Apple, a Silver Green World award and recognised as a Green world ambassador. The local businesses have benefited from an improved local environment and have a certificate showing environmental partner ship.

Policy

UK BAP: Urban Forestry Initiatives

Further data

19476b16_20171024_010454_89599c6415969fd23.pdf

Where to learn more/get involved

- The project is officially launched
- Available here http://eprints.gla.ac.uk/150672/
- And from CIRIA (www.ciria.org)
- An Institute of Civil Engineers paper explains the protocol
- We are keen to know how our outputs can be tweaked to best help you
- And to learn how you’ve used them to help in your day-to-day work