



# Circular Economy

Approach and Routemap

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## Revision history

Revision date	Details	Created		Reviewed		Approved	
		Name	Position	Name	Position	Name	Position
June 2016	Development following Steering Committee Meeting in May 2016.	David Smith	Technical Director, AECOM	Debra Power	Technical Director, AECOM	Caroline Crewther	Atkins
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## 1 Context and Objectives

The Road Investment Strategy (RIS) outlines a significant increase in capital investment on the road network and a much increased maintenance and renewals programme. To deliver this scale of investment will require major increases in human, plant and material resources. At the same time other major infrastructure developments are taking place across the UK as well as increased house building. These trends are replicated across Europe and further afield.

This increased activity raises pressure on availability of, and competition for, resources. This heightens supply chain risk and material criticality and the need to ensure security of supply for delivery of Highways England performance requirements. The Highways Agency began to take steps to mitigate these risks by promoting resource efficiency with delivery partners through procurement frameworks.

Highways England recognises these and other drivers for the circular economy, including: national and international legislation, safety, financial benefits, the need for innovation and the development of low carbon infrastructure (URS, 2014). A move to a circular economy will also address failures in the wider economy, however, Highways England cannot move to a circular economy in isolation, collaboration with other stakeholders is vital for success.

Highways England's licence to operate (Highways England 2015a) includes a requirement to put sustainable development, defined as 'encouraging economic growth while protecting the environment and improving safety and quality of life for current and future generations' into practice. 'Manufactured Capital - circular economy' is one of the five key objectives of Highways England's Sustainable Development Strategy (2016), this provides a high level statement of Highways England's vision and ambition.

The RIS (Highways England, 2014) involves delivery of c£9 billion of road schemes between 2015 and 2020, with capital efficiency savings of £1.21 billion by 2020 (Highways England, 2015b). Highways England's transition to the circular economy has a valuable contribution to make to this. Earlier work (URS, 2014) reviewed five Highways Agency schemes valued at £251 million, and identified opportunities to deliver a total of 1,160 tonnes of avoided greenhouse gas emissions and £8.1 million of cost savings through improved materials efficiency. These saving are equivalent to a saving of 3% of project cost, which if replicated across the RIS could generate financial savings of £290 million. Although further research is required to fully characterise and quantify the benefits of circularity for Highways England, a move to the circular economy would build upon initiatives to improve resource efficiency with additional measures to improve resource longevity and end of life value and hence, can be expected to provide even greater financial gains in the longer term. Highways England's transition to the circular economy therefore has a valuable contribution to make in achieving the savings required by the RIS.

Highways England commissioned AECOM and Atkins to deliver a corporate circular economy plan to help build a culture of resource efficiency and effectiveness across the organisation.

The specific objectives of this project are to:

- Develop a corporate circular economy strategy within the context of the Highways England Sustainable Development strategy;
- Define what circularity means for Highways England;
- Develop a Routemap towards fully optimised resource use on Highways England's projects and operations. To include, where possible, staged targets and realistic timetables for achievement; and
- Deliver a plan to embed a culture of resource efficiency across the organisation and Highways England's supply chain.

Successful implementation of the Plan and Routemap will be a significant element of Highways England's approach to achieving resource security and resilience within the overall context of sustainable development. Implementation will allow Highways England to contribute to economic growth while de-coupling from resource extraction. This project was delivered in parallel with other work focussed on supply chain responsibility and traceability which sought to understand the environmental, social and ethical risks in Highways England's supply chain. Measures to incorporate a circular economy approach at Highways England will, in part, mitigate some of the supply chain risks currently being faced. The overall aim is to inform the approach to achieving security of supply of the resources needed to deliver the Road Investment Strategy and to minimise risks in Highways England's supply chain, and to make our contribution to economic growth while de-coupling from resource extraction.

## 2 Approach to Project Delivery

Highways England's Sustainable Development Strategy (2016) includes a corporate commitment to the circular economy, this encompasses both Highways England's road infrastructure and offices. The drivers for, and benefits of, resource efficiency and the circular economy for Highways England have been documented (URS, 2014). Earlier work also identified opportunities for actions and initiatives required to improve resource efficiency.

The key stages in project delivery are summarised in Figure 1, with the associated timeline provided in the Routemap (Appendix A):

- 1) Review of the literature to identify existing definitions of circular economy;
- 2) Discussion / agreement with the Highways England delivery manager of alternative definitions for Highways England;
- 3) Identification and development / documentation of supporting case studies;
- 4) Parallel discussions with other Highways England internal stakeholders to identify potential components of Highways England's approach to the circular economy;
- 5) Development of Highways England's outline approach to the circular economy;
- 6) 6) Review of 'Efficient Material Flows' (URS, 2014) and development of a matrix summarising opportunities / actions and their associated priority. Development of the matrix through Q4 2015 and Q1 2016, through discussions with stakeholders to produce a more comprehensive understanding of the potential opportunities for circularity within Highways England and the associated actions and tools available and necessary to achieve this;
- 7) Development of a time-line for actions / Routemap and identification of the critical path for delivery (Appendix A);
- 8) An overview of the potential 'components' of Highways England's approach to the circular economy and the high-level draft Routemap were summarised and discussed at a circular economy and Responsible Procurement workshop (January 2016) in order to obtain stakeholder feedback to direct further development and refinement of the Routemap. The list of workshop attendees, and other stakeholders with whom the project team has consulted, is provided in Appendix C;
- 9) The project recommendations were documented (Section 5, this report) during February and March 2016;
- 10) The project report was prepared and circulated for review / revision during February, March and April 2016; and
- 11) The Routemap and Communications Plans prepared on the basis of the report during April 2016. Finally the Report, Routemap and Communications Plan were circulated to project stakeholders for comment and final revisions during April and May 2016.

Activity	Start Date	End Date	Description	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16
1	Aug-15	Dec-15	Literature review	█	█	█	█	█						
2	Sep-15	Apr-16	Identification an preparation of supporting case studies		█	█	█	█	█	█	█	█		
3	Oct-15	Oct-15	Consideration and agreement of working definition for circular economy			█								
4	Aug-15	March-16	Discussions with Highways England internal stakeholders	█	█	█	█	█	█	█	█	█		
5	Oct-15	Dec-15	Development of outline approach to Circular Economy			█	█	█						
6	Nov-15	March-16	Development of matrix summarising potential opportunities for circular economy				█	█	█	█	█			
7	Dec-15	March-16	Development of a Gannt chart for circular economy implementation				█	█	█	█				
8	Jan-16	Jan-16	Circular Economy and Responsible Procurement Workshop						█					
9	Feb-16	Feb-16	Review of feedback and revision of outline approach to circular economy							█				
10	Feb-16	Jun-16	Preparation and evolution of the project report							█	█	█	█	
11a	Mar-16	Jun-16	Development of Routemap									█	█	
11b	Mar-16	Jun-16	Development of Communications Plan									█	█	█

Figure 1: Project Delivery Schedule

### 3 Characterising the Circular Economy

There are a number of definitions of ‘circular economy’ (Appendix D) but the following definition is adopted as a ‘working definition’, as it is concise, ambitious and aligns with Highway’s England’s Delivery Plan:

“A circular economy is one that is restorative by design, and which aims to keep products, components and materials at their highest utility and value, at all times.”  
(Ellen MacArthur Foundation, 2013)

The opportunities with the greatest potential for improving resource efficiency and contributing to the circular economy in construction projects occur during the feasibility and early design stage. Implementing these opportunities can provide significant reductions in cost, waste and carbon.

RSA (2016) recognise that ‘good design plays a critical role in the shift to a circular economy by influencing the way we make, consume and dispose of all products. The move to a circular economy requires a move from the prevailing product centric focus to a more system based design approach, considering value in the broader sense, including design longevity, opportunities for renovation, reuse and material recovery.

Figure 2, based on ‘Building Revolutions’ (RIBA, 2016), is consistent with ‘Highways England’s approach. The diagram has ‘four design models’ or alternative paths a product can take in order to be designed for circularity. Designers are encouraged to:

- 1) Look to design as close to the user as possible, on the inner loop – for longevity;
- 2) If this is not realistic or relevant to the product, move on to designing for a different business model; leasing or service provision; then consider
- 3) Remanufacturing, with broken or obsolete components replaced and the product restored to its original or better state; and
- 4) Finally consider the outer loop of material recovery (or recycling) involves the complete breakdown of materials before some are restored to the manufacturing process.

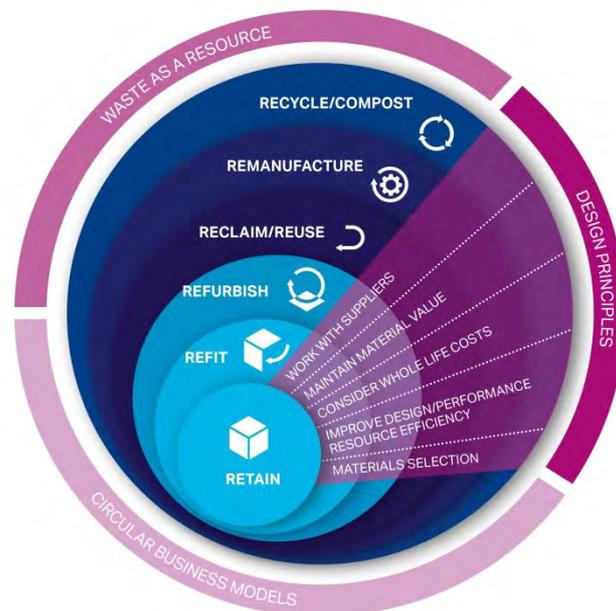


Figure 2: Approaches to Product Design

The model allows the designer to identify and consider the key knowledge holders for the extended design team.

For Highways England this means:

- Minimising demand for primary resources extracted from the ground; and maximising the reuse of resources already in use on the network and ultimately in the wider economy. Reutilising them at end of life in as high a value application as is possible;
- Being innovative; working with Highways England's suppliers to find new ways to deliver a more resilient and adaptable network – seeking efficiency and value for money;
- Working to achieve security of supply; working with others to improve the stability and predictability of demand for high-performance products and services. Enabling suppliers to invest in innovative approaches and secure long-term partnerships with wider supply networks, their staff and wider communities;
- Supporting the objectives of Biodiversity 2020 (DEFRA, 2011), seeking to reverse biodiversity loss and, in the longer term, delivering biodiversity gains; and
- Consideration of the potential for a natural capital approach to capture the value of Highways England's land holding.

Specific opportunities will be determined by each project's unique circumstances, however, a number of opportunities have been identified for the A14 Pathfinder Project (Appendix E) which can be aligned with the Ellen MacArthur Foundation RESOLVE framework, as follows:

### **Re**generate:

- Highways England will consider opportunities to generate and use renewable energy and materials where appropriate; and
- Highways England will seek and consider opportunities to restore the health of ecosystems.

### **S**hare:

- Priority will be given to prolonging the life of assets, through consideration of durable design, opportunities for maintenance upgrades and retention of high material value through end of life reuse;
- Highways England will consider opportunities to work with other major infrastructure schemes to facilitate sharing of plant and reuse of resources such as excavated and secondary materials; and
- Working with local skills agencies to help develop local capability and capacity.

### **O**ptimise:

- Design / performance and efficiency, designing out waste and the recording of data and information (including asset composition and condition via BIM) in order to support future asset management; and
- Improve resource management e.g. reducing waste through off-site manufacture and development of programme level resource management planning tools.

### **L**oop:

- Seek to achieve longer term resource reuse / re-management with maintenance of material value; and
- At end of life seek to return resources to the biosphere with beneficial impact (e.g. carbon sequestration).

Other Highways England opportunities, not currently applicable to the A14 project, include:

### **V**irtualise:

- Looking for opportunities to 'dematerialise' its services, for example, removing the need for overhead gantries by the transmission of information to in-car 'set top boxes'.

### **E**xchange:

- Adoption of BIM will provide accurate (GIS linked) knowledge of infrastructure composition and location with the potential to reduce the demand for investigative works such as 'trial holes'. BIM will improve resource management and maintenance across the road network.

Over a period of time Highways England will develop a list of opportunities which can then be used as 'menus' for future projects using Highways England's Value Chain Plans (Highways England, 2016c).

## 4 Highways England's Approach to Circular Economy

Adoption of a circular economy approach compliments and brings benefits to Highways England's priorities of safety, customer service and delivery of the RIS. Whilst Highways England's Sustainability Team will develop the tools and facilitate their implementation, ultimately success is dependent upon the whole organisation understanding and 'buying-into' Highways England's role in the circular economy.

Highways England's commitment to supporting economic growth will be difficult to realise in the context of increased competition for finite and diminishing resources. The key resources for Highways England are materials, plant and people. There is huge potential to expand materials reuse and recycling (URS, 2014). Collaboration between stakeholders both within and between major infrastructure projects can help utilise plant more efficiently. The circular economy can also help Highways England deliver its commitments to training and innovation. An engaged and collaborative supply chain is key to success throughout all of Highways England's value chains.

Historically a key barrier to achieving opportunities of resource efficiency has been a failure to articulate and recognise the benefit / opportunity associated with improved resource efficiency and circularity. This section seeks to define Highways England's corporate commitment to the circular economy in order to provide a basis for subsequent development of the Routemap.

Once Highways England has achieved 1-6 below it will continue to embed circular economy best practice within Highways England projects and supply chain with the longer term aspiration of becoming an enabler for the circular economy.

- 1) Highways England is committed to working within and supporting the circular economy.**  
**"A circular economy is one that is restorative by design, and which aims to keep products, components and materials at their highest utility and value, at all times."**<sup>1</sup>

Moving from a linear business model to a circular one requires changing multiple business models to enable the loop of products and components. This implies the development of (new) value networks – a network of businesses or other enterprises that generate economic value through dynamic exchange of resources or services. The most successful circular approaches come from a network in which the business models are aligned. These networks are often disruptive to existing supply chains and deliver new benefits or propositions to the final customer (Innovate UK, 2015).

- 2) Highways England will work with its stakeholders to develop understanding and awareness of the circular economy.**

Highways England will continue to work with existing partners, including other client organisations, commercial and academic bodies that can help and support circularity. Highways England is currently gathering case studies of resource efficiency and circular economy successes which it will use to help raise awareness of and promote the circular economy within Highways England and its stakeholders.

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<sup>1</sup> This 'working definition' will be reviewed and replaced with Highways England definition following this project.

Highways England will identify and consider common approaches to procurement for circular economy through for example the workings of the MI-ROG<sup>2</sup> Procurement Working Group.

Highways England will establish a circular economy Steering Group including stakeholders and external specialists to help guide the implementation of circular economy within Highways England.

**3) Highways England will work collaboratively with stakeholders to better understand and predict future resource demand and opportunities.**

Highways England will use existing networks such as the expert advisory panel of MI-ROG to maintain communications and seek circular economy opportunities with other major infrastructure projects.

**4) Highways England will work more closely with suppliers / improve supplier relationship management.**

Highways England will provide its supply chain with clarity on what the circular economy looks like for Highways England and, in particular, what success looks like. 'Success' includes benefits such as:

- Designing for durability;
- Reducing demand for primary resources;
- Increasing the reuse of resources already in use on the network. Reutilising them in as high a value application as is possible;
- Being innovative; finding new ways to deliver a more resilient and adaptable network – improving efficiency and value for money;
- Improving security of supply; working with others to improve the stability and predictability of demand for high-sustainability-performance products and services;
- Building long-term partnerships with wider supply networks; and
- Being restorative, for example through carbon sequestration.

**5) Highways England will use Whole Life Costing to recognise a wider range of impacts within decision making and provide a defined process to recognise 'value', including financial and sustainability value.**

Highways England will continue to focus on safety, customer service and delivery of the RIS – projects and opportunities must be financially viable. Highways England's Licence to Operate (Highways England, 2015a, paragraph 5.12) mandates the use of a whole life cost (WLC) approach to managing its assets to ensure efficiency and value for money. Use of whole life costing to support investment decisions is critical to the measuring and monitoring of efficiencies (Highways England, 2015b).

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<sup>2</sup> The Major Infrastructure–Resource Optimisation Group (MI-ROG) was established in 2013 as a forum for the UK's infrastructure operators to collaborate across the circular economy theme and to meet the challenge of delivering major infrastructure in a constrained economy. The first forum of its kind in the infrastructure sector, MI-ROG has inspired and facilitated workflows on asset life cycle, carbon performance, circular economy planning, critical materials availability, materials exchange and sustainable procurement and supply chains. MI-ROG members include senior representatives of Anglian Water, Centrica, Crossrail, EDF Energy, the Environment Agency, Heathrow Airport, Highways England, HS2, National Grid, Network Rail, Thames Tideway Tunnel and United Utilities.

Highways England has not yet developed a standard WLC methodology for application across all projects, it is however, intended that the NDD Asset Management Database will underpin WLC. Highways England's current capability, focussed on financial costs, is based on existing standards, which have been developed to support (financial) WLC with Professional Technical Services (PTS) such as Pavement Structures providing relevant technical knowledge about the design/operational life of assets. Highways England is currently looking at Anglian Water's (established) use of GHG emissions as a metric / efficiency driver to incorporate an element of environmental impact into the WLC process.

Whole life costing will need to consider elements such as sustainability impacts associated with selection of materials, transport, creation of employment and project longevity.

Highways England will develop Supplier Procurement Briefings for suppliers in its priority areas. These will identify the key areas of consideration e.g. key impact areas such as transportation costs / economies of scale etc.

### 6) Develop and implement WLC decision making tools across Highways England.

Highways England's Efficiency and Inflation Monitoring Manual (Highways England, 2015b) defines the approach to measuring and monitor efficiencies throughout Road Period 1 of the RIS.

Highways England is tasked through its Licence to use WLC as a basis for investment decision making. Quantifying benefits and linking them to the investment, will encourage a WLC approach, and should also discourage behaviours which do not measure benefits on a WLC basis. The process diagram (Figure 3) illustrates Highways England's definition of an efficiency as an improved relationship between cost (inputs) and output (or outcome) (Highways England, 2015b).

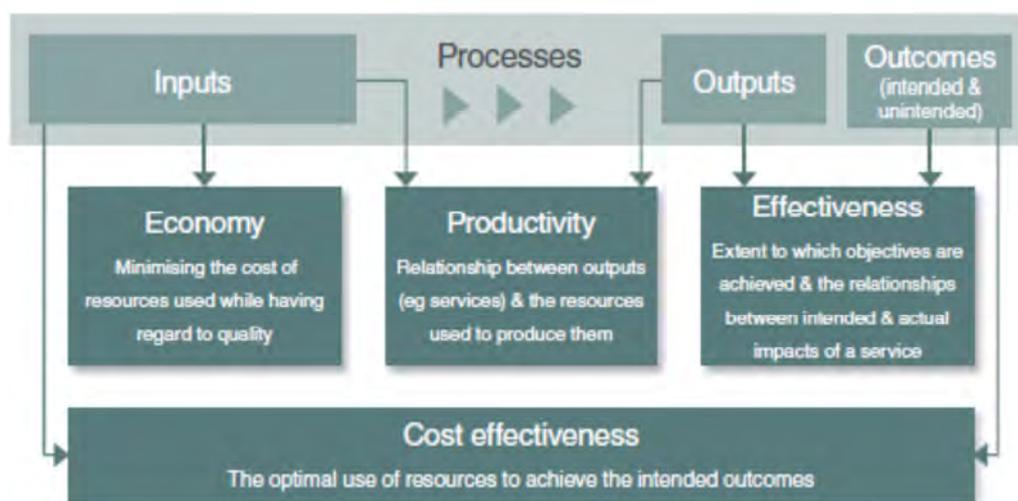


Figure 3: Highways England Efficiency Process Diagram

The approach for monitoring CE should follow the key efficiency reporting principles which have been adopted by Highways England (Highways England 2015b):

- 1) Baseline costs;
- 2) Baseline point in time;
- 3) Entire costs;

- 4) Quality / end product;
- 5) Efficiencies stated net;
- 6) Standard capture mechanism;
- 7) Doing the right thing; and
- 8) Appropriateness test.

## 5 Key Stakeholder Messages

The principal messages relating to the circular economy emerging from the January 2016 Circular Economy and Responsible Procurement workshop were:

- The need for clear communication of what Highways England is trying to achieve;
- The need for involvement of internal stakeholders including: Highways England Procurement, Major Projects and Network Design and Delivery (NDD);
- The need to ensure collaborative working within the supply chain and more broadly across the sector; and
- Agreement that Highways England should begin to move to a circular economy now and allow their approach to evolve throughout the remainder of RIS 1.

Stakeholders also commented that:

- Highways England's corporate commitments around the circular economy need to be supported by a clear vision, as well as effective procedures and tools. Systems need to be in place to enable progress and performance to be tracked and measured. Importantly, a simple approach and language will help to embed the approach in thinking and culture so that it can become "business as usual";
- Stakeholders agreed that this is not a journey that Highways England can, or should, progress alone. Success will be dependent on working with others and using the experience and knowledge from both within the supply chain and more generally in the sector. A clear message from stakeholders was that Highways England should use external resources. Other organisations, commercial and academic, can and should help and support Highways England;
- There is a need for transparency and also the rewarding of transparency, along with the need for sharing of lessons learnt and successes; and
- Highways England also needs to be better at enabling and rewarding innovation.

## 6 Development of the Routemap

In any business change process, a key element is defining the path to the goal – the Routemap. This Routemap addresses the ‘Manufactured Capital - Circular Economy’ priorities identified in Highways England’s Sustainable Development Strategy and further developed through the ‘Core Components’ above. The Routemap focusses on four key areas (Figure 4): Governance (including Stakeholder Engagement); Procurement; Monitoring and Reporting; and Tools and Guidance.

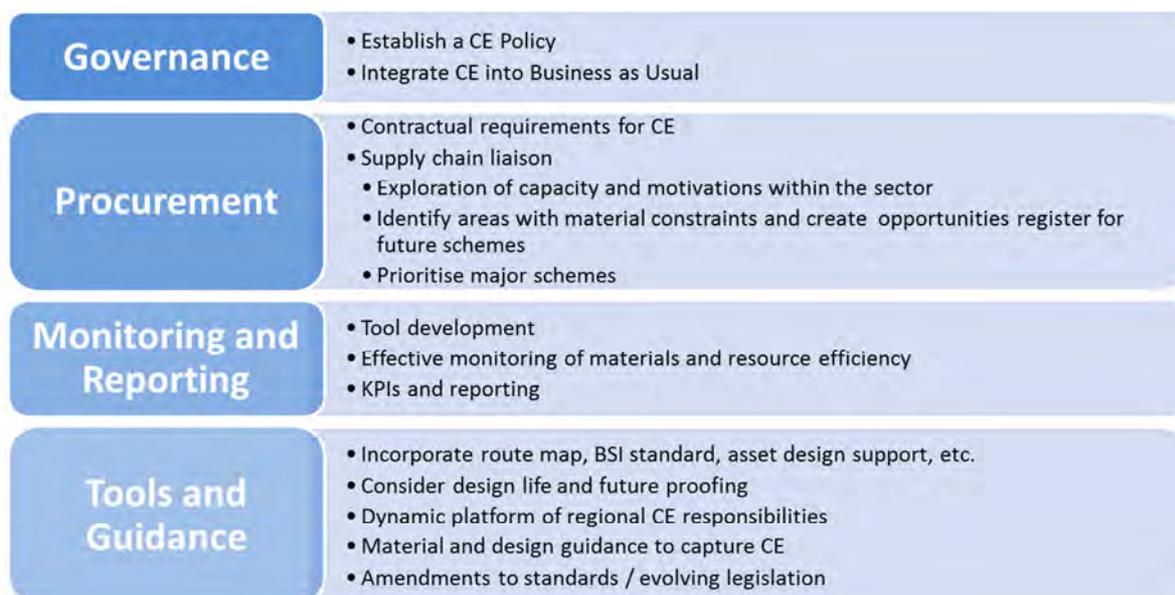


Figure 4: Routemap Key Areas

### Governance

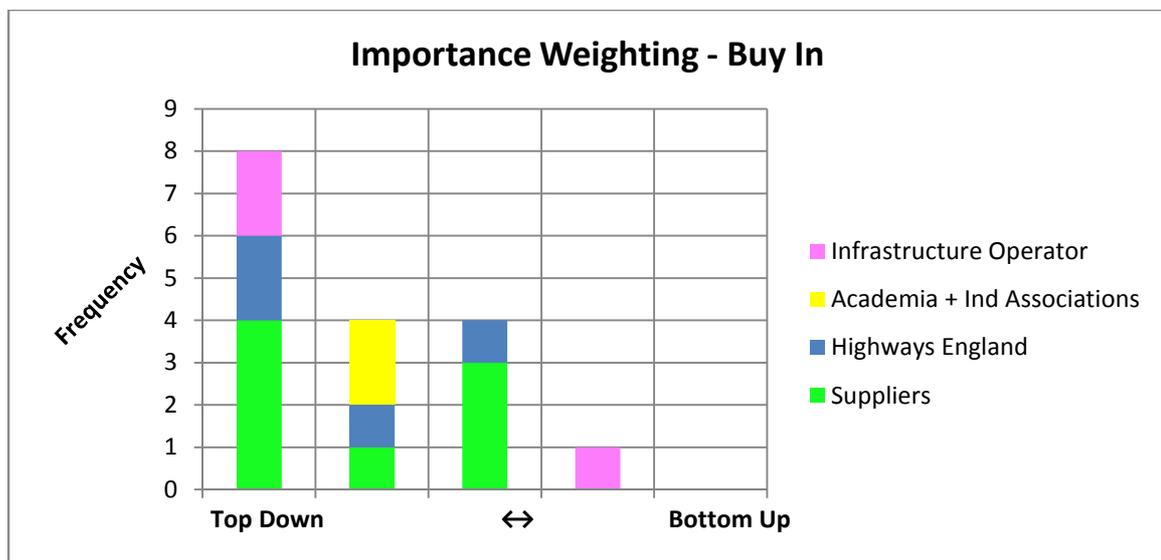
The OECD defines corporate governance as involving “a set of relationships between a company’s management, its board, its shareholders and other stakeholders.” Governance “provides the structure through which the objectives of the company are set, and the means of attaining those objectives and monitoring performance are determined” (OECD, 2004). The sustainable development priorities established by the Board are to be cascaded through to operations by the programmes that the Board implements, one of which is the circular economy Routemap.

In the same way that good corporate governance is necessary to conduct and run businesses competently and with integrity, programmes and projects comprising the business’ strategy also need good governance. “Effective governance of project management ensures that an organisation’s project portfolio is aligned to business objectives, is delivered efficiently and is sustainable (APM, 2011).” Governance of project management is about doing the right projects, and influences the way that corporate sponsors and other major stakeholders exchange timely, relevant and reliable information.

The circular economy Routemap is for Highways England, for its internal business processes. It is not intended to be a set of procedures for external stakeholders, although some elements of the Routemap may result in procedural changes for external stakeholders (i.e. changes to procurement, supply chain monitoring, etc.). It is an investment approach and a sign of Highways England’s intent

towards external stakeholders, and lets them know what is expected of them. The Routemap will include clear cost saving / benefit objectives, to enable Highways England staff and stakeholders to understand and measure their impact upon the business. Getting the governance of the Routemap right will enable an investment approach, rather than an asset focus, and enable visibility and effective control. Data will be assembled over time to enable formation of metrics to enhance the business case for the circular economy and drive improved performance. Perhaps the most significant element of Highways England’s move to a circular economy will be the increased focus on getting the design right from inception, rather than the more traditional approach of considering options for waste management at the end of the asset’s life.

Embedding the Routemap and circular economy approach in to Highways England’s projects and supply chain was highlighted by the January 2016 workshop attendees as being key outcomes, and one that requires strong leadership to achieve. Figure 5 shows the importance rating for ‘Buy In’ as considered by workshop attendees. Attendees considered a ‘Top Down’ approach to be most important in ensuring buy in, and therefore governance is the beginning of the critical path for delivery of the Routemap.

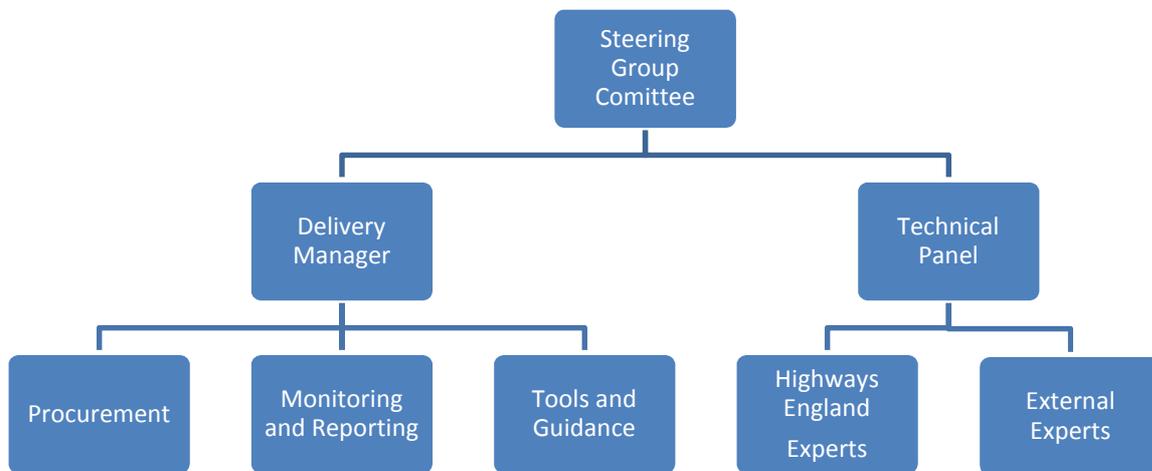


**Figure 5: Importance Weighting - Buy In**

Good governance encompasses relationships and behaviours, aligned to process and structured delivery. With responsibility devolved from the Highways England Board to an internal steering group, this group needs to set the culture and demonstrate the right behaviours throughout the organisation.

Where projects are delivered across a multi-functional organisation, collaboration, alignment and compatibility will be required to ensure mutual understanding interdepartmentally. Representation at steering group level by senior individuals from each department or functional area (including procurement, Major Projects, NDD, BIM etc.) is important to continue to develop the Routemap, and to address issues arising during delivery. The development of KPIs, how progress is reported, and how quality of delivery is assured, needs to be addressed at steering group level, taking into account the needs of each department or functional area, whilst still ensuring the Routemap can be driven

forward to the benefit of the organisation as a whole. The organogram (Figure 6) suggests the governance structure for embedding a CE approach for Highways England.



**Figure 6: Highways England CE Governance Structure**

The overall delivery manager will be a member of the steering group and responsible for leading the change process. This is an important senior leadership role, with the individual being accountable for ensuring the Routemap is governed effectively and delivers the objectives identified. This individual is a vital link between the Highways England Board and the steering group, enabling support, continuity and alignment of objectives, enabling the Routemap to become business as usual for Highways England.

Delivering a top down approach requires accountability and a number of actions are recommended to drive the Routemap forward:

- 1) Establish an internal steering group to take ownership of the Routemap governance, delivery and development. Nominations for the delivery manager and steering group members are required, along with an agreed schedule of meeting dates, accountability structure, etc.;
- 2) Identify the business critical path and associated timeline for the Routemap. The focus for the approach needs to be on the first 12 months with recommendation for review and revision after 12 months; and
- 3) Establish a technical panel of external specialists and stakeholders willing to work with the steering group. It is recommended that existing groups such as MI-ROG, Knowledge Transfer Network (KTN), and Ellen MacArthur Foundation are considered – MI-ROG has already indicated its willingness to work with Highways England.

## Procurement

Procurement impacts upon all aspects of Highways England's operations, and is a key tool for managing relationships with the supply chain. It is critical that procurement continues to operate as business as usual, whilst enabling change towards a circular economy to develop without imposing barriers. It is important that the Routemap does not simply introduce a procurement tick-box. Procurement is essential to project delivery and should enable project managers to deliver schemes on time, to budget and to the required specification. As such, it can be a key project management tool through which success can be measured.

It is often difficult for companies to accurately specify a product that will perform as required in the intended environment. Whilst the procurement function manages the procurement process, it is Highways England's project managers who write the detailed specifications. If the procurement function can provide guidance tools or templates for the specification process, this will enable more accurate specification, which will, in turn, provide clarity for the supply chain and offer technical teams a greater ability to manage risk. There is also a need to understand Contract Procurement Rules (CPR) and standards. These are both in the PTS arena.

Currently, if circular economy opportunities are considered, it is frequently at the implementation stage, rather than inception or design stage, and therefore the potential outcomes may be less than might have been achieved had a circular economy approach been considered at an earlier stage. The A14 Pathfinder Project (Appendix E) is the first project in which Highways England's Environmental Advisors have worked with partners throughout the supply chain to implement a circular economy approach from project design.

Existing technical standards may be a barrier to innovation, which may result in existing procurement practices restricting innovation by being too prescriptive, resulting in tenders based on tried and tested approaches. Different approaches to procurement may provide an opportunity to encourage innovation by asking for 'services' rather than established specifications, particularly at contract or framework renewal. However, whilst such an approach can increase the requirement for technical evaluation of innovative or alternative approaches and also potentially increase risk in service delivery, such risks can be mitigated by evaluation of new solutions through Pathfinder Projects to evaluate performance before widespread adoption. Alternative methods for risk mitigation may include risk sharing opportunities through mechanisms such as collaborative performance frameworks or Design Build Finance Operate (DBFO) opportunities. These procurement processes should include reference to circular economy outcomes - value chain plans will be key to this.

At the January 2016 workshop, delegates expressed concern about potential changes to procurement procedures, because changes could represent a risk both internally and for stakeholders. Whilst embedding clear requirements in tender documents is essential, suppliers in particular wanted to emphasise that leaving opportunity for innovation was essential. Tender/Pre-Qualification Questionnaire (PQQ) evaluation criteria and weighting was perceived by some delegates in the supply chain to be a key barrier to delivery of circular economy outcomes. This is something that Highways England should investigate and if necessary correct, but it is outside the scope of this report.

Existing procurement procedures operate interdepartmentally and cross-functionally. Delivery of circular economy outcomes will depend upon the ability of procurement processes to develop at a similar pace as implementation of the Routemap. The Responsible Sourcing element of this project is proposing a Responsible Sourcing Management System which will deliver the following outcomes:

- 1) Supply chain code of conduct;
- 2) Supplier evaluation process;
- 3) Risk assessment process; and
- 4) Procurement team guidance notes.

The steering group includes a senior individual from the procurement department. This key member has the authority to agree and drive the implementation of requisite changes to procurement processes, including changes to systems, procedures and personnel.

Highways England has an extensive supply chain and stakeholder base, which should open up opportunities for adapting existing procedures to reflect industry best practice through stakeholder groups such as MI-ROG. Consideration should be given to re-engineering business models and relationships with the supply chain (e.g. service / lease agreements). Development of potential 'quick wins' in procurement should be targeted in the first twelve months of implementation of the Routemap, utilising both supplier and stakeholder operations as potential examples of successful change. These 'quick wins' can then be used as case studies to help drive delivery of subsequent elements.

Value Chain Plans (VCP), owned by the Strategic Supplier Development programme's Senior Responsible Officer (SRO) will facilitate the transfer and implementation of best practice from one programme or project to another. It is anticipated that the Value Chain Plans will be 'living documents' which are regularly updated. It is recommended that an exemplar VCP providing a 'menu' of ideas and opportunities for resource efficiency and the circular economy be prepared and maintained which can then be referenced by future projects (Highways England, 2016c).

The current A14 Cambridge to Huntingdon Scheme which will serve as a Pathfinder Project (Appendix E). Whilst this is Highways England's first major project in which its Environmental Advisors have worked with the project contractor and designer to apply the overarching circular economy vision, very few if any of the individual initiatives adopted to date are unique or new to the project. Circular economy is a natural progression from other pre-existing Highways England initiatives, commitments and practices, such as resource efficiency, revenue generation through material sales, and reducing waste disposal to landfill. This highlights the validity of the approach of generating and maintaining a 'menu' of circular economy opportunities which should be routinely reviewed by Project Managers and others throughout project delivery in order to identify potentially applicable opportunities for further consideration and adoption and associated stakeholders.

A number of generic case studies have been generated as part of this project (Appendix F), whilst these are not limited to civil engineering; they are intended to illustrate the broad range of opportunities and benefits available.

Opportunities to identify changes in procurement procedures could be highlighted through:

- Establishing working groups to develop circular economy business models, identifying key benefits, analysing and developing focussed action plans, informing and influencing stakeholders. These could be included in the Value Chain Plans;
- Working cross-functionally to develop ‘themed’ working groups for the various supply chains (e.g. pavements / Personal Protective Equipment) to support procurement (development of specifications and decision making). The Pavements Efficiency Group already exists and would be an ideal partner.
- A move to servitisation has the potential to improve innovation;
- Working cross-functionally to understand material flow, identifying where the value is and where are the key opportunities lie (e.g. pavements, gantries, PPE etc.), and identifying further ‘Pathfinder Projects’ – forthcoming major / high-profile which could be used to test pilot changes to procurement procedures;
- Development of Collaborative Performance Frameworks with stakeholders; and
- Consideration of how to prioritise suppliers, goods and services e.g. start with tier 1 suppliers, innovators or priority materials (e.g. pavements) in order to enable better circular economy outcomes.

A number of actions are recommended to drive the Routemap forward:

- 1) Identify a key individual to drive the procurement focus area. This individual should be a member of the circular economy internal stakeholder steering group;
- 2) Agree the key areas on which to focus, for example, service / lease agreements, Tier 1 suppliers or priority materials such as pavements, gantries, etc., or provision of a regional or sectoral focus for procurement;
- 3) Establish working groups comprising members of various teams, including procurement, design panel, priority materials;
- 4) Identify ‘Pathfinder Projects’ – forthcoming major / high-profile projects (e.g. A14) which can be used to pilot new procurement methods / points of intervention. Assess value of intervention at different project stages;
- 5) Document opportunities and successes identified and realised through Pathfinder Projects, including safety, fiscal and sustainability benefits
- 6) Identify stakeholder groups;
- 7) Identify best practice among stakeholder groups, and define opportunities for implementation;
- 8) Investigate how Collaborative Performance Frameworks (with stakeholders) could be developed and implemented; and
- 9) Identify and define timescale for implementation of necessary changes to existing tools and procedures.

## **Monitoring and Reporting**

The routine and systematic collection of information against a plan enables organisations to learn about their activities and results and how those activities and results are impacted by internal and external factors; supports planning and development; enables accountability to stakeholders; provides evidence to support decision making; and enables effective communication of achievements.

The January 2016 workshop highlighted the need for accountability. Successful implementation of the Routemap requires SMART (Specific, Measurable, Achievable, Realistic and Time bound) objectives that enable monitoring of the journey towards the goal. Implementation of SMART objectives should be reflected in procurement, project management and operational procedures as appropriate, with progress and performance regularly reviewed and reported to the steering group.

The first step is to understand what is already measured and that could be used to monitor progress towards implementation of the circular economy. Objectives that don't have existing supporting measurement could be identified, allowing actions and metrics required to establish a baseline and support monitoring and measurement of future progress to be defined and implemented.

Effective monitoring, with identification and consideration of what works / doesn't work is crucial, and a range of KPIs in a scorecard, providing uniformity and direct comparison, need to be developed at steering group level to address the various needs of the various parts of the business (e.g. requirements for monitoring the use of linear assets may be different for those required for construction projects, requirements for monitoring procurement procedures will be very different from those for monitoring project delivery, and different again from those for monitoring financial aspects).

The monitoring cycle should flow from data collection, through base lining and alerts, reporting and analysis, to communication.

### **Data collection**

Once the circular economy Routemap KPIs are agreed, methods for data collection need to be agreed and implemented, because if data can't be collected, it can't be monitored. The data collection method(s) need to be based on existing systems that are easily accessible to users (both for data input and output), and existing systems should be reviewed to understand what data already exists and how it can be collected.

The Operational Metrics Manual (linked to the Delivery Plan) provides over 150 different metrics. However, Highways England recognises that the existing corporate key performance indicators and performance indicators which it must deliver against do not fully capture its sustainability value, or 'true value', as a consequence of the activities it carries out directly, through its supply chain and through the use of the strategic road network. Recent work identified a general weakness in Highways England's data collection, coordination and analysis and provided recommendations to address this (Highways England 2016d), including suggesting a number of new values or impacts for further consideration, including ones focussed on

‘delivering better environmental outcomes’ and ‘achieving real efficiency’ (Highways England 2016e).

A circular economy performance indicator such as ‘material use / km of road built’ could potentially be based on the existing ‘material use in schemes’ metric currently recorded by Highways England’s existing Carbon Tool. Other potential metrics include: financial performance / savings and materials purchased / used and recycled content. It is however, noted that not all existing Highways England monitoring systems are mature and further research is required to establish the extent and format of existing data.

Highways England’s BIM process, which is currently being developed , will collate a range of data and will be a valuable tool to support Highways England’s move to the circular economy. BIM will provide a virtual model of materials / resources and associated locations within the road network and as such will support the efficiency use, maintenance and movement of materials and resources throughout the lifecycle of road infrastructure. BIMS is currently scheduled to become ‘business as usual’ within the next four years.

A task group should be established to work cross-functionally to identify appropriate data collection opportunities. Data will be collected over time, and data collection needs and methods may change over time. The task group should keep the data collection methods and requirements under regular on-going review.

### **Base Lining and Alerts**

An initial broad data set will enable the establishment of a baseline representing “normal” performance. Deviation from the “normal” will trigger an alert, and alerts should be monitored by the steering group. With the implementation of the change process, “normal” performance can be amended over time to reflect the way the organisation is developing. Baselining data sets should include behavioural change elements, such as:

- 1) Number, type and target audience for communications issued in the last 12 months mentioning the circular economy;
- 2) Number of specifications issued encouraging innovative solutions (e.g. specification of services rather than products);
- 3) Number of innovative solutions implemented and captured as case studies;
- 4) Training and awareness raising events; and
- 5) Number of entries for internal / external awards mentioning circular economy.

### **Reporting and Analysis**

Project level reporting via a balanced scorecard approach should be a key element of the steering group quarterly meetings, providing analysis of performance against target, to identify any opportunities for change and improvement. Actions arising from the report(s) need agreement, along with defined timescales for completing and feeding back on individual actions. The steering committee needs to understand pre-existing datasets, what reports are generated from existing data, and how existing data can be used to provide metrics to measure CE performance. Once the existing data is understood, the steering committee can define what a balanced scorecard looks like for CE. This is as a key first task for the steering committee.

## Communication

The balanced scorecard approach will enable communication to be tailored to the needs of the various stakeholder groups. The steering group should include, or have access to communications team individual(s) who are able to develop and manage the draft communications plan (see Communications Plan below) to feedback on results, processes and opportunities.

In order to drive the Routemap forward, the following actions are recommended:

- 1) Identify a key individual to drive the monitoring and reporting focus area. This individual should be a member of the steering group;
- 2) Establish a task group to identify appropriate existing Highways England tools that can be used to develop auditable outputs for the Routemap, and to establish data collection opportunities cross-functionally, (e.g. individuals from the Asset Information Group and BIM taskforce);
- 3) Review existing initiatives and projects aimed at resource efficiency (e.g. PRINCE 2 procurement process gateways 'D' and 'E') to capture best practice, learn from best practice, demonstrate lessons learnt, materials reused / saved, and identify further Pathfinder projects e.g. Lower Thames Crossing (LEAN) and the A47 (adoption of a natural capital approach); and
- 4) Create a balanced scorecard for implementation of circular economy at project level and use the scorecard to inform performance monitoring, along with other business processes such as procurement for the particular project, to ensure KPIs are agreed at project outset. Review progress regularly with a major review at the end of the first 12 month implementation period and revise / refine the Routemap accordingly.

## Tools and Guidance

Feedback from the January 2016 workshop clearly demonstrated the need for a range of tools and guidance to support the move to a circular economy approach. Some current Highways England standards and procedures were identified as barriers for suppliers and for innovation in particular. Subsequent discussion with Highways England identified the following considerations:

### a) Procurement Context

As a public procurer for the motorway and trunk road network, all products used by Highways England (including our designers and anyone working for us) have to meet the essential characteristics of the harmonised standards where they exist. If a product falls within the scope of a harmonised standard, Highways England can only specify in terms of essential characteristics and accept products that have a CE mark meeting Highways England's requirements.

Highways England, as a research procurer, can procure anything in the name of research. It is, however, limited by the research section of its Licence and the Highways Act on the public highway, manufacturers are limited in what they can offer Highways England by CE Marking and 'making available on the market'. Even if the research is 'successful', Highways England cannot

preferentially promote an innovative product from 'research' to the 'public procurer', or change requirements in such a way as to preferentially select the innovative product.

The Constructor is free to choose products that meet Highways England's specified requirements (essential characteristics). However, Highways England is not permitted to add additional requirements which might direct the Constructor to a specific product or product family.

b) Issues and Opportunities

- 1) Highways England is perceived to be risk averse and this may stifle innovation. Suppliers are required to take on board risks associated with use of innovative materials. The recently published Highways England Innovation Strategy (2016f) exists to facilitate innovation.
- 2) There may be opportunities to facilitate innovation through the use of performance led specification based on the essential characteristics. Standards should be based on project specific performance requirements rather than use of default specifications. Low temperature asphalt with high recycled content, for example, could be used where it meets the applicable performance specification.
- 3) The HD22 Geotechnics process exists to provide a robust technical framework to ensure that project designs comply with existing group conditions, it is however, limited in scope and is not aligned with the identification of reuse opportunities;
- 4) The NDD value management process is used to apportion funding between projects on the basis of scores against defined criteria. this process can favour low risk projects, thereby acting as a barrier to innovation;
- 5) Technical specialists such as the Pavement Specialists may not be involved in projects at an sufficiently early stage to optimise their influence on the design and specification; and
- 6) Projects may be subject to a statutory requirement to inform the Local Planning Officer of their plans in order to facilitate regional resource planning, but it is common practice for Highways England Geotechnical Advisors not to do this - i.e. there is a cultural barrier. The Highways England Geotechnical Advisor currently does not generally talk to local authorities on this matter. The design team should inform the local mineral planning authority of significant material requirements.

Stakeholders reported that historically, even when it has been agreed that standards need to change, changes were frequently slow to be implemented, this deters suppliers from innovating, because they feel there is too high a risk involved in moving outside currently agreed standards.

A key member of the steering group needs to be an individual who will focus on the development of tools and guidance. This individual needs to be able to work effectively cross-functionally to develop and, critically, to communicate the development of tools and guidance internally and externally, to monitor the use of the tools and to provide feedback for on-going development.

There is a need to work closely with designers to ensure that they are involved from an early stage of projects to help inform decisions in order to design product / assets better aligned with the principals of circular economy. Understanding the asset is vital to identifying replacement timescales and therefore decisions for future procurement. It is anticipated that development

and application of BIM and a balanced score card will allowing a structured approach to whole life costing through consideration of a range of factors , including health and safety, financial costs and sustainability benefits including durability and opportunities for reuse.

Highways England has a range of existing tools and guidance materials. The initial workstream for this area should focus on identifying these, including how they are used (which could differ by functionality, team and/or stakeholder group), fitness for purpose (both existing and any change(s) as the circular economy process develops), gap analysis and development need. Once this basic information understanding is established, a plan can be created for updates, new developments, communications and training.

Communication is a key workstream element. A draft communications plan is in development (see Communications Plan below), which will form the basis for this workstream.

A range of communications tools and methods will be required, and should be discussed and agreed at steering group level. Consistently worded internal and external communications will build confidence that the aims and objectives of the change process are possible, and will reinforce that this is not a new concept through the progress Highways England has already made towards its goal (e.g. Pathfinder Project summaries, such as the A14 Project, Appendix E).

Along with standard communications methods such as reports, posters, emails, webpages, etc., alternative methods should also be used, such as the introduction of internal awards. Such awards could be used to highlight best practice which will encourage and reward the development of desired behaviours.

The following actions are recommended:

- 1) Identify a key individual to drive the tools and guidance focus area. This individual should be a member of the steering group;
- 2) Identify a key individual to drive communications. This individual should be a member of the steering group;
- 3) Establish a task group to review existing tools and guidance to establish those fit for purpose, or requiring revision;
- 4) Development of internal training for the effective use of existing and new tools and guidance;
- 5) Development of case studies demonstrating the successful adoption of circular economy;
- 6) Identification of Pathfinder Projects and use of these to develop and document the implementation of circular economy. Document successes and analyse / learn from aspects that didn't work as well as they might. Use this information to inform future projects and the review / revision of Tools and Guidance; and
- 7) Development of a communications plan for internal and external communications – including identification of benefits (Tools & Guidance).

## 7 Development of the Implementation Plan

Aligned to the critical path, an implementation plan with SMART objectives and auditable outcomes for the first year (to enable accountability) should be developed, implemented and reviewed on a regular basis by the steering group. The implementation plan needs to identify existing components for integration as business as usual, using existing components where possible rather than duplicating systems. The plan is represented pictorially in the Routemap (Appendix A). A Circular Economy Manifesto and draft Terms of Reference for the Circular Economy Steering Group has been prepared, and is provided in Appendix B.

Governance		
Delivery Manager	Circular Economy Delivery Manager identified and in place	May – June 2016
Steering Group	Steering Group Identified, purpose and responsibilities agreed, meeting schedule arranged and implemented	May - June 2016
Review Schedule	Quarterly review Schedule agreed	June 2016
	First Quarterly Review	June 2016
Metrics	Agreement of which defined metrics can be measured for first 12 months	June 2016
	The list should include hard metrics e.g. greenhouse gas emissions, tonnage of materials used, etc.	
	The list should include soft metrics e.g. behavioural change, engagement internally and with stakeholders, collaboration successes interdepartmentally and across functions	
	Metrics should be linked to the consideration of opportunities to increase durability, reuse, repair, refurbish, remanufacture, retrieve, recycle, restore etc.	
Working Groups	Working Groups tasked to address governance requirements	June 2016
	Identification of key relationships between departments / functions	May 2016
	Identification of interactions with existing Highways England initiatives, such as resource efficiency and revenue generation through materials sales	June 2016
	Review of process and structure to assess barriers to Route map implementation	June 2016
	Identification of cost saving / benefit objectives by June 2016 for development into WLC approach and measurement metrics;	June 2016
	Development of balanced scorecard approach for assessing procurement approach and overall project delivery to measure metrics	June 2016
Procurement		
Lead	Procurement lead for steering group identified and engaged	May – June 2016
Assessment	Assessment of what resources can be made available for procurement initiatives	June 2016
Working Groups	Procurement task groups agreed, objectives and outcomes defined, and initiated	June 2016

<b>Monitoring &amp; Reporting:</b>		
Lead	Monitoring and reporting lead for steering group identified and engaged	May – June 2016
Working Groups	Monitoring and reporting task groups agreed, objectives and outcomes defined, and initiated	June 2016
Balanced Scorecard	Balanced scorecard draft agreed for future development	June 2016
<b>Tools and Guidance</b>		
Lead	Tools and guidance lead for steering group identified and engaged	May - June 2016
Communications	Communications lead for steering group identified and engaged	May – June 2016
	Communications plan draft agreed for future development	June 2016
Assessment	Assessment of what resources can be made available for communications initiatives	June 2016
Working Groups	Tools and guidance task groups agreed, objectives and outcomes defined, and initiate	June 2016

## 8 Communications Plan

The development and implementation of a Communications Plan is a key tool for delivery of circular economy outcomes which needs to be led by the steering committee and delivered through the communications working group. A range of communications tools and methods are required to disseminate information both internally and externally. Different stakeholders will have different roles to play and it is important that each stakeholder fully understands what is required of them and also the benefits associated with delivery of the strategy.

The objectives of the communications plan are:

- 1) To embed a culture of the circular economy across Highways England;
- 2) To develop a consistent approach that will include sustainability in policy, procurement, and project delivery; and
- 3) To provide a framework for training and development.

The first element of designing the plan will be to define which stakeholder groups to communicate with, the nature of engagement, and the stakeholder-specific messaging required to enable effective communication with all groups. Stakeholder target groups will vary depending upon the message to be disseminated, and could include:

- 1) Employees – current and potential;
- 2) Internal departments – such as Procurement, and Information Management;
- 3) Clients / Sponsors – Cabinet office, DEFRA, Environment Agency;
- 4) Contractors – existing and potential;
- 5) Suppliers - existing and potential;
- 6) External groups / Professional bodies - Chartered Institute of Procurement and Supply (CIPS), Crown Commercial Service, MI-ROG;
- 7) Regulators - HSE, Environment Agency, English Nature; and
- 8) Local community groups.

Communications will need to balance and achieve consistent messages through the right communications channels to reach all stakeholders but will also need to reflect that the nature of engagement will be variable. Different stakeholder groups will have different levels of involvement. This means some stakeholders will need to be consulted to gain buy-in and support for a particular project while others will be informed of changes and the impact of changes. A stakeholder map can help to identify target stakeholders (internal and external) with a vested interest in individual schemes and projects, what their likely areas of interest are and how Highways England should communicate with them.

Work on a communications plan for the project is underway. The communications plan will contain detail on: audiences, key, secondary and audience specific messages, communication activities and channels, communication milestones and measuring the success of communications. The communications plan is owned by Gerry Bagnall, Communications Business Partner and Simon Baldry and Paul Marshal, Sustainability Team.

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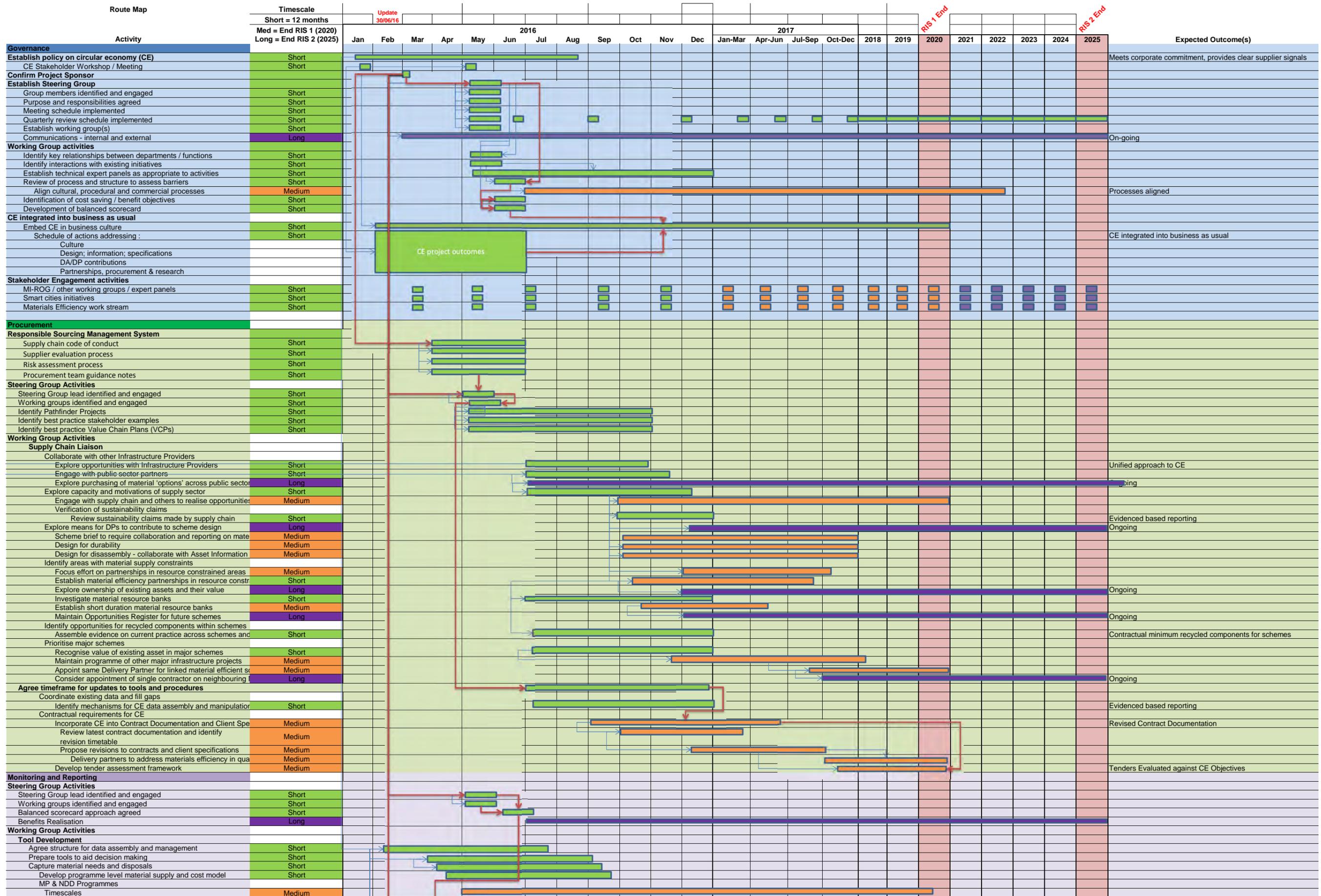
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**Appendix A - The Routemap**





## In Support of the Routemap

The Road Investment Strategy (RIS) outlines a significant increase in capital investment on the road network and a much increased maintenance and renewals programme. To deliver this scale of investment will require major increases in human, plant and material resources.

This increased activity raises pressure on availability of, and competition for, resources (primarily materials, plant and people). This heightens supply chain risk and material criticality and the need to ensure security of supply for delivery of Highways England performance requirements.

Highways England recognises these and other drivers for the circular economy, including: national and international legislation, safety, financial benefits, the need for innovation and the development of low carbon infrastructure. A move to a circular economy will also address failures in the wider economy, however, Highways England cannot move to a circular economy in isolation, collaboration with other stakeholders is vital for success.

Successful implementation of a corporate circular economy plan and this Routemap will be a significant element of Highways England’s approach to achieving resource security and resilience within the overall context of sustainable development, and will help build a culture of resource efficiency and effectiveness across the organisation.

Implementation will allow Highways England to contribute to economic growth while de-coupling from resource extraction. Measures to incorporate a circular economy approach at Highways England will, in part, mitigate some of the supply chain risks currently being faced. The overall aim is to inform the approach to achieving security of supply of the resources needed to deliver the Road Investment Strategy (RIS) and to minimise risks in Highways England’s supply chain, and to make our contribution to economic growth while de-coupling from resource extraction.

### Key Drivers in Support of the Routemap

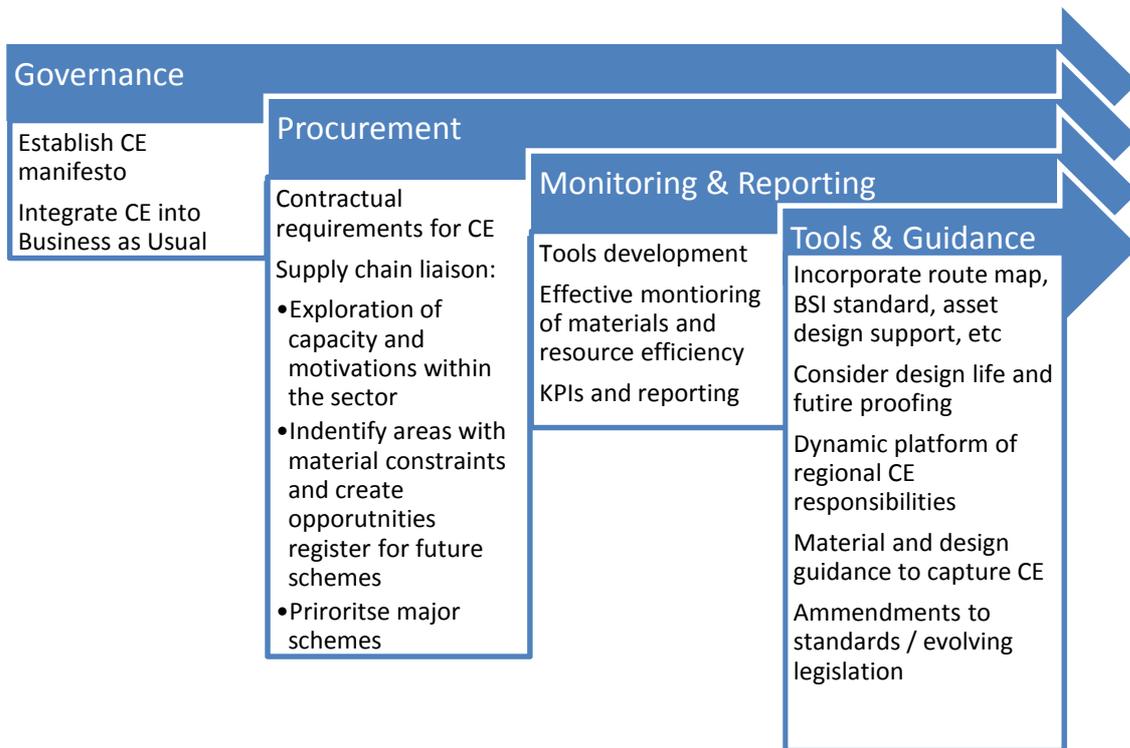
	<b>RIS</b> – outlining a significant increase in capital investment on the roads network
	<b>Highways England’s licence to operate</b> – putting sustainable development into action - as ‘encouraging economic growth while protecting the environment and improving safety and quality of life for current and future generations’
	<b>Highways England’s Sustainable Development Strategy</b> - a corporate commitment to the circular economy, encompassing both road infrastructure and offices

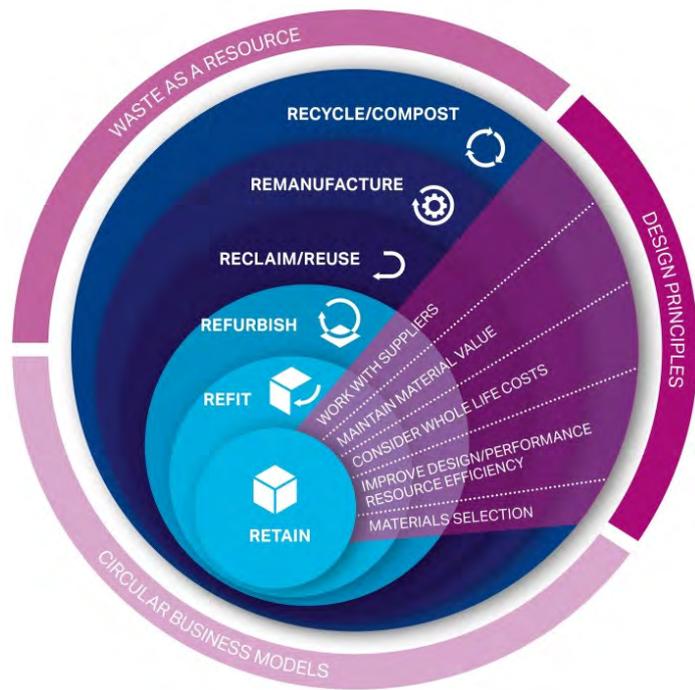
### Key Elements of the CE Plan

	<b>An Implementation Plan</b> - aligned to the critical path, an implementation plan with SMART objectives and auditable outcomes for the first year (to enable accountability) to be developed, implemented and reviewed on a regular basis by the Circular Economy Steering Group
	<b>Actions for driving the Routemap</b> <ul style="list-style-type: none"> <li>• Identify key people to drive the process – a Steering Group Committee</li> <li>• Use working groups to agree on areas of focus</li> <li>• Identify and document Pathfinder projects</li> <li>• Document opportunities, successes and failures</li> </ul>

	<ul style="list-style-type: none"> <li>• Identify stakeholders and best practice amongst stakeholders</li> <li>• Investigate collaborative performance frameworks with stakeholders</li> <li>• Identify and define timescales for implanting change to existing tools</li> </ul>
	<p><b>Communications</b></p> <ul style="list-style-type: none"> <li>• To embed a culture of the circular economy across Highways England;</li> <li>• To develop a consistent approach that will include sustainability in policy, procurement, and project delivery; and</li> <li>• To provide a framework for training and development.</li> </ul>

**Routemap Focus on 4 Key Areas:**





Circularity for Highways England - based on 'Building Revolutions' (RIBA, 2016)

### Actions to drive the Routemap forward:

#### Governance:

1. Establish an internal steering group to take ownership of the Routemap governance, delivery and development;
2. Identify the business critical path and associated timeline for the Routemap. The focus for the approach needs to be on the first 12 months with recommendation for review and revision after 12 months; and
3. Establish a technical panel of external specialists and stakeholders willing to work with the steering group.

#### Procurement:

1. Agree focus areas key areas;
2. Identify 'Pathfinder Projects' and document opportunities and successes identified and realised, including safety, fiscal and sustainability benefits;
3. Identify stakeholder groups and best practice among them;
4. Investigate how Collaborative Performance Frameworks (with stakeholders) could be developed and implemented; and
5. Identify and define timescale for implementation of necessary changes to existing tools and procedures.

#### Monitoring and Reporting:

1. Establish a task group to identify appropriate existing Highways England tools that can be used to develop auditable outputs for the Routemap, and to establish data collection opportunities cross-functionally;

2. Review existing initiatives and projects aimed at resource to capture and learn from best practice; and
3. Create a balanced scorecard for implementation of circular economy at project level and use the scorecard to inform performance monitoring.

**Tools and Guidance:**

1. Development of internal training for the effective use of existing and new tools and guidance;
2. Development of case studies demonstrating the successful adoption of circular economy;
3. Identify of Pathfinder Projects and use these to develop and document the implementation of circular economy; and
4. Development of a communications plan for internal and external communications – including identification of benefits.

**Implementation Plan**

Aligned to the critical path in the Routemap Gantt chart, an implementation plan with SMART objectives and auditable outcomes for the first year (to enable accountability) should be developed, implemented and reviewed on a regular basis by the steering group. The implementation plan needs to identify existing components for integration as business as usual, using existing components where possible rather than duplicating systems.

<b>Governance</b>		
Delivery Manager	Circular Economy Delivery Manager identified and in place	May – June 2016
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	First Quarterly Review	June 2016
Metrics	Agreement of which defined metrics can be measured for first 12 months	June 2016
	The list should include hard metrics e.g. greenhouse gas emissions, tonnage of materials used, etc.	
	The list should include soft metrics e.g. behavioural change, engagement internally and with stakeholders, collaboration successes interdepartmentally and across functions	
	Metrics should be linked to the consideration of opportunities to increase durability, reuse, repair, refurbish, remanufacture, retrieve, recycle, restore etc.	
Working Groups	Working Groups tasked to address governance requirements	June 2016
	Identification of key relationships between departments / functions	May 2016
	Identification of interactions with existing Highways England initiatives, such as resource efficiency and revenue	June 2016

	generation through materials sales	
	Review of process and structure to assess barriers to Route map implementation	June 2016
	Identification of cost saving / benefit objectives by June 2016 for development into WLC approach and measurement metrics;	June 2016
	Development of balanced scorecard approach for assessing procurement approach and overall project delivery to measure metrics	June 2016
<b>Procurement</b>		
Lead	Procurement lead for steering group identified and engaged	May – June 2016
Assessment	Assessment of what resources can be made available for procurement initiatives	June 2016
Working Groups	Procurement task groups agreed, objectives and outcomes defined, and initiated	June 2016
<b>Monitoring &amp; Reporting:</b>		
Lead	Monitoring and reporting lead for steering group identified and engaged	May – June 2016
Working Groups	Monitoring and reporting task groups agreed, objectives and outcomes defined, and initiated	June 2016
Balanced Scorecard	Balanced scorecard draft agreed for future development	June 2016
<b>Tools and Guidance</b>		
Lead	Tools and guidance lead for steering group identified and engaged	May - June 2016
Communications	Communications lead for steering group identified and engaged	May – June 2016
	Communications plan draft agreed for future development	June 2016
Assessment	Assessment of what resources can be made available for communications initiatives	June 2016
Working Groups	Tools and guidance task groups agreed, objectives and outcomes defined, and initiate	June 2016

## **Appendix B – Circular Economy Manifesto and Draft Terms of Reference**

## Circular Economy – Our Approach

### **Ambition**

To create an environment in the roads infrastructure sector that supports innovation and stimulates a circular economy in the use of materials and plant, and works fairly and equitably for people at all levels in our supply chain. To support delivery of the Roads Investment Strategy, re-thinking value; designing for longevity and ease of repair and replacement, striving for ever greater efficiency and effectiveness in the use of resources.

### **Principles**

We will:

1. Encourage people both within Highways England and across our supply chain to think differently about resources - whether that be in major civil engineering projects, maintenance, operations or within our office environment;
2. Design for longevity of our assets through increased durability, ease of inspection and maintenance and flexibility of use, to allow future upgrading as an alternative to replacement;
3. Improve the efficiency of our resource use including natural resources, capital and people. Seek opportunities to 'design out waste' and increase asset efficiency. Use asset data to enhance maintenance regimes;
4. Design assets and components for ease of remanufacture or recycling at end of useful life, by reducing cross contamination of materials and avoidance, where practical, of elements hazardous to human health or the environment;
5. Look for and implement opportunities to ensure delivery to our customers through services not assets. For example delivery of travel information direct to vehicles without the use of hard infrastructure like gantries;
6. Step up our use of innovative approaches such as offsite manufacture and 3D printing and to take a wider view on how to contribute to mobility for people and goods. See also Innovation strategy;
7. Contribute to enhancing local ecosystems and regeneration of the biosphere. Increase our use of renewable energy on the network;
8. Collaborate widely with our suppliers, academics, and other interested parties to improve our work practices and circular approach;
9. Source materials responsibly that meet defined ethical and environmental standards (See Responsible Sourcing – Code of Conduct); and
10. Embrace diversity in suppliers, partners and methods to encourage adaptive behaviour and generate innovation.

## Terms of Reference: Circular Economy Steering Group

**Purpose:** To give a strategic steer to implementation of the Circular Economy Plan and oversee delivery of the routemap and development of tools for the business to aid the transition.

**Frequency :** Quarterly

**Review purpose:** Annual review of progress and identification of priority actions

**Attendees:**

**Responsibilities:**

**Roles:**

**Inputs**

TBA

Strategic co-ordination and collaboration to promote circular economy as a means to delivery of business needs

Oversee development of tools to aid the business transition to circularity

Advise on communications strategies to ensure wider understanding of circular economy

Chair : TBA  
V Chair: TBA  
Scribe: TBA

- Programme and pipeline (both quantities and value)
- Lesson Learnt from both business and supply chain and examples of success.
- Early warning of risk and opportunities
- Supply chain feedback
- Intelligence on planned developments
- Engagement on supply chain performance

**By Invite representative from Suppliers; Infrastructure companies, cities, HE Business areas**

**Quorum:**

N/A

**Scope:**

- Understanding of overall business requirement for the supply of materials to deliver the Agency's Programme.
- Development of stakeholder communications by building collaborative relationships.
- Engage with colleagues to raise awareness of circular economy and explore benefits to be realised.
- Explore benefits of untapped opportunities.
- Identify potential blocker and instruct PTS to investigate
- Establish a forward focus on the future supply chain delivery solutions. Encourage innovation
- Take lead in identifying potential metrics to be used as indicators of progress
- Define roles of Delivery manager and Technical advisor

**Expectations:**

Collaboration  
Start and finish on time  
Follow agenda  
Come prepared having read relevant paperwork  
Actions completed

**Outputs:**

- Strategic guidance on future CE application
- Provide guidance to the business on the best usage of CE.
- Translation of CE lesson learnt to best practise within projects/programmes.
- Give the business/supply chain a better understanding circular economy issues from an infrastructure perspective.

**Code**

Collective ownership  
Solution focused  
Open and honest  
Co-operative and collaborative

**Outcome/Impact**

- Better visibility programme and pipeline (both quantities and value)
- Applications of lesson learnt from both business and supply chain.
- CE risk and opportunities embraced within projects
- Supply chain feedback
- Greater visibility resource criticality issues.

## Appendix C - Not Used

## Appendix D – Alternative Definitions of Circular Economy

The following definitions of circular economy were identified by preliminary research to support project delivery during Q4 2015.

“A circular economy is one that is restorative by design, and which aims to keep products, components and materials at their highest utility and value, at all times.” (Ellen MacArthur Foundation, 2013)

“The concept of the ‘circular economy’ is grounded in the study of non-linear systems and encompasses more than the production and consumption of goods and services, including a shift from fossil fuels to the use of renewable energy, and the role of diversity as a characteristic of resilient and productive systems.” (BSI, 2014)

“A circular economy is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life.” (Wrap, 2015)

“A circular economy should see a departure from the current “take, make and dispose” approach that underlines much of modern civilisation. Instead, in the circular economy model, durable goods would be designed so that they could be repaired rather than replaced and biological materials would be managed so that they could be returned to the biosphere without contamination.” (Financial Times)

BSI is currently developing a new standard which encompasses the circular economy and combines all separate standards that allude to the circular economy. This is expected to be completed in Q3 2016. The current definition in the draft standard is “a systemic approach to the design of business models, enabling the sustainable management of resources in products and services” (BSI, 2015).

The common theme to all of these definitions is the movement away from a linear system towards a circular system where materials are recovered and recycled at the end of the product life. There is the acknowledgement that design is important in making sure products are durable and that the materials can be recovered. The materials that are returned to the natural system should do so with minimum contamination. Materials aren’t confined to physical resources but also resources, like energy, that may be required to make them (Environmental Science, 2015).

## Appendix E – A14 Pathfinder Project

### Adoption of the Circular Economy by Highways England's A14 Cambridge to Huntingdon Improvement Scheme

#### Background and Objective

The A14 Cambridge to Huntingdon improvement scheme (the A14 scheme) is a £1.5 billion project to upgrade the strategic route between Ellington, to the west of Huntingdon, and Milton, in the north-east of Cambridge. The A14 scheme will relieve congestion, unlock growth and help to connect communities.

The A14 is one of the most heavily-trafficked trunk roads in the United Kingdom and provides a strategic link between the Midlands and East Anglia. It is part of the Trans-European Network and is a gateway to the East Coast ports of Felixstowe, Ipswich and Harwich. Congestion on the section of the route between Huntingdon and Cambridge causes delays to strategic through-traffic and is a constraint to economic development in the Cambridgeshire region.

The existing trunk road infrastructure between Cambridge and Huntingdon is now forty years old, does not meet present-day design standards, and has insufficient capacity to cope with either existing or predicted traffic flows. Around 85,000 vehicles a day use this section of road, with a quarter of that traffic comprising heavy goods vehicles. Congestion and delays occur daily and there are around a dozen lane or carriageway closures a week as a result of incidents and accidents.

A Development Consent Order (DCO) application was submitted to the Planning Inspectorate (PINS) in December 2014. The examination period was completed in December 2015 and PINS' recommendation made in Jan 2016. The DCO was granted on the 11th May 2016 and construction of the A14 scheme is expected to start in the summer 2016. The Project has an Integrated Delivery Team (IDT) of Highways England, contractor and designer. Project mobilisation commenced in 2015 with activities including planning and earthworks strategy, detailed design continue through 2016.

This is the first project in which Highways England have worked with partners throughout the supply chain to implement a Circular Economy (CE) approach. However, other than this overarching vision, very few if any, of the individual initiatives adopted are unique or new to the project. Circular Economy is a natural progression from other pre-existing practices such as, resource efficiency, revenue generation through material sales, reducing waste disposal to landfill, responsible (sustainable) sourcing and reducing greenhouse gas emissions. Project level adoption of the circular economy began overtly at the Detailed Design Phase and has broadly followed the Ellen MacArthur Foundation RESOLVE framework with opportunities for circularity identified by stakeholders including: the Highways England Environmental Advisors, Highways England Supply Chain Manager and construction sub-contractors.

This summary was produced (Q1 2016 and updated Q2 2016) to identify and summarise aspects of the project aligned with the Circular Economy in order to document the approaches adopted to implement CE and the key opportunities identified. It is intended that this summary will help the future adoption of CE across other Highways England projects and thereby support progress from 'project' to 'programme'.

## Implementation of the Circular Economy Approach

Project planning included high level and early consideration of resource (including people and plant) requirements and potential sources in order to establish how to make the best use of resources, including materials, energy and water, over the lifetime of the project.

The best opportunities for improving resource efficiency in construction projects occur during the design stage. Implementing these opportunities can provide significant reductions in cost, waste and carbon.<sup>3</sup>

The key steps within the A14 scheme development through which the circular economy approach has been implemented into the early stages of scheme development are:

1. The **CEQUAL Assessment**, which includes assessment criteria (REAC Item G1, M4 and M6) that were addressed through a detailed design phase 'Design for Resource Efficiency Workshop'.<sup>4</sup>
2. The **Design for Resource Efficiency Workshop** (November 2015) brought together IDT technical leads including: CEEQUAL, air quality, environment, carbon, Product Design / Innovation, drainage, geotechnics, ITS technology innovation, lighting, traffic modelling, materials and pavement and lean and focussed on the identification and prioritisation of resource efficiency opportunities. Opportunities considered to have the greatest potential impact and also to be relatively easy to implement, 'Category A opportunities', were prioritised for further investigation and potential incorporation into the project. Other opportunities, not currently considered a priority for this project, will be reviewed from time-to-time by the action holder(s) to check whether changes to the scheme increase their potential for consideration. All opportunities identified have been documented for further consideration in the wider CE agenda through Highways England's forthcoming Value Chain Plan.

Category A opportunity, action holders will further assess viability through consideration of cost, programme, 'buildability', compliance with Highways England standards, Development Consent Order limits, CDM, clash detection, impact on design concept etc. and report on progress at a future Design Team Meeting. Design, Planning, Construction, Commercial and Project Director approval of any viable design changes will be required before opportunities are embedded in the detailed design.

3. Development of an **Integrated Delivery Team (IDT) Earthworks Strategy** to aid the planning and costing process, mass haul and construction logistics planning. A significant element of the Strategy is to maximise the use of the available granular materials (sands, gravels /aggregates) sourced from the borrow pits as engineered products delivering significant commercial and environmental benefits, whilst having no detrimental effect on the cut/fill earthworks operations. This strategy is supported by a report (November 2015) including:

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<sup>3</sup> WRAP, <http://www.wrap.org.uk/content/designing-resource-efficiency>

<sup>4</sup> CEEQUAL is the evidence-based sustainability assessment, rating and awards scheme for civil engineering, infrastructure, landscaping and public realm projects. CEEQUAL promote and celebrate the achievement of high environmental and social performance. CEEQUAL helps to deliver improved project specification, design and construction of civil engineering works by encouraging project or contract teams to consider sustainability issues at the most appropriate time throughout project development, design and construction.

<http://www.ceequal.com/>

- The main earthworks quantities and earthworks balances and the information and assumptions used to prepare them;
- A detailed analysis of earthworks movements linked to the construction programme, resource requirements and temporary works;
- Details of borrow pit dewatering and excavation sequences; and
- Proposals to maximise the use of the gravels from the borrow pits to the best overall commercial and environmental benefit of the project.

The report will also inform the Benefits Business Case for the proposed strategy.

Development of the final earthworks delivery strategy will be an iterative process and regular updates will be required as the design progresses and earthworks quantities change.

4. Following receipt of the **Notice to Proceed**, the A14 project will continue to hold quarterly meetings to raise visibility and identify transferable 'best practice' in the application of Highway's England's forthcoming Route Map for the Circular Economy' to the A14 scheme.

## Potential Opportunities and Initiatives for Circular Economy

The following general considerations are noted at this early stage of project delivery:

- Adoption of CE opportunities is closely linked to the financial efficiency of the project;
- The project is likely to be a net importer of construction and demolition waste. Material supply is currently driven by the market (i.e. cost). Highways England must be willing to pay more in the short-term where this is justified by whole life costing. At this point it is difficult to plan in great detail as markets are dynamic;
- The IDT will focus on getting the best value from materials through consideration of longevity, best value and resource efficiency;
- The IDT will consider opportunities to reduce resource requirements by changing specification and value engineering (e.g. refining designs to flatten slopes / reduce volumes);
- The IDT will take a structured approach to the consideration and planning and management of recycling centres to facilitate reuse of road pavements and redundant foundations; and
- The IDT will consider the use of compounds for temporary storage and processing of materials to facilitate their beneficial reuse. Potential to work with local contractors and develop infrastructure that will extend beyond the life of the project noting the planning implications of temporary / permanent facilities.

The Design for Resource Efficiency Workshop identified multiple opportunities in each of the five WRAP resource efficiency categories:

1. Design for Reuse and Recovery
  - Utilisation of recycled aggregate material from demolition / excavation
  - Utilisation of recycled / secondary materials in the current earthworks strategy
  - Recycle concrete from demolished structures in project earthworks, drainage trenches, pavement layers etc.
2. Design for Off Site Construction
  - Use of prefabricated reinforcement cages to assist in the modular construction of structural elements on-site

3. Design for Resource Optimisation;
  - Use of railhead for materials import, reducing HGV impact and transport related carbon emissions
  - Use of borrow pits for selected fills, construction aggregates, pavement aggregates and concrete aggregates
4. Design for Resource Efficient Procurement ;
  - Consider setting project targets covering (sustainability) - these targets should form part of the tender process for suppliers, e.g. beam suppliers to provide evidence of reduced material and energy usage
  - Consider a take-back development arrangement with suppliers; negotiate a take back arrangement with the supplier for unused materials; all packaging and pallets to be collected by suppliers
5. Design for the Future
  - Review TD 34/07 to allow for use of LED lighting; use of 25 year life luminaires or reducing the amount needed; and use of modular LED luminaires components to allow replacement of sections rather than complete luminaires

Other Associated Initiatives include:

- Strategic relationships (to support supply security) with other major infrastructure projects e.g. Network Rail which is currently supplying Highways England via third parties. Network Rail may also be able to help move materials via its network;
- Review of competition for resource from, and opportunities to work with, the wider construction economy e.g. other major construction projects;
- CL:AIRE;<sup>5</sup>
- MI-ROG;<sup>6</sup> and
- HE's role to develop local capability and capacity by working with local skills agencies such as West Anglian Training Agency by align training centres with major projects.

Broader Highways England initiatives supporting the circular economy for the A14 project include:

- Efficiency Targets;
- Operations Directorate (OD) is currently developing a forward programme which will facilitate planning of material flows between projects / areas and the identification of synergies within the OD programme through consideration of project location, timing and resource requirements;
- Materials matching between OD projects and wider will be supported by the development and adoption of GIS tools. These will include identification of sensitive receptors to allow identification of appropriate transport routes;

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<sup>5</sup> Contaminated Land: Applications in Real Environments (CL:AIRE) is an independent not-for-profit organisation that promotes sustainable remediation of contaminated land and groundwater. <http://www.claire.co.uk/>

<sup>6</sup> The Major Infrastructure–Resource Optimisation Group (MI-ROG) is a forum for the UK's infrastructure operators to collaborate across the circular economy theme and to meet the challenge of delivering major infrastructure in a constrained economy. MI-ROG has inspired and facilitated workflows on asset life cycle, carbon performance, circular economy planning, critical materials availability, materials exchange and sustainable procurement and supply chains.

- HE's Solutions Group holds weekly meetings which include consideration of opportunities to Improve linkage of planned preventative maintenance will help provide a better service to road users;
- Adoption of supply chain strategy focussed on identifying value and recording challenges to / from Highways England systems to support improved delivery of this and future schemes.
- Educating the supply chain to be more resource efficient by raising awareness and pushing for best practice; and
- All Highways England major projects have an associated training academy. Appropriately trained people are recognised as a finite resource. Highways England has a target of 5,000 apprentices by the end of RIS 1.

### References:

Ellen MacArthur Foundation, Delivering the Circular Economy, a toolkit for policy makers. [www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation\\_PolicymakerToolkit.pdf](http://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_PolicymakerToolkit.pdf)

A14 Project Intergraded Delivery Team, A14 Cambridge to Huntingdon Improvements, IDT Earthworks Delivery Strategy – DRAFT 07: 30/11/15

A14 Cambridge to Huntingdon Improvement Scheme, Design for Resource Efficiency Workshop – Summary Report, IDT Environment Team, HA528983-ACJV-EGN-SG\_M&W-RP-C-0001

WRAP, What is Designing for Resource Efficiency? <http://www.wrap.org.uk/content/designing-resource-efficiency>

## Appendix F – Case Studies

The following case studies are provided in this Appendix:

- Caterpillar Remanufacturing;
- Construction Consolidation Centres (WRAP);
- Engineering a new life for Hoo Island (NISP);
- Highways Agency M25 DBFO Widening (Green Construction Board);
- Plastic Hoarding;
- Integrated approach to RE (WRAP);
- Japanese Knotweed;
- Plastic Road Surfaces (VolkerWessels);
- Plastic bottle recycling (RECOUP);
- Tar Bound Planings (WRAP);
- TonerPave (Lexmark); and
- WEEE.



Caterpillar Remanufacturing.

Caterpillar's remanufacturing activity began in 1973, and has since grown to encompass nine locations around the world, employing over 3600 people in a business model with an emphasis on component recovery.

Over the past 40 years, Caterpillar's remanufacturing activity has been improved and expanded; now employing over 3600 people worldwide. Through Cat Reman, the company has been able to increase profit margin whilst still producing components of the highest quality, by replacing products before they break and rebuilding them with a mixture of new and used parts.

The circular economy framework places emphasis on the importance of designing effective products and systems rather than aiming solely for efficiency. Caterpillar have employed this strategy in their own product design, and rather than aiming to use less and less material, increasing amounts of consideration goes into creating a product that is intended to be remanufactured a number of times. In addition, Cat estimate that 35% of their costs lie in overheads, while the majority – 65% – are materials costs. So salvaging materials gives a greater business advantage for the company over their competitors, where goals are often focused on driving down overhead costs.

Caterpillar have a number of examples of this in their product portfolio. One of the most well-known involves an engine block with a removable sleeve in the cylinder bore. When the component is recovered, this material can be removed and replaced to return the engine to as-new performance.

Previous techniques for

remanufacturing engine blocks have

involved re-boring the engine cylinder and using a larger piston, but this can only be done up to three times before the quality of the product is affected. Additive manufacturing is also another option in use – cylinder bores can be resprayed with metal to return them to as-new condition.



In order to intercept products before they break, it is crucial to have consistent knowledge of the condition of the key components. Typically, this is monitored through regular and simplified maintenance process between the dealer and the customer, but Caterpillar are now beginning to make use of digital technology to add a 'Product Link' service to units in the field. This enables the manufacturer to monitor a number of criteria related to the general status of the item, such as fuel levels and potential risks, allowing closer and more detailed tracking of the customer's assets adding value and lowering owning and operating costs while creating a more effective reverse cycle.

In terms of pricing, Caterpillar is able to offer customers significantly lower prices on remanufactured parts when compared to their new products. However, an important part of the

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Pictures and text from the Caterpillar from their website <https://parts.cat.com/en/catcorp/cat-reman-products>

[http://www.ellenmacarthurfoundation.org/case\\_studies/caterpillar](http://www.ellenmacarthurfoundation.org/case_studies/caterpillar)

<http://www.caterpillar.com/en/company/sustainability/remanufacturing.html>



pricing structure of remanufactured components is a core deposit, approximately equal to that of the unit itself. Increasing core recovery rates is a challenge for any manufacturer engaging in remanufacturing activity, so offering an economic incentive to return the component keeps the embodied



energy and materials within the Caterpillar network. This in turn enables Caterpillar to salvage parts from returned cores, driving down remanufacturing costs. True to the definition of remanufacturing, Caterpillar's remanufactured products are rebuilt and tested to the same standards – and sometimes higher – as new products, and are sold with the same warranty.

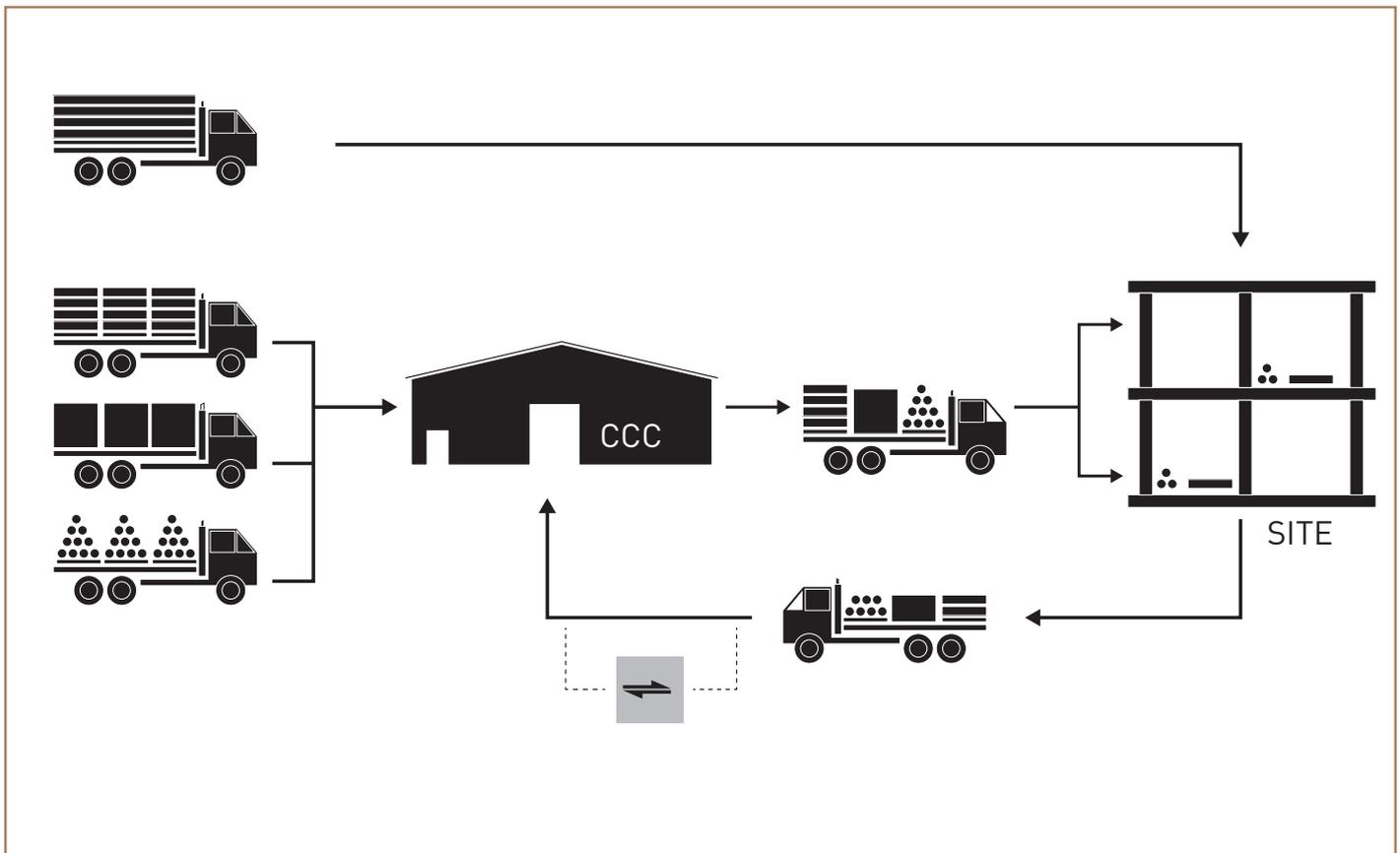
“People think it means washed, painted, repaired, second hand and so on. It's a challenge to convince and educate the consumer that they're getting the same performance at 50-60% of the cost of new” Matt Bulley - EAME Product Manager

- Managing Director

Other than increasing recovery rates for cores, which is a continual opportunity for improvement, one of the key obstacles with the practice of remanufacturing is in the customer understanding and perception of the process and term. This issue exists outside of the heavy machinery industry, and can affect sales due to the misconception that remanufacturing results in inferior quality or performance, or the even safety risks. Caterpillar's brand reputation and offer of a warranty with the product goes some way to overcoming this issue, but there is still widespread misunderstanding and misuse of the term.

All images are © Caterpillar from their website <https://parts.cat.com/en/catcorp/cat-reman-products>  
[http://www.ellenmacarthurfoundation.org/case\\_studies/caterpillar](http://www.ellenmacarthurfoundation.org/case_studies/caterpillar)  
<http://www.caterpillar.com/en/company/sustainability/remanufacturing.html>

# Using Construction Consolidation Centres to reduce construction waste and carbon emissions



A guide demonstrating the costs and benefits of using a Construction Consolidation Centre and how it can reduce waste and carbon

Our vision is a world without waste, where resources are used sustainably.

We work with businesses, individuals and communities to help them reap the benefits of reducing waste, developing sustainable products and using resources in an efficient way.

**Written by:** Greger Lundesjo, The Logistics Business



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**Front cover photography:** An overview of a typical Construction Consolidation Centre process

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# Executive summary

A Construction Consolidation Centre (CCC) is a distribution facility through which material deliveries are channelled to construction sites. The material is handled with appropriate equipment and stored in dry, secure locations. On call off from the site, the CCC operator makes up consolidated loads and delivers them on a Just-In-Time basis. This process is often combined with on-site logistics specialists delivering materials to the point of use and provides an excellent opportunity to improve the overall resource efficiency of a construction project.

## Benefits

The direct benefits of a CCC relate to the reduction in construction traffic both on site and particularly relevant in city centre locations. Traditional transport to construction sites is often uncoordinated, with many separate deliveries and various peaks of congestion at the site. The vehicle utilisation is poor with vehicles often travelling half-empty to site and empty from site, leading to excessive traffic flow and carbon emissions out of proportion to tonnage handled.

The environmental benefits of reducing construction traffic are obvious, i.e. a reduction in congestion, noise, pollution and carbon emissions, while the utilisation of reverse logistics ensures that journeys from site can be used for waste removal, the return of unused material and packaging for reuse and recycling, and the return of pallets and reusable packaging.

In addition to the environmental benefits, fewer and more productive vehicle journeys mean cost savings for main and trade contractors, suppliers and clients, and faster turnaround times benefit the haulier. Several studies also show that the way a CCC enables effective Just-in-time delivery to site leads to waste reduction, productivity improvements and improved programme certainty.

While data varies from project to project, some notable statistics have been:

- a reduction in freight traffic to site by up to 70%;
- increased productivity of site labour by 30 minutes per day leading to a 6% productivity gain; and
- a waste reduction of 7-15% from reduced damage and shrinkage through loss of material.

## Project size

Project size is not necessarily decisive as to whether a CCC should be used or not, so long as there is an ongoing business volume to maintain the operation. The CCCs that were studied varied between 650 m<sup>2</sup> of warehouse space with one warehouse operative, two drivers and an administrator and 10,000 m<sup>2</sup> warehouse space plus yard area. There are, however, advantages in shared user as opposed to single user CCCs; for example, small projects can tap into services that are already in place, the costs of operating a CCC will be spread more efficiently and a permanent operation will allow experience and expertise to develop.

## Location

The locating of CCCs should take into account the proximity of the motorway network and major roads, to both lessen the impact on local roads of incoming deliveries and minimise hauliers' turnaround times. Ideally, a CCC should be situated where a cluster of construction sites can be reached in under 30 minutes' drive time. With these guidelines in mind, we have modelled what coverage could be provided near major population centres throughout the UK.

## The challenge

Currently there are limited examples of CCCs in operation in the UK and despite the benefits, there are a variety of reasons why they are not taken up so readily.

It is normally up to the main contractor to take the decision to use a CCC and to carry the cost. However, it is not only the main contractor who benefits from the use of a CCC. Subcontractors, suppliers and hauliers all benefit, and ways needs to be found to spread the cost among these other participants in line with the savings they make. The fixed cost of setting up one CCC for one site may be prohibitive.

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## 1.0 Introduction

This guidance document has been developed to give construction clients and contractors an overview of when they should consider a Construction Consolidation Centre (CCC) and an indication of some of the costs and benefits associated with opening this. The guidance document is intended to review how the operation of a CCC impacts on a supply chain and typical barriers to setting one up.

The purpose of this guidance document is therefore to raise awareness of opportunities and benefits through the use of a CCC to improve resource efficiency in construction. Previous WRAP studies have looked at resource efficient operations benefitting from effective logistics strategies which are often combined with the use of a CCC.<sup>1</sup> This includes delivery to site and the collection of waste from site.

Included in this document are:

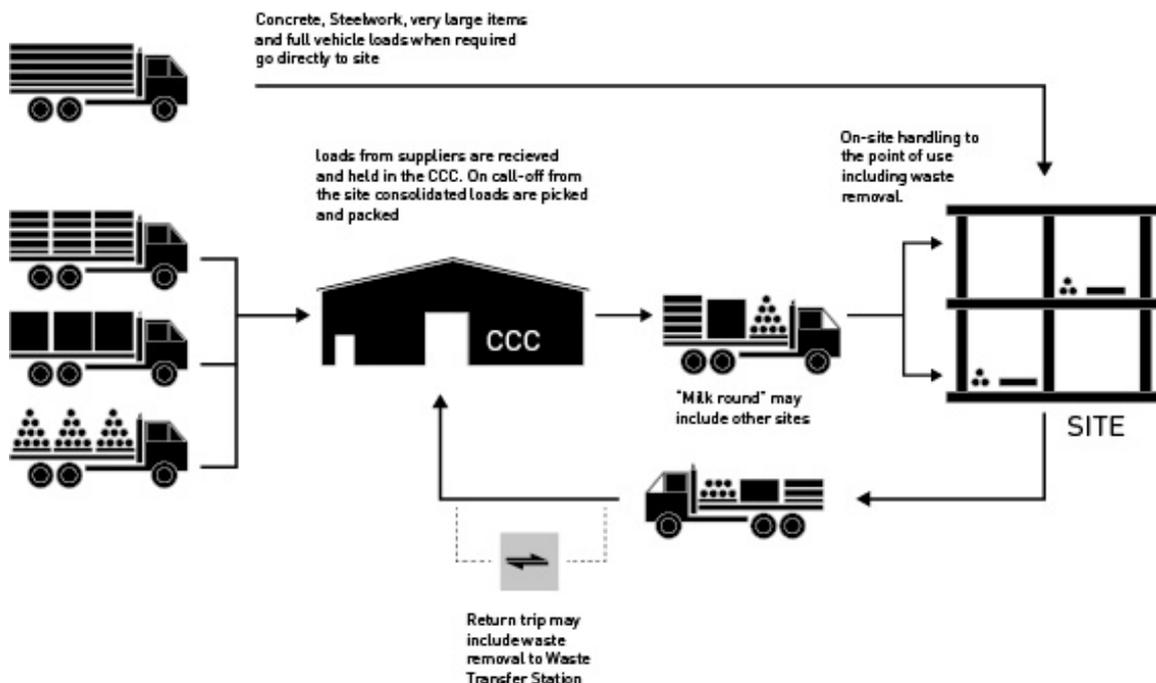
- a summary of a CCC;
- an overview of some current examples of a CCC;
- tangible benefits of using a CCC;
- benefits in terms of which part of the supply chain benefits;
- details on where a CCC could be conveniently located currently; and
- considerations of setting up a CCC.

## 2.0 What is a Construction Consolidation Centre?

Traditional transport to construction sites is often uncoordinated with many separate deliveries and a great risk of congestion at the site entrance and unloading points. Many vehicles travel half-empty to site and empty from site leading to carbon emissions out of proportion to tonnage handled. Alternatively, full loads lead to excessive material stocks on site, which result in a congested work environment and excessive material damage and waste.

A Construction Consolidation Centre (CCC) is a distribution centre through which material deliveries are channelled (see Figure 1). This is a small warehouse equipped for material handling where vehicles can be off-loaded and turned around quickly. Volumes that allow sensible vehicle loading can be accommodated, the exception being very large items such as steel work and heavy plant where a full vehicle load is required and should therefore be taken directly to site.

**Figure 1** The principles of a Construction Consolidation Centre



<sup>1</sup> <http://www.wrap.org.uk/constructionlogistics>

On arrival at the CCC all items are checked and booked in either on a simple spreadsheet or on a Warehouse Management System. The material is handled by appropriate equipment and stored in dry and secure locations, to avoid damage.

Contractors on the site call off material from the CCC. At the CCC operatives pick and make up consolidated loads and deliver to site on a Just-in-time basis. This way full vehicle loads serving several contractors in one delivery can be made up without delivering excessive quantities for any one contractor.

**Figure 2** Off-loading a delivery from the London Construction Consolidation Centre at the Quadrant project in central London



### 3.0 Examples of CCC

The consolidation centre has been used in other sectors for many years such as distribution centres. Within construction, it is a relatively new concept. In 2001 the Heathrow Consolidation Centre (HCC) was set up to serve the ongoing construction work at Heathrow's terminals 1-4. At the same time a well publicised CCC was in operation in Stockholm<sup>2</sup> to support a large residential project called Hammarby Sjöstad. A few years later in 2005 the London Construction Consolidation Centre (LCCC) began operation in Bermondsey, London. The HCC was set up by Mace and continues to be run by

Wilson James for BAA, while the LCCC was created for a pilot study in a partnership between Transport for London, Stanhope PLC, Bovis Lend Lease and Wilson James (who also operated the facility). After the pilot study Wilson James carried on the activity on a commercial basis and it has now relocated to Silvertown just south of City of London Airport.

All these early examples of CCCs were studied in some depth, and generally regarded as successful. The benefits of using a CCC based on these experiences and some other more recent examples will be set out in the following chapter. Following the early, much publicised experiences of CCCs one would have expected strong growth in this approach to construction logistics. To date this has not happened, and in the final chapters of the report some of the reasons for this are discussed.

There are however a number of CCCs currently in operation. For instance, logistics company Wincanton have, at the time of writing this report, three CCCs in operation:

- Greenford - a shared multiuser site with about 60 clients. At the moment it supports three central London construction projects. It is a bonded warehouse and very secure – a critical factor in one of the construction projects.
- Cardiff – also shared user facility, some smaller construction projects
- Portbury near Bristol - also shared user facility, some smaller construction projects

Overall, Wincanton has some 420 locations across the country and the business concept is to use shared facilities rather than have exclusive construction consolidation sites. Wincanton feels that using an existing network is more cost effective than setting up dedicated CC for construction only use. This approach allows them to switch the CC on and off as and when it is required.

Another approach is where a company establishes its own CCC for supporting its own construction projects. This is the approach of house builder Taylor Wimpey.<sup>3</sup> Taylor Wimpey Logistics operates a warehouse facility in Newmarket that consolidates material supply for over 120 sites across England and Wales. This is a similar strategy to that followed by Sainsbury's which is covered in more detail below.

<sup>2</sup> This overview on Freight consolidation centres has Stockholm as one of its studies:  
<http://www.sestran.gov.uk/uploads/Freight%20Consolidation%20Centre%20Study%20-%20Final%20Report.pdf>

<sup>3</sup> <http://www.wrap.org.uk/constructionlogistics>

To illustrate how viable and successful CCCs operate and how they can vary, but also to give an idea of common features, three CCCs are presented below:

	<b>The London CCC, Silvertown</b>	<b>The Nine Elms CCC, London</b>	<b>Sainsbury's consolidation, reuse and recycle centre, Park Royal, London</b>
<b>Operator</b>	Wilson James	MLogic (part of Mace) – Site is owned by DHL.	Sainsbury's in partnership with Fit Out (UK) Ltd
<b>Size and throughput</b>	10,000 m <sup>2</sup> warehouse space plus yard area. 50,000 pallets per year throughput (Pallet equivalent Unit – PEU).	650 m <sup>2</sup> fully secure warehouse area (at peak), including an extra secure caged area contained within. About 6,000 PEUs. Approximately 4,000 bins of 660 litre capacity removed from site in reverse logistics operation, back to CCC from where waste company collects.	6,000 m <sup>2</sup> warehousing space and 1,500 m <sup>2</sup> mezzanine area. Yard area. 12,000 PEUs (first two years of operation).
<b>Staffing</b>	Eight employees; manager, administrator, warehouse operatives and drivers.	Four employees; manager, administrator, one warehouse operative and two drivers.	A manager and a consolidation coordinator. Six warehouse operatives shared with other activities and seven drivers also shared with other activities. Note this is a 24/7 operation.
<b>Vehicles and materials handling at CCC</b>	1x26 tonne flatbed with crane 2x18 tonne flatbed 1x18 tonne curtain sided with tail lift 1xLWB Transit 4xforklift trucks The fleet is regularly adjusted to demand.	1x rigid flatbed lorry 1x18 tonne curtain sided lorry with tail lift 1x large Transit van 1xforklift truck	1x18 tonne curtain sided lorry Articulated lorries hired in as and when required for larger loads 1x forklift truck
<b>Construction projects</b>	The LCCC supports between three and six projects. Current projects include Barts Hospital phase II with Skanska as main contractor and the Quadrant III run by Sir Robert McAlpine.	Single user facility for One Hyde Park where Laing O'Rourke are the main contractor.	Predominantly within the M25 – has now delivered as far afield as Leamington Spa. Has delivered to 29 projects over the first two years' operation.
<b>Comments</b>	It also serves as a London based storage facility for a number of trade contractors.	Only a one-hour delivery slot to site allowed each day – therefore consolidation the only option.	This facility is shared with other Fit Out (UK) activities such as manufacture and delivery of fit out materials. There is also refurbishment (deep cleaning) of refrigeration equipment and serves as a store for returned equipment available for reuse.

**Figure 3** Loading at the LCCC



**Figure 4** Warehouse with racking at Sainsbury's consolidation centre which is operated in partnership with Fit Out (UK) and which also serves as reuse and recycling centre



**Figure 5** The air-conditioned secure area at Nine Elms with caged high-security zone



**4.0 The benefits of using a CCC**

The direct benefits of using CCCs relate to the reduction in construction traffic – and this is the main reason that CCCs have been promoted by authorities as in the case of Transport for London and City of Stockholm. The environmental effects are obvious, i.e. a reduction in congestion, noise pollution and carbon emissions. However, the way a CCC enables effective Just-in-time delivery to site creates a host of other equally important benefits such as waste reduction and productivity improvements that can reduce costs and improve the overall resource efficiency of a project. The table below sets out the areas where CCCs can bring benefits – quantified in many published case studies.

Category	Benefit	Reference
Environmental	Traffic reduction	<p>CCCs successfully reduce traffic in the zones they serve and this is well documented, for instance the LCCC demonstrated the following benefits<sup>4</sup>:</p> <ul style="list-style-type: none"> <li>■ Reduction in the number of construction vehicles entering the City of London and delivering to sites served by the LCCC, of 68%</li> <li>■ Reduction in supply journey times, by going directly to the LCCC rather than driving into the City of London (including loading/unloading time), of an average of two hours</li> <li>■ Achievement of delivery performance of 97% of goods delivered right first time</li> <li>■ Reduction of CO<sub>2</sub> emissions, as a direct result of the reduction in vehicles highlighted above of c.75%</li> </ul> <p>The objectives for the Hammarby Sjöstad consolidation project in Stockholm<sup>5</sup> were:</p> <ul style="list-style-type: none"> <li>■ decreasing the number of small direct deliveries (fewer than four pallets) to the site by 80% through co-transportation</li> <li>■ less traffic congestion on the construction site</li> <li>■ improved living conditions at site for new inhabitants</li> <li>■ improved working environment; and</li> <li>■ reduced energy use, emissions of CO<sub>2</sub>, nitrogen oxides and particulate matter</li> </ul> <p>On all these counts the project was deemed a success following evaluation by the City of Stockholm.</p>

<sup>4</sup> Interim and Final reports on the LCCC by Transport for London, Bovis Lend Lease, Constructing Excellence, Stanhope and Wilson James

<sup>5</sup> Civitas Trendsetter report no. 2005:7 - Evaluation Report – New Concepts for the Distribution of Goods (WP 9)

Category	Benefit	Reference																								
		<p>The LCCC also demonstrated a variety of benefits from a freight perspective.<sup>6</sup> Several key performance indicators (KPI) were studied:</p> <table border="1"> <thead> <tr> <th>KPI</th> <th>Target</th> <th>Currently achieving</th> </tr> </thead> <tbody> <tr> <td>Reduction in freight journeys</td> <td>40%</td> <td>70%</td> </tr> <tr> <td>Reduction in journey time of supplier deliveries to contractors</td> <td>30-60 minutes</td> <td>2 hours</td> </tr> <tr> <td>Delivery reliability</td> <td>95%</td> <td>97%</td> </tr> </tbody> </table> <p>Other KPIs included reduction in vehicle mileage, reduction in number of vehicles used, back-loading of pallets and stillages and reduction in waste. The LCCC report also looked at the congestion charge savings per annum:</p> <table border="1"> <thead> <tr> <th></th> <th>No of vehicles</th> <th>Cost of congestion charges (at £8 per vehicle per day)</th> </tr> </thead> <tbody> <tr> <td>Without LCCC</td> <td>4,099</td> <td>£32,792</td> </tr> <tr> <td>With LCCC</td> <td>1,461</td> <td>£11,688</td> </tr> <tr> <td>Minimum saving (£)</td> <td></td> <td>£21,104</td> </tr> </tbody> </table> <p>In conclusion, the report endorses construction consolidation centres as an effective way of reducing vehicle mileage (and associated fuel consumption and emissions) and of reducing traffic congestion in urban areas.</p> <p>WRAP case studies on Barts Hospital and Central St Giles, December 2009 show a reduction of vehicle journeys into central London of 74% and 75% respectively.</p>	KPI	Target	Currently achieving	Reduction in freight journeys	40%	70%	Reduction in journey time of supplier deliveries to contractors	30-60 minutes	2 hours	Delivery reliability	95%	97%		No of vehicles	Cost of congestion charges (at £8 per vehicle per day)	Without LCCC	4,099	£32,792	With LCCC	1,461	£11,688	Minimum saving (£)		£21,104
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	Traffic reduction through reverse logistics	<p>A WRAP report on Reverse Logistics on construction sites estimated that 80% of vehicles delivering to a site leave empty.<sup>7</sup> Using a CCC greatly facilitates reverse logistics as has been shown in the case studies for Barts Hospital and Central St Giles as mentioned above.</p> <p>The three examples of currently operating CCCs mentioned in this report also fully utilise the reverse logistics opportunities. The reverse journeys are used for:</p> <ul style="list-style-type: none"> <li>■ Waste removal – typically where bins rather than skips are used on site, or for compacted and banded packaging waste and timber</li> <li>■ Returning unused materials and packaging for reuse and recycling</li> <li>■ Returning pallets, reusable packaging, cable drums etc.</li> <li>■ Equipment as in the case of refrigeration equipment returned for cleaning during Sainsbury's store refurbishments</li> <li>■ Construction equipment</li> </ul>																								
	Waste reduction	<p>Several studies testify to significant waste reduction through the improved storage and handling in a CCC operation:</p> <ul style="list-style-type: none"> <li>■ The refurbishment of Unilever House in London was covered in a WRAP case study of 2007: <ul style="list-style-type: none"> <li>○ In all, some 13,200 pallets (or pallet equivalent) were handled by the LCCC over a two-year period.</li> <li>○ 90% of all delivered pallets were returned to the LCCC for collection by suppliers.</li> <li>○ The project also provided an excellent illustration of over-ordering in the industry, and of the waste-reducing effect of using a CCC. At the end of the project 38 full 26-tonne lorry loads of unused materials worth approximately £200,000 remained at the CCC rather than ending up in waste skips.</li> </ul> </li> <li>■ A WRAP case study showed that at Barts Hospital the plasterboard waste was 10% lower than at The London Hospital being constructed at the same</li> </ul>																								

<sup>6</sup> Freight Best Practice, 2007, Department of Transport  
<http://www.freightbestpractice.org.uk/london-construction-consolidation-centre-tool>  
<sup>7</sup> <http://www.wrap.org.uk/constructionlogistics>

Category	Benefit	Reference																					
		<p>time and by the same contractor (Skanska). Barts Hospital used the LCCC and had the plasterboard delivered by plot and just-in-time, reducing storage and handling. The London Construction Consolidation Centre, Interim Report – May 2007 evaluating the LCCC found a reduction of materials waste of up to 15% resulting from less damage and reduced shrinkage.</p> <ul style="list-style-type: none"> <li>At Sainsbury's first project using the CCC, 33 pallets of bricks/blocks were returned and available for reuse. Without the CCC and its inbuilt return logistics facility it is possible that these would have been wasted. There have been similar experiences at other projects involving terrazzo tiles, ceiling tiles and lighting equipment.</li> </ul>																					
Social	Health and safety	Virtually all studies point to a positive effect on the work environment and a reduction in incidents on site as a result of lower stocks on site, reduced vehicles on site <sup>8</sup> and material handling by dedicated logistics contractors. For instance studies at Barts and Central St.Giles <sup>9</sup> show significant reductions (c.75%) in vehicle traffic to site: at Barts the number of vehicles accessing the site over a 17-month period was reduced by 2,239 and at Central St.Giles there was a reduction of 956 vehicles over a six-month period.																					
Productivity and programme certainty	Reduced on site handling	The LCCC increased productivity of the site labour force by up to 30 minutes per day. <sup>10</sup> On a site employing 500, this is up to 250 hours per day saved, equating to 30 workers if working an eight-hour shift.																					
	Fewer shortages	At the HCCC, delays (tasks incomplete) due to materials not being available reduced from 6% to 0.4% - a factor of 15. <sup>11</sup> This enhances overall programme certainty as well as ensuring that the workforce is being used with enhanced productivity.																					
Business case		<p>A recent study (not in the public domain), modelling the logistics costs in some detail for the establishment of three new regional CCCs, and also drawing on many of the above-mentioned earlier studies, made the following financial assessment:</p> <table border="1"> <thead> <tr> <th>Attribute/cost</th> <th>% of construction cost</th> <th>Potential benefits of effective logistics</th> </tr> </thead> <tbody> <tr> <td>Profit</td> <td>5%</td> <td>+8%</td> </tr> <tr> <td>Overhead</td> <td>7%</td> <td>-2%</td> </tr> <tr> <td>Preliminaries</td> <td>13%</td> <td>-5%</td> </tr> <tr> <td>Subcontractors</td> <td>Up to 80%</td> <td>-10%</td> </tr> <tr> <td>Labour</td> <td>40%</td> <td>-10%</td> </tr> <tr> <td>Material</td> <td>40%</td> <td>-15%</td> </tr> </tbody> </table> <p>An overall saving of up to 8% will have to be offset against the cost of operating the CCC. It must be noted that the savings apply to different members of the supply chain and therefore a transparent method of sharing benefits and costs must be found.</p> <p>The business case for using a CCC was then summarised:</p> <ul style="list-style-type: none"> <li><b>Environmental:</b> if 75% of material were delivered via the CCC there would be a 50% reduction in local traffic and emissions.</li> </ul>	Attribute/cost	% of construction cost	Potential benefits of effective logistics	Profit	5%	+8%	Overhead	7%	-2%	Preliminaries	13%	-5%	Subcontractors	Up to 80%	-10%	Labour	40%	-10%	Material	40%	-15%
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<sup>8</sup> <http://www.hse.gov.uk/construction/safetytopics/vehicledtrafficmanagement.htm>

<sup>9</sup> [www.wrap.org.uk/constructionlogistics](http://www.wrap.org.uk/constructionlogistics)

<sup>10</sup> The London Construction Consolidation Centre, Interim Report (May 2007)

<sup>11</sup> Managing Construction Logistics (2010), Gary Sullivan, Stephen Barthorpe and Stephen Robbins

Category	Benefit	Reference
		<ul style="list-style-type: none"> <li>■ <b>Productivity of construction workforce:</b> several studies show that operatives save 30 min per day through better logistics which gives a 6% productivity improvement and 3% cost reduction.</li> <li>■ <b>Productivity of hauliers:</b> a 10-20% reduction in delivery cost is achievable.</li> <li>■ <b>Material waste:</b> if just one half of material waste were eliminated material costs would reduce by 7.5% and construction cost by 3%.</li> </ul> <p>The report suggests that depending on the form of construction the cost of the CCC is in the region of 0.5% to 3% of the construction value. With potential savings of up to 8% it would appear easy to make a business case.</p> <p>It should be noted however that this business case depends not only on using a CCC but also on engaging a logistics specialist to integrate the CCC operation with on site handling in order to achieve the productivity increase.</p> <p>Sainsbury's identified strong incentives for using the CCC:</p> <ul style="list-style-type: none"> <li>■ A superstore trades at about £1 million per week so fast construction processes are essential.</li> <li>■ Space savings are also very important e.g. on refurbishment projects when stores remain open, car parking space often has to be used for lay down and waste handling. As availability of parking spaces is essential for customer access there is a strong incentive to minimise space use on site.</li> </ul>

**Figure 6** Packaging waste returned from site to Sainsbury's CCC



## 5.0 When is a CCC the right choice?

In most cases a CCC is used when the main contractor is forced down that route by specific constraints. Those constraints are normally space restrictions on site (limiting storage and/or access via gates) or restrictions limiting vehicle access such as narrow time windows. While these are good reasons for using a CCC, the advantages identified above – environmental benefits, productivity gains, programme certainty and cost savings that can outweigh the cost of using a CCC - mean that CCCs should be considered much more widely as a construction logistics strategy.

Before discussing some specific aspects of CCCs we should ask if there are situations when a CCC is not the right choice. There are two main factors to consider:

- What are the material supply characteristics of the project? If the most efficient material supply, depending on the usage on site, is to send predominantly full vehicle loads directly from suppliers/manufacturers then there is little demand for consolidation.
- If the construction site itself is in a favourable location for inbound transport (see Chapter 5 on CCC locations) and can offer very good conditions (dry, secure, accessible) for material storage then an external CCC is not needed. However, in such a situation it is still advisable to manage the on-site storage area on similar principles to a CCC and to control the flow of materials into the workplace on a Just-in-time basis. In their book *Managing Construction Logistics*, Sullivan, Barthorpe and Robbins call such an arrangement a concealed consolidation centre.

### 5.1 Is there a minimum project size for using a CCC?

There are two sides to this question:

- Is there a minimum critical size of a CCC below which you cannot run a viable CCC operation?
- If you have access to a CCC in operation, is there a minimum size of project which could benefit from its use?

Dealing with the first question first. There clearly is a minimum viable size; typically you need some warehouse space, a warehouse operative, a driver, and an administrator for stock control and communication with site and suppliers. However, a smallest size defined this way is surprisingly small. Among the CCCs studied the smallest operation had only 400 m<sup>2</sup> of warehouse space and exactly the minimum staffing level just mentioned. Continuity is desirable; if you only operate for a single year the costs of setting up and closing down a facility would be prohibitive. The practicality of setting up a small operation means that it is most readily done in conjunction with an existing distribution facility. This way, backup can be organised for any resource shortages, absence etc. One thing is clear however – you don't need a very large project to justify a CCC.

To estimate the handling volumes that are generated by construction projects, a study by Peter Brett Associates for Transport for London developed a guide related to square metres of commercial property constructed<sup>12</sup>; a further report by Peter Brett Associates has updated to include apartments and houses (the full report is not in the public domain):

- Commercial – 0.45 PEU/m<sup>2</sup> (PEU-Pallet Equivalent Unit)
- Apartments – 1.0 PEU/m<sup>2</sup>
- Houses – 1.5 PEU/m<sup>2</sup>

This can give an indication of volumes that may be required at a CCC.

The second question - Is there a minimum size of project below which you will not benefit from using a CCC, given that one is available? Construction managers with no experience of using a CCC will normally claim that it is a relevant logistics solution for very large projects only, such as the Olympics; but those with experience of using CCCs say that very small projects can benefit as much as large projects. Wilson James quotes the convenience store in London where during an eight-week installation two deliveries were made three days per week; and Sainsbury's states that the CCC works just as well in supporting its convenience store developments as the super stores. These are small projects with a programme of just five weeks. Because these projects are small there is pressure on them to be extremely fast. Consolidation, often in combination with off site manufacturing or some level of pre-assembly, makes possible the streamlining of processes required for fast turnaround projects.

<sup>12</sup> Peter Brett's "Construction Consolidation Centres - An Assessment of the Potential for London-wide use" for Transport for London, May 2007

In conclusion: we should not think of project size as decisive for whether a CCC should be used or not. Small projects can be supported by a CCC within a shared facility as long as there is enough volume for the CCC to maintain its profitability.

## 5.2 Shared user versus single user CCC

There is a variety of benefits in shared user CCCs:

- More projects and higher material throughput mean that the fixed costs of operating the CCC will be spread more efficiently leading to a lower cost per unit handled.
- Small projects that would otherwise not consider using a CCC can tap in to the service as the warehousing, labour, equipment and administrative systems are already in place, and the costs are shared by several parties.
- Set up costs for each individual project are minimised.
- There are greater opportunities to optimise resource utilisation; delivery milk rounds can cover more than one site if consignments are small and reverse logistics opportunities are maximised.
- A permanent operation rather than one set up for an individual project will allow expertise to develop.

A special category of sharing is where the CCC, supporting one or more projects, share resources within a distribution centre that operate in other sectors, such as the Wincanton examples mentioned earlier. A separate area can be partitioned in a warehouse and experienced warehouse administrators and operatives are already on hand and can be allocated to the CCC operation on full or part time depending on requirements. This can be a flexible solution with low start-up costs.

There are not many arguments in favour of single user CCCs, but the one most often put forward concerns security. Where the security demands are extreme, a single user facility can make whatever arrangements are required whereas fencing off special areas and controlling staff access may be more difficult to achieve in a shared facility. Having said that, the major distribution companies with large existing depot networks are used to setting up customer-specific operations within the physical confines of a general warehousing operation – in effect, a single user CCC within a shared facility.

A special case of single user facility is where there is a high level of integration between the construction consolidation and other activities. A good example of this is Sainsbury's consolidation, reuse and recycle centre operated in partnership with Fit Out (UK) Ltd. At the site, Fit Out (UK) Ltd manufactures fit out equipment (counters, vanity units, etc.) for the stores. Large volumes of equipment such as refrigeration units are returned for cleaning and overhaul so there is a level of activity over and above conventional construction consolidation that is integrated with the CCC operation. This tailoring of activities to suit Sainsbury's requirements would probably be hard to achieve in a shared facility and there may also be issues around competitive sensitivities. However, while serving just a single customer, in one sense a single user facility shares some characteristics with shared CCCs in that it supports many projects in parallel.

## 6.0 Where should CCCs be located?

Studies using traffic modelling show that the distance between CCC and site is critical for the reduction of carbon emissions and transport costs.

A practical consideration is that delivery vehicles should be able to complete at least two return trips within one shift – otherwise the result is a lot of vehicle under-utilisation and waiting time. With a 30-45 minute drive to the site and a load/unload time of between 30 minutes and one hour, each vehicle can do two to three journeys per eight-hour shift.

### 6.1 Every road freight mile is not the same

CCCs should be easy to reach for incoming supplies, wherever they originate. The negative impact of traffic differs depending on which roads are used. This is well illustrated by Freight Mode Shift Benefit Values (MSB values); from 1<sup>st</sup> April 2010 these replaced the Sensitive Lorry Miles (SLM).<sup>13</sup> These are values attached to all roads by the Department for Transport to calculate the benefit of reducing a road mile by shifting the freight to rail or waterways. The MSB values represent marginal external costs that freight imposes on other members of

<sup>7</sup> <http://www.dft.gov.uk/pgr/freight/railfreight/modeshiftben/>

society (apart from the freight operator who naturally assesses his own cost) and include congestion, accidents, noise, climate change, air pollution and infrastructure costs.

The MSB values are:

<b>Motorways</b>	High value*	£0.86
	Standard	£0.07
<b>All A-roads</b>		£0.74
<b>Other roads</b> (all B, C and unclassified roads)		£1.43

High value motorways are those sections with particularly heavy traffic such as the M25, and identified sections of other motorways.

As consolidation reduces traffic from the CCC to the sites and the sites are normally in urban or city areas, it is clear that the traffic reduction created by the CCC is on the roads that matter most for a whole range of environmental and social reasons. The table shows that each drive mile eliminated on local (other) roads is worth 20 miles on a standard motorway or about twice that of a high value motorway or A-road. Were such environmental values taken into account as part of the project costs, a truer value of using a CCC would be demonstrated in terms of internal and external costs to the contractors and society at large.

### 6.2 Locating the CCC

A good set of rules for the location of CCCs:

- CCCs should be located where a cluster of construction sites can be reached in under 45 minutes' drive time
- CCCs should be close to the motorway network or major roads so that the impact on local roads of incoming deliveries is minimised
- CCCs should be close to the motorway network or major roads so that hauliers' turnaround times are minimised
- If there is a reasonable number of construction projects it is better to have two smaller CCCs (that can each be closer to the respective sites) than one large CCC which will incur a higher mileage on local roads - on condition that both CCCs can be reached by incoming deliveries via major trunk roads or motorways

### 6.3 Mapping locations

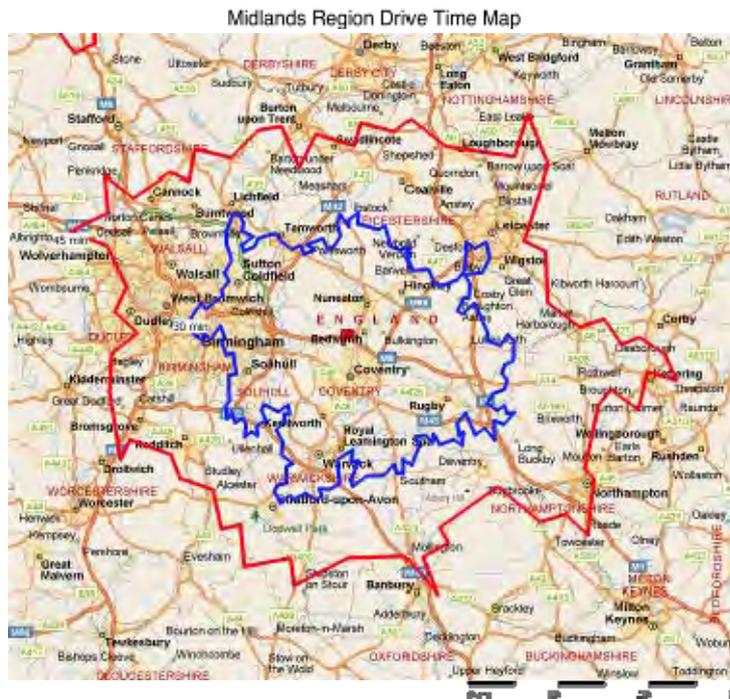
The maps below indicate coverage that could be provided by applying these rules and locating CCCs near major population centres. The flag indicates the CCC location, the blue line represents 30 minutes' and the red line 45 minutes' drive time. Note that a well-placed CCC will cover both Bristol and Bath within the 30-minute zone.

### 6.3.1 Bristol region



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### 6.3.2 Midland region



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### 6.3.3 Leeds region

Leeds Region Drive Time Map



### 6.3.4 North West region

NW Region Drive Time Map

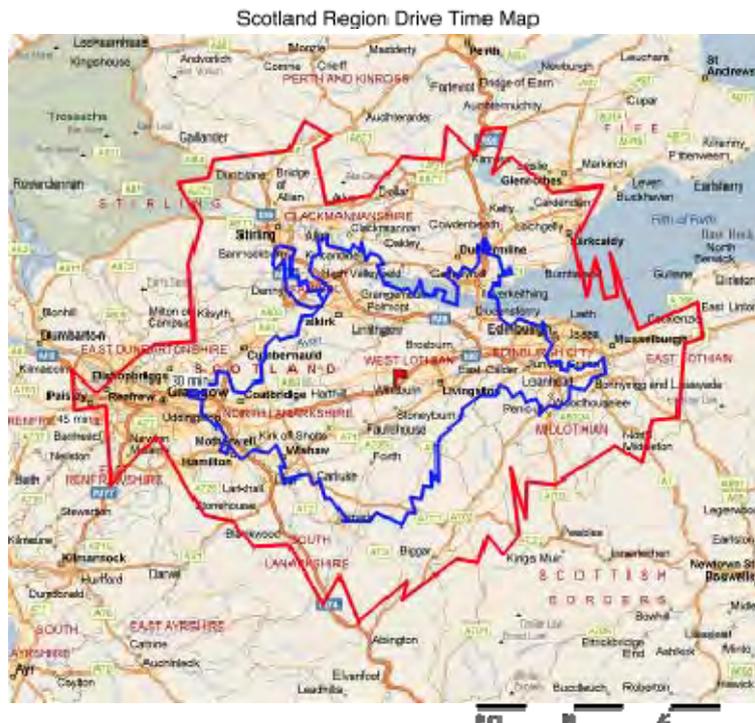


### 6.3.5 North east region



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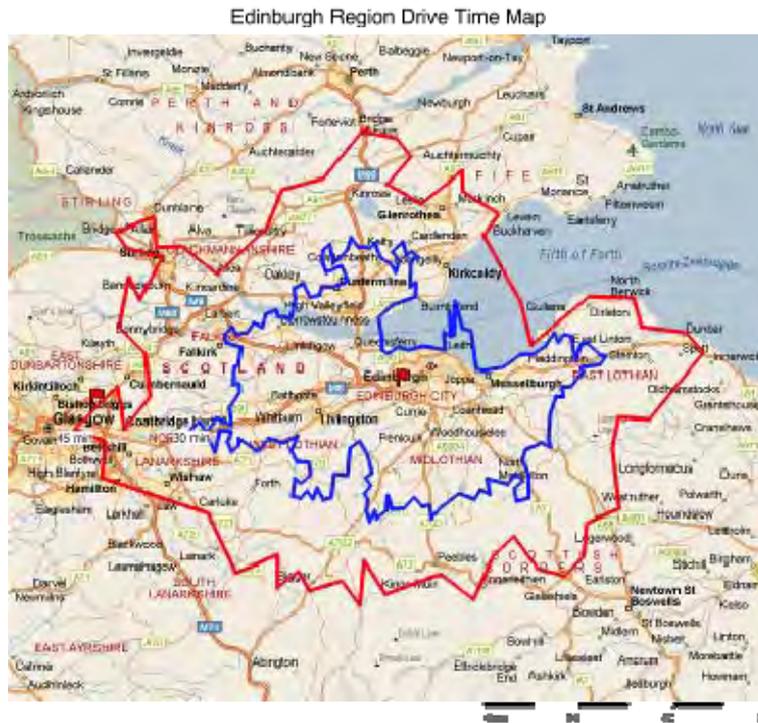
### 6.3.6 Scotland



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It is interesting to compare the single Scotland region map above with the two separate Edinburgh and Glasgow maps. Unless the locations of projects were to be mainly on the east side of Glasgow and to the west of Edinburgh the drive time will normally be in the 30-45 minute range.

A detailed transport study based on real project locations would very likely show that two smaller CCCs would be the preferred option from both an environmental and a financial point of view.



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## 7.0 How should a CCC be integrated into the construction process?

The purely transport related benefits of consolidation can be achieved whether an on site logistics service is provided or not. Reduction in local area traffic, better vehicle utilisation and fewer arrivals at the site on a Just-in-time basis are useful whatever the on site arrangements. There are however many strong arguments in favour of integrating the CCC operation, the transport between site and CCC and the on site material management and handling. There are many successful examples from other industries of such integration of logistics processes with forward business operations:

- Just-in-time delivery to the point of use of material kits and subassemblies in the car industry in a process that seeks to eliminate waste (including wasted time) and maximise efficiency – as pioneered by Toyota.
- The different parts that make up a complete computer system (servers, screens, keyboards, printers etc) sourced from different parts of the world and matched up as a complete system at the clients' premises by the logistics operator – as in the case of Dell.
- At the supermarkets' distribution centres roll cages are packed with mixed products in a sequence to match shelf locations in the supermarket for most efficient shelf stacking which minimises costs and disruption to the customers.

These strategies reduce cost and increase productivity in these very different sectors; there is nothing to suggest they aren't equally relevant in the construction industry.

### 7.1 Controlled supply chain to the point of use

As has been shown at many sites there are significant additional benefits of using a CCC, namely improved productivity, better housekeeping with less material held on site, reduced material wastage and fewer safety hazards. In fact these are benefits that can make using a CCC a very profitable option; and without integrating the CCC with the on site handling you cannot be sure that you gain those benefits. If on site handling is performed in the traditional way by the trade contractors they will spend a significant time handling materials; studies show that a time saving per trade operative of 30 minutes per day can be expected if on site handling is provided.

Gates and goods receiving points are often bottlenecks. If the on site handling is not integrated with the delivery process, coordination between contractors can cause problems, resulting in waiting time.

### 7.2 Extended use of the CCC

Once a CCC is in use, creative contractors learn to use it to its full advantage. At the Central St Giles project (a central London project by Bovis Lend Lease) the air conditioning contractor organised a work area at the LCCC and did the lagging of the ducts there. This had many advantages: a good working environment meant the job was completed faster, the operative was not in the way of other trades on a busy site, less waste was generated and any material that was wasted was never carried to site but could go straight to the waste handling at the LCCC. Pallets were made up of completed duct-work for each area, speeding up installation on site.

At the Quadrant III project in London's West End Sir Robert McAlpine has adopted a similar approach. Plaster-board is cut at the LCCC instead of on site, and the off cuts are also boxed up and delivered, to be used for boxing in. Lighting units are fitted into ceiling panels; this speeds up installation on site while movement of large volumes of packaging waste from the site is avoided.

Creative use of CCCs, undertaking some normally site-based activities at the CCC, can give many advantages:

- speedier process by organising a better working environment than the often cramped site conditions;
- faster installation processes on site;
- waste reduction through improved control at CCC;
- reduced waste handling on site; and
- reduced waste removal from site.

**Figure 7** A workstation at the LCCC used for lagging air-conditioning units prior to delivery to site



## 8.0 Sharing the costs and benefits of a CCC

It is normally up to the main contractor to take the decision to use a CCC and to carry the costs. As has been shown above the savings from using a CCC often clearly outweigh the costs – yet contractors often fail to be convinced of the business case. Why is that? Being able to analyse the cost savings doesn't necessarily make it easy for the main contractor to realise those savings.

Most projects are broken down into a number of major subcontracts where each contractor in turn supplies both labour and materials, often on a fixed price basis. This makes it difficult to identify all the savings that are achieved through waste reduction and reduced over-ordering, productivity improvements, reduced waiting time, reduced haulage costs, programme certainty etc. To establish these costs subcontractors must evaluate their material suppliers in more detail – for instance separating out transport costs so that faster vehicle turnaround times can be reflected in appropriate cost reductions.

In summary – all the participants in a construction project can benefit from using a CCC:

### Hauliers

- Faster vehicle turnaround time at a CCC compared to when delivering construction sites. Apart from driving into a city centre and/or to a congested site the actual time spent off-loading is also significantly shorter at a purpose-built distribution facility. For instance a study has shown that it takes more than 50 minutes longer to deliver in central London than to the Heathrow CCC.
- Better vehicle fill as the CCC can receive and store materials in a good environment and then deliver smaller lot sizes to site.
- Increased opportunities for reverse logistics, for instance collecting unused materials and reusable packaging at the CCC.

### Material suppliers

- Can deliver in economic load sizes, as suitable site batches are made up at the CCC.
- It is easy to implement a reverse logistics solution with a CCC; suppliers can easily take back pallets and reusable packaging.

### Trade contractors

- Improved productivity as no or minimal time is wasted in looking for and handling materials. Studies show that on average 30 minutes per day are saved.
- Improved safety – a significant proportion of on-site incidents and injuries relate to the handling of materials.
- Reduction in material waste by 10-15% according to several studies.

### Waste management contractors

- Waste removal integrated with CCC return journeys reduce waste handling costs.

### Main contractor

- Improved programme certainty.
- Reduced over-ordering of materials. Over-ordering at a 15% level is not unusual; providing a CCC should allow contractors to target a 10% reduction in waste. As key waste streams are measured in the SWMP the savings can be verified.
- Improved site conditions.
- Lower costs and improved competitiveness.
- Reduced waste and carbon emissions enabling the attainment of environmental objectives. Site traffic related to material deliveries often reduced by up to 70%.

### Clients

- Faster project programmes.
- Improved project certainty.
- Lower overall costs.
- Reduced impact on the environment through reduced traffic, a better organised site and minimisation of waste.

Clients and main contractors need to develop models that break down the overall contract into the major subcontracts and apportion the benefits of using the CCC in line with the expected savings of each subcontractor. This then can form the basis of a CCC cost recovery formula.

9.0 Acknowledgements

We would like to thank the following organisations for their contributions to the study:



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0800 100 2040

[www.wrap.org.uk/construction](http://www.wrap.org.uk/construction)



## Case Study

# Engineering a new life for Hoo Island

**Organisations involved:** GPS Marine, H. Sivyer, Peel Ports, and Thames Water

### The Challenge

Hoo Island covers an area of 160 acres and lies in the River Medway in Kent. Its owners, Peel Ports, recently began works to transform the area and upgrade their deposition site facilities. The company turned to NISP South East to help source a sustainable supply of aggregate materials to rebuild the infrastructure on the island.

Meanwhile, long-standing NISP Member, Thames Water, had earlier initiated discussions with NISP's South East team for effective solutions to thousands of tonnes of excavated materials arising from their Victorian Mains replacement work in London. Thames Water were working closely on a solution with one of their main contractors, H. Sivyer.



Above: Hoo Island facility

### The Solution

NISP's South East team facilitated a complex collaboration between the companies, which sees clay and spoil material from Thames Water's mains replacement works being recovered, reprocessed, transported down the Thames by barge and reused to inject new life into Peel Port's island facility near Chatham Docks. Chatham-based contracting firm GPS Marine provides the final piece in the puzzle, working in partnership with Peel Ports to transport the excavated and reprocessed material down the Thames by barge and deposit it at Hoo Island to be used in rebuilding the infrastructure at the site.

The project was not only shortlisted as a finalist in the 2008 CIWM Awards for Environmental Excellence but also featured in a recent edition of The Environmentalist journal. The CIWM Judges called it an "excellent example of synergy and brokering of partnerships".

### The Results

- **Additional sales generated: £1.62 million**
- **Virgin materials saved and waste diverted from landfill: 100,000 tonnes**
- **Carbon emissions reduced by: 12,152 tonnes**
- **Jobs saved: 2**

“

...”the concept of NISP is an excellent format for companies such as Thames Water to benefit from and the introductions to companies brokered by the South East team have allowed far reaching relationships to be formed that will ensure cost benefits for years to come.”

”

**Alan Young**  
Head of Waste  
Thames Water

## CASE STUDY: Highways Agency - M25 DBFO Widening



### SECTOR TYPE:

Infrastructure - roads

### LOCATION:

M25

### CLIENT:

Highways Agency

### PRINCIPAL DESIGNER:

Connect Plus Consortium

### CONTRACTORS ENVIRONMENTAL CONSULTANT:

Connect Plus Consortium

### PRINCIPAL CONTRACTOR:

Connect Plus Consortium

### CONTRACT VALUE:

c.£1 billion

### CONTRACT DURATION:

30 years

## The Project

The M25 DBFO (Design, Build, Finance and Operate) project involved both widening of the M25 and its operation and maintenance. It includes the M25 orbital and a series of major feeder roads onto the M25, making up half of the 400km length of the total project road.

The widening works spanned 63km of motorway between Junctions 16-23 and 27-30 to provide four lanes with hard shoulder, as well as refurbishment of the Hatfield Tunnel on the A1(M). The Connect Plus, a consortium of Skanska, Balfour Beatty, Atkins and Egis Projects, was formed to deliver these services on behalf of the Highways Agency. The works were completed in May 2012, three months ahead of schedule.

The widening had to be carried out while maintaining three lanes of traffic in both directions for the 150,000 daily user vehicles. Keeping the widening within the existing highway boundary allowed it to be carried out under the Highways Agency's 'permitted development' classification, but this required a significant length of retaining wall to be constructed to provide the additional 3m of space to widen into. Value engineering reduced the number of retaining wall options to two basic designs, keeping things simple to maintain the accelerated programme.

The innovative design and procurement approach taken by Connect Plus Consortium resulting in various environmental, social and economic benefits, including reduced carbon footprint and cost, increased programme security and workforce and public safety.

# The Green Construction Board

## The Benefits

- **Reduced carbon** – the use of 100% recycled sheet piles from Europe, coupled with the reduced quantity required, reduced embodied carbon by 44,000 tonnes or 75%, whilst also lowering transport emissions.
  - 92% of aggregate used was either recycled or from a secondary source, which reduced embodied energy and transport emissions by 35,000 tonnes compared with primary aggregate. Where primary aggregate was used, it was responsibly sourced to BES6001.
  - Reduced pavement thickness was achieved by matching existing construction rather than creating a fully flexible pavement by ‘crack and seat’. This saved around 400,000 tonnes of asphalt and reduced embodied carbon by 25,000 tonnes.
  - Areas of land were purchased by agreement with adjacent landowners for the construction of drainage and attenuation ponds. This meant that much of the planned inline attenuation using oversized drainage pipes could be replaced by pond capacity. Reduced pipe size not only reduced the quantity of pipe, but also the associated earthworks were reduced by around 90%, significantly reducing plant emissions.
- **Materials** – Balfour Beatty’s King Sheet Pile™ (KSP) system achieved double the output of conventional sheet piling methods, providing programme security and taking retaining wall construction off the critical path. It also reduced the steel required by 30%, in addition to reduced installation time which saved over £10 million. The piles used can remain uncoated, meaning virtually zero maintenance.
  - Control of aggregate production on site meant that quantity and quality could be managed. This provided certainty of supply and flexibility in how material was used, which consequently decreased programme risk.
  - There was also increased flexibility of control due to the installation of motorway lighting with separate controls for junctions and the main carriageway.
  - A system is being trialled to provide dimming or completely switch off lighting depending on the volume of traffic using the motorway. This reduces electricity consumption by 25%.
  - Innovative pollution controls (including penstocks that automatically shut off the drainage network if oil is detected, and hydrodynamic separators to remove silt laden with heavy metals) also contributed to an efficient design, replacing bulkier equipment.
- **Safety** – quicker installation meant less time working alongside the busy motorway with 150,000 vehicles passing by each day, which resulted in increased safety for both the workforce and travelling public.
- **Public** – existing sections of pavement could be retained without work, reducing the requirement for working across the full carriageway. This reduced the project programme and was less disruptive for the travelling public.

- **Cost** – the use of recycled and secondary aggregates was cheaper, saving the project around £18 million. The reduced material use for the pavements also resulted in a saving of £25 million.

## The Process

The key processes underpinning the project:

- The team achieved a more sustainable solution by using Balfour Beatty’s KSP™ retaining wall system. This revolutionises 120 years of an innovative approach to sheet piling practice by taking advantage of spare structural capacity and eliminating the structural excess by replacing alternative pairs of full length Z piles with lighter, thinner and shorter piling sections spanning horizontally between the remaining full length sheet piles.
- This, in combination with the sheet pile profile, reduced the quantity of steel required by 30%, directly reducing embodied carbon in steel use, transportation and installation energy.
- A major benefit of the short intermediates was the virtual elimination of clutch friction, which contributes substantially to the energy required to drive sheet piles. This can be the case particularly in ground, where large flints can cause piles to deviate slightly during installation. As a result, the installation rate on some sections was routinely four times that planned and the overall installation rate was at least doubled. An important advantage was that the majority of the piles could be driven using a vibrator without recourse to the percussive impact driving often required for a conventional sheet pile wall. In the limited cases where impact driving was still required, the noise and energy consumption was more than halved, benefiting residents and the environment.
- The team developed a materials strategy to maximise the use of recycled, secondary and manufactured aggregates in preference to primary aggregates. This required specifications to be adapted and agreed with the Highways Agency.
- Inert construction and demolition waste such as concrete and brick were sourced from other construction and demolition projects in the south-east and processed at two recycling hubs. Other sources of material were also identified, such as glass sand, a by-product of processing co-mingled domestic waste collections. This innovative approach gave the consortium more direct control over the quality of material available, rather than being reliant on an external supply chain. It provided flexibility to create the most efficient outcome for the project.

## Key Learning Points

Innovation in design and procurement of the major materials for the project has led to a reduced carbon footprint and cost, increased programme security and benefits to safety.

# The Green Construction Board

## End User Feedback

“ The Highways Agency was pleased to see the JV recognising innovation as a contributor to more sustainable development. The JV have approached the construction challenges intelligently and conscious of numerous sustainability aspects. Together these have delivered efficient and effective solutions to the motorway widening without compromising the essential operational requirements. The keen awareness of costs, resource consumption, efficient production and transportation led to solutions which the Agency should seek to transfer to comparable locations were prudent and practical.”

Dean Kerwick-Chrisp, Sustainability, Equality and Diversity,  
Highways Agency

## Learn more

[www.highways.gov.uk/our-road-network/managing-our-roads/private-finance-initiatives-design-build-finance-and-operate-dbfo/m25-dbfo-design-build-finance-and-operate-contract/](http://www.highways.gov.uk/our-road-network/managing-our-roads/private-finance-initiatives-design-build-finance-and-operate-dbfo/m25-dbfo-design-build-finance-and-operate-contract/)

[www.connectplum25.co.uk/aboutus.html](http://www.connectplum25.co.uk/aboutus.html)

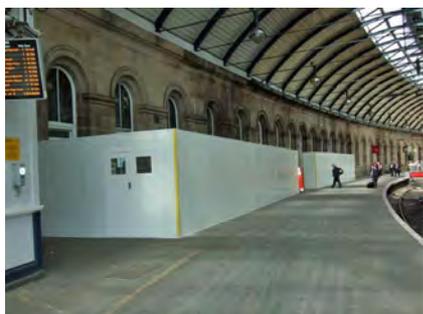
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For more information on  
**The Green Construction Board**  
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or email [green.board@bis.gsi.gov.uk](mailto:green.board@bis.gsi.gov.uk)

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## Hoarding Solutions

Traffic management is a key aspect of road maintenance. Often the barriers and cones used are made from plastic. Additionally hoarding is used to screen construction sites and these can be made from wood. At the end of life, it may be a challenge to decide on how best to dispose of the barriers, particularly if there has been a mix of plastics used.



[www.kwik.co.uk](http://www.kwik.co.uk)

Barriers could be purchased based on the recycled content of the materials and on how re-usable and easy to recycle they are. Where hoarding is required, recycled plastic hoarding or a living green screen could be used as an alternative. Plastic Hoarding with a high recycled content can be branded according to the requirements of the project. It can be recycled at the end of life back into more hoarding or re-used in subsequent phases of work. .

The green screens are offered as a service – the company that provides them, retains ownership of them, maintains them and waters them and then re-deploys them when they are no longer needed.

An example of plastic barrier recycling:



[www.treebox.co.uk](http://www.treebox.co.uk)

Skanska had accumulated a quantity of plastic barriers previously used as protection around street works and other construction activities. Broken or end of life items had been stock piled in one of their yards. The barriers are made of two different plastic types including PVC which make finding a reuse or recycling outlet more problematic. NISP Introduced them to Express Plastics who agreed to take the material, sort it, processing the HDPE themselves and moving on the PVC element.

Organisations that sell the described products:

Living Hoarding:

<http://www.treebox.co.uk/products/reusable-living-hoarding.html>

<http://www.urbangreening.co.uk/>

<http://www.fastfence.co.uk/products/greenhoard/>

Recycled Plastic Hoarding

<http://www.perimeters.co.uk/>

<http://www.ecogenik.co.uk/>

<http://www.kwik-klik.co.uk/sustainable-hoardings/ecogeniks-aims>

<http://www.plasloc.com/>

By Mentioning organisations, products or services, AECOM are not recommending or endorsing them.

# An integrated approach to resource efficiency

**This case study demonstrates the benefits of an integrated and systemised approach to resource management in a highway maintenance organisation.**

## Background

A-one+ Integrated Highway Services are a Managing Agent Contractor (MAC) for the Highways Agency (HA), and are currently managing in Areas 14, 12, and 7. These areas consist of 1500km of trunk roads and motorways, equating to 23% of the HA's network.

A-one+ are committed to improving their sustainability performance, and this case study explains how they have taken an integrated approach to resource efficiency.

A-one+ is a joint venture between Halcrow, Colas and Costain.

## Organisations involved

- Highways Agency (Client); and
- A-one+ (Highways Managing Agent Contractor).

## Why take a resource efficient approach?

Being resource efficient is important to A-one+ because they are committed to improving the sustainability performance across all aspects of their work, and want to lead by example in the highways maintenance sector.

They are proactively responding to the HA's clear objectives and requirements on sustainability which include resource efficiency, as shown in their Procurement Strategy<sup>1</sup>, Sustainable Development Plan<sup>2</sup>, and Strategic Alignment Review Toolkit.<sup>3</sup>

The cost benefits of a more resource efficient approach are also a positive incentive for A-one+ to improve its performance.

## An integrated approach

A-one+ recognise that for an organisation to become resource efficient it needs to take an integrated and joined-up approach. It is not about just delivering one off good examples of resource efficient practice, but a more systemic approach that means resource efficiency is embedded in the organisations culture.

A-one+ have implemented measures which have engrained resource efficiency through-out the way they work which cover:

- policy and commitment;
- measurement and monitoring;
- procedures, plans and regulation;
- culture change and knowledge management;
- innovation and challenging 'the norm';
- client and regulator engagement; and
- supply chain partnership.

## Policy and commitment

The A-one+ approach starts from the top with organisational commitments covering resource efficiency.

A-one+ are committed to halving waste to landfill in support of parent company signatories to the WRAP halving waste to landfill campaign, and in 2010 introduced the A-one+ waste hierarchy. They have set SMART targets such as 5% reduction in fuel use and 5% reduction in energy consumption, and made contractual commitments to the inclusion of carbon<sup>4</sup> within their business management system.

These measures and associated action plans are captured within the A-one+ SHE strategy and Area Specific Business Strategies, providing visible commitment throughout all levels of their organisation.

<sup>1</sup> [www.highways.gov.uk/aboutus/28854.aspx](http://www.highways.gov.uk/aboutus/28854.aspx)

<sup>2</sup> [www.highways.gov.uk/aboutus/33752.aspx](http://www.highways.gov.uk/aboutus/33752.aspx)

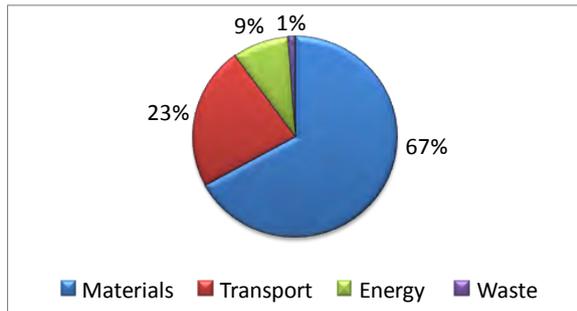
<sup>3</sup> [www.highways.gov.uk/business/28546.aspx](http://www.highways.gov.uk/business/28546.aspx)

<sup>4</sup> Carbon is used as shorthand for carbon dioxide equivalents

## Measurement and monitoring

The starting point for the management of environmental sustainability is their 14001 certified integrated business management system which provides the foundation for managing risk, achieving legal compliance and protecting the environment. A-one+ have used the knowledge and expertise from maintaining their 14001 certification to take a systemised approach to resource efficiency measurement and management.

The HA require carbon data to be reported using their Carbon Accounting Framework<sup>5</sup>, and so A-one+ established systemised data collation mechanisms to allow data population on a quarterly basis.



### A-one+ carbon footprint 2009/10

Data has been collated since 2009 allowing A-one+ to benchmark their carbon performance year on year. This approach has also highlighted significant contribution factors, such as embodied carbon in materials, allowing carbon reduction efforts to be focused.

A-one+ have conducted energy saving audits of their depots to better understand the energy use. This has led to investigating improvements including isolation of electrical supply and control timers for wall heaters, light sensors, energy efficient lamps for salt barn and garage areas, and innovative electronic control gears for external depot lights and computer management systems for remote control of depot lighting. The measures which have been adopted have resulted in significant energy and cost savings.

They have also completed a Network Energy Saving Study in support of the Highways Agency's objective for their MACs to reduce Network Energy consumption by 35% by 2015 (against a 2008/09 baseline).

A-one+ use telematic systems on their vehicle fleet which identifies inefficient vehicles usage and enables targeted training to correct the inefficiency resulting in fuel savings, reduced servicing and extended vehicle life. The telematic system helped A-one+ to identify that there was a significant amount of vehicle idling being undertaken within the depots, which has since been addressed providing fuel, carbon and cost savings.

They have implemented print management software across all their contract areas, which has reduced ink and paper consumption delivering cost savings of £25,000 per annum.

A-one+ also undertook a grey water study in Area 14 which identified rainwater harvesting to support the production of brine for the new winter vehicle fleet, reducing reliance on mains water supply.

## Procedures, plans and regulation

Drawing on the analysis of their carbon footprint, A-one+ have produced area specific carbon reduction plans that outline high level actions to be delivered across A-one+ as well as local actions that are specific to the individual areas. These are reinforced by the inclusion of carbon in the individual Area Business Strategies and the Performance Management Framework.

A-one+ have successfully implemented Site Waste Management Plans (SWMP) across all of their contracts. For example the proactive use of a SWMP on a large project on the M60 identified potential significant waste planings arising. This led to the adoption and further development of the WRAP quality protocol in respect of road planings enabling them to be classed as a product rather than waste, resulting in over 35,000 tonnes of non hazardous planings to be removed from site as a product, reducing waste to landfill for this project by 81%. A-one+ have subsequently implemented the road planings protocol in other management areas.

## Culture change and knowledge management

The key to success comes from involving their people through a comprehensive system of training and communication which includes alerts and tool box talks, pencil case workshops, staff and operative forums and awareness campaigns. For example, their 'Big Ideas' campaign which focused on variety of topics including how to reduce carbon emissions.

To ensure effective knowledge dissemination within A-one+ and the parent companies they use a Best Practice Continual Improvement sheet system.

Standard Method		Improvement Summary	Key Drivers for Improvement																								
		<p>For the new design on the site, the contractor's design was not in line with the requirements of the sign. The contractor used a grey GRP substrate material which was not suitable for the application. The contractor used a grey GRP substrate material which was not suitable for the application. The contractor used a grey GRP substrate material which was not suitable for the application.</p>	<table border="1"> <thead> <tr> <th>Operational</th> <th>Reduce</th> <th>Cost</th> </tr> </thead> <tbody> <tr> <td>Operational</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Customer</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Network</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Value</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Respect the Environment</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Asset</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Efficiency</td> <td>✓</td> <td>✓</td> </tr> </tbody> </table>	Operational	Reduce	Cost	Operational	✓	✓	Customer	✓	✓	Network	✓	✓	Value	✓	✓	Respect the Environment	✓	✓	Asset	✓	✓	Efficiency	✓	✓
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Asset	✓	✓																									
Efficiency	✓	✓																									
		<p><b>Benefits Realised</b> Improved health and safety for the workforce by using a lighter material which reduced the risk of injury from lifting and carrying heavy materials. The innovative method also reduced the risk of injury from lifting and carrying heavy materials. The innovative method also reduced the risk of injury from lifting and carrying heavy materials.</p>	<p>Area 24 Sub-process</p> <p>3.4 Develop Systems</p> <p>Additional Information</p> <p>Contact Details: Andrew 45898@highways.gov.uk</p> <p>Supply Chain: [Redacted]</p> <p>Area 10: Area 14, Area 12, Area 10, Area 7</p> <p>Area 10: Area 14, Area 12, Area 10, Area 7</p> <p>Area 10: Area 14, Area 12, Area 10, Area 7</p>																								

### MP GRP Best Practice Continual Improvement sheet

<sup>5</sup> [www.highways.gov.uk/business/31530.aspx](http://www.highways.gov.uk/business/31530.aspx)

## Innovation and challenging 'the norm'

One of the most important elements of the A-one+ approach is a focus on innovation and challenging the normal ways of working. Barriers to resource efficient innovation can be presented by the way product/material standards and specification are set, the regulatory regime for waste management, and people's general resistance to change.

A key step to introducing a new or innovative approach is early engagement with all stakeholders such as the client, regulators, contractors and other suppliers. This proactive early engagement has enabled A-one+ to deploy industry leading innovations. For example through securing departures from standard and process approvals from the HA, agreeing waste regulatory positions with the Environment Agency, and identifying novel approaches from material suppliers and contractors.

The following are some specific examples of the resource efficient innovations A-one+ have implemented.

### Repave

A-one+ use the Colas Repave system which is a hot in-situ recycling process for rejuvenating and resurfacing existing surface courses. The system can typically save between 30-50% of the embodied carbon and reduces raw material demand and waste.

Data available up to 2010 shows that the process has delivered a carbon saving of 2317 tonnes, energy savings of 57% and cost savings of £2.3m.



**Repave Process**

### Space heaters

Acting on the results of the vehicle monitoring system space heaters were installed in some of the A-one+ Incident Support Units which reduced the amount of engine idling giving decreased fuel usage.

### VRS beam re-use<sup>6</sup>

A-one+ are the first MAC to use renovated Vehicle Restraint System (VRS) beams. This is a step change

in waste management, by increasing the lifespan of safety barriers through renovating and re-using beams. The process is delivering significant savings in waste and embodied carbon.



**Steel Vehicle Restraint System**

### Recycling tar bound road planings<sup>7</sup>

A-one+ avoided hazardous waste disposal costs in the region of £1.3m by employing ex-situ recycling of 9000 tonnes of tar bound road planings.



**Treatment of waste tar bound planings**

### GRP sign material

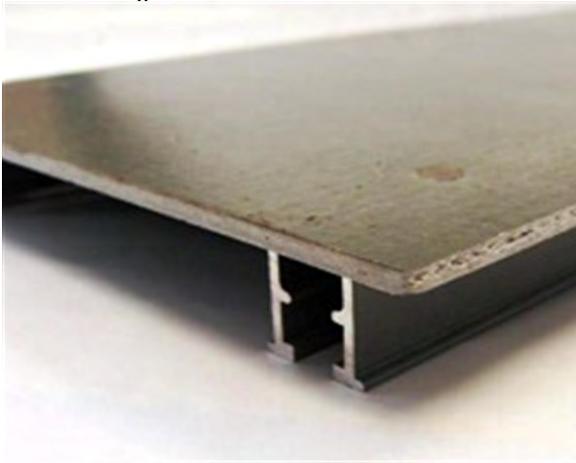
Working in partnership with Morelock Signs Ltd, A-one+ were one of the first companies to use the multi-purpose glass-resin reinforced polyester (MP GRP) material on the trunk road and motorway network for permanent signs. The material has been used to replace the standard aluminium used to make sign structures. The key benefits that have arising from this are:

- costs savings of around 12% saved on scheme delivery compared to traditional products;
- MP GRP is made of recyclable materials, and is also recyclable at the end of its life;
- carbon footprint data shows MP GRP has between 50-70% less embodied carbon than aluminium;
- increased material security - there is no scrap value for MP GRP signs; therefore resource and

<sup>6,7</sup> More information is available in the VRS Renovation and the A66 Little Burdon case studies from the WRAP website

money is not wasted on replacing stolen signs; and

- improves health and safety - MP GRP is 40% lighter than aluminium, making the signs easier and quicker to install, reducing risks from manual handling.



**GRP cross section**

### Durakerb

A-one+ in partnership with the Durakerb Group was the first company to receive HA approval to use the lightweight Durakerb on the trunk road network.

Durakerb is a lightweight kerb manufactured from polymer blend of which 88% is recycled material.



**Laying of Durakerb**

The initiative started with the Durakerb Group gave a presentation to A-one+ designers as part of the 'Pencil Case Workshop' forum.

The key benefits from its use are:

- 20% reduction in carbon emissions compared with precast concrete units in manufacture
- quicker laying - experience to date indicates laying rates up to four times faster than for concrete kerbs, with associated programme and cost savings; and
- improved safety – Durakerb only weighs just under 6kg and so does not need the mechanical handling required for concrete kerbs.

### Supply chain partnership

A-one+ have found the best results come from taking a partnership approach with their supply chain. This has encouraged a trusting and open relationship in which innovation can be fostered.

A-one+ have obtained carbon reduction commitments from our key supply chain partners, which is helping to tackle their significant sources of carbon such as material use through development of green procurement strategies, use of new technologies and alternative material options.

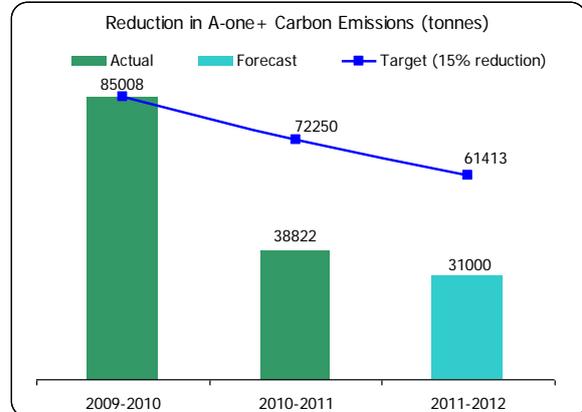
In addition to some of the suppliers mentioned above A-one+ are also working in partnership with Wastecycle, who act as a broker for all their recyclable waste. This has resulted in approximately 98% of depot and office waste being recycled.

In Area 14 they have worked with another supply chain partner to introduce recycling of sweeper/gully emptier arisings which reduces water usage and the waste to landfill.

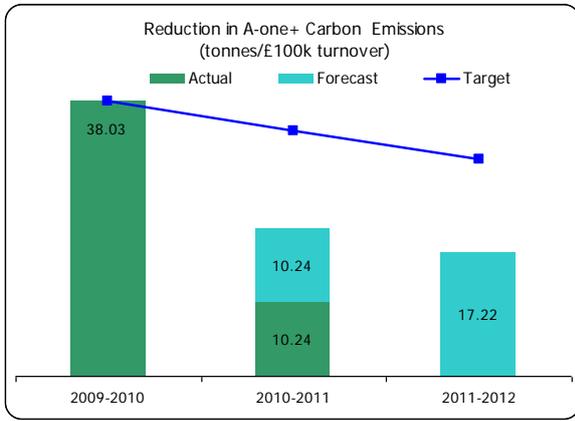
### Benefits

As a result of their integrated and systemised approach, A-one+ have demonstrable improvements in resource efficiency.

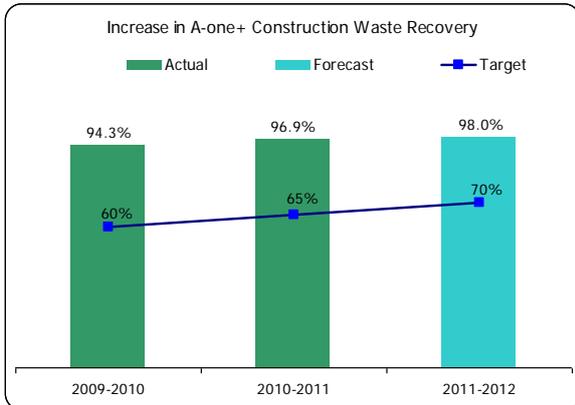
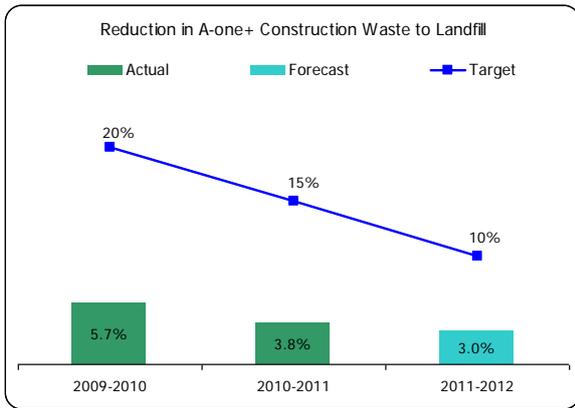
The following graph shows the carbon emissions aggregated for all MAC contracts in the A-one+ portfolio.



Actual carbon emission figures were extracted from the carbon toolkit that is submitted quarterly to the Highways Agency. These figures have been normalised to take account of changing turnover levels, as shown in the next graph.



The next two graphs show the percentage waste from maintenance, small schemes and depots being sent to landfill, and being recovered.



## Lessons Learnt

- The culture of an organisation and its people is critical to truly embedding resource efficiency;
- Set clear goals and targets which are effectively communicated and reinforced with all;
- Engage early with clients, regulators, and suppliers to identified opportunities, barriers, and innovations;
- Do not be afraid to challenge 'the norm' with innovations and new techniques; and
- Embed resource efficiency through a systemised approach to monitoring resource use, planning and taking action.

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## Japanese Knotweed

Japanese knotweed (*Fallopia japonica*) is a strong-growing, clump-forming perennial, with tall, dense annual stems. Stem growth is renewed each year from the stout, deeply-penetrating rhizomes (creeping underground stems) (<https://www.rhs.org.uk/advice/profile?pid=218>). The weed can start growing from small parts of rhizomes which may be left during management. As a result of this, It can be a challenge to manage.

There are two main ways to manage the weed which can involve either excavating the contaminated soil and taking it for disposal to landfill; or alternatively, the weed can be treated using a chemical treatment. The knotweed may need to be treated more than once but there are companies that can treat Japanese knotweed within one growing season.

Treatment of Japanese Knotweed in-situ means that there is no requirement for excavation of material and subsequent disposal of spoil to landfill. This also reduces the likelihood of the Japanese knotweed being spread. There is no requirement to source new material to replace any excavated material.

Example From IVM <http://www.knotweed-uk.com/>:

## Japanese Knotweed - FAST System Case Study Location: West London

**Site** - Development Site in West London

**Planning** - Construction of new apartments and regeneration of existing building.

**Problem** - Site contaminated with Japanese knotweed, main stand located off site, adjacent to public highway.

**IVM Solution** - Treat both on and off site japanese knotweed using the IVM 'FAST' System, which fully guaranteed eradication. No soil needed to leave site, no root barrier system was required, both passing cost savings to the client.

The treatment is fully guaranteed by IVM.

The images of the site below are taken throughout the treatment program, starting in July, then August and finally December.





  
VolkerWessels onderneming

# PlasticRoad

A lightweight design, a fraction of the construction time, virtually maintenance free, and three times the expected life-span.

## KWS



  
een VolkerWessels onderneming

A lightweight design, a fraction of the construction time, virtually maintenance free, and three times the expected lifespan. PlasticRoad, which consists of 100% recycled material, is the ideal sustainable alternative to conventional road structures.

## New Innovations

PlasticRoad features numerous advantages compared to conventional roads, both in terms of construction and maintenance. Plastic is much more sustainable and opens the door for a number of new innovations such as power generation, quiet road surfaces, heated roads and modular construction. Additionally, the PlasticRoad design features a 'hollow' space that can be used for cables, pipes and rainwater.

## Prefabrication

PlasticRoad's concept is in line with developments such as Cradle to Cradle and The Ocean Cleanup: the initiative to free the seas of 'plastic soup'. Recycled plastic is made into prefabricated road parts that can be installed in one piece. The prefabricated production and the lightweight design also make the construction of a PlasticRoad into a much simpler task. Roads can be built in weeks instead of months. It is also much easier to control the quality of the road (stiffness, water drainage etc.).

## More resistant to the elements and wear

PlasticRoad is a virtually maintenance free product. It is unaffected by corrosion and the weather. The road structure handles temperatures as low as -40 degrees



Anne Koudstaal and Simon Jorritsma (InfraLinq) the inventors of PlasticRoad.

and as high as 80 degrees Celsius with ease. It is also much more resistant to chemical corrosion. Estimations predict that the lifespan of roads will be tripled. That means less road maintenance and less to no traffic jams and detours.

## Space for cables, pipes, and water

A major advantage of PlasticRoad is the hollow structure that can simply be installed on a surface of sand. In addition to the options mentioned above, it is also possible to integrate other elements in the prefabrication phase. These elements include traffic loops sensors, measuring equipment, and connections for light poles.

## For more information

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## Questions and Answers - PlasticRoad

### Q1. Why is the PlasticRoad more sustainable than conventional road structures?

*We expect that the PlasticRoad will last three times longer than conventional road structures. The expected lifespan of at least fifty years is based on the lifespan of other plastic products such as sewage pipes and plastic platforms.*

### Q2. What are the main advantages of the PlasticRoad?

- *Lightweight prefab construction*
- *Faster construction (months shorter) and less maintenance time*
- *Higher quality and a longer lifespan (homogeneous and prefab)*
- *Little to no maintenance required. The material is almost impervious to conditions such as the weather and weeds.*
- *The innovation is considerably more sustainable. PlasticRoad consists of 100% recycled plastic and is fully reusable. It is perfectly in line with the Cradle-to-Cradle philosophy and the principles of the circular economy.*
- *Double use of space. The hollow space in the design can be used to store water or as space for cables and pipes.*
- *The possibility of constant (traffic) safety and water drainage*
- *Everything in relation to the road can be made prefab (road markings, guardrail)*
- *The concept offers opportunities for further innovation. Examples include solar heated roads, light poles and traffic loop sensors.*
- *Contribution to the societal problem of plastic waste*

### Q3. Is it possible to reuse the material of PlasticRoad?

*It is possible to reuse the material, but the degree to which is currently being examined. The idea is to fabricate the PlasticRoad from plastic that usually gets incinerated. This makes the concept so appealing: plastic waste is given a new, high quality utility.*

### Q4. What about sound? Is driving on asphalt more or less noisy?

*We'll have to wait and see. PlasticRoad certainly offers a number of opportunities when it comes to noise reduction. With asphalt, we are getting closer to optimal structures for minimal noise pollution. It's actually much easier to produce this structure in plastic than*

*in asphalt. By pressing or printing the structure into plastic we can achieve optimal sound reduction. In the pilot (a bicycle path), this is not a relevant issue.*

 **Q5. Won't the PlasticRoad act as a large resonance box?**

*This is unlikely to cause problems on a bicycle path. We will have to investigate whether this presents challenges for roads. At the same time, noise also provides an opportunity because sound energy can be used to generate power.*

 **Q6. How feasible is it to actually produce PlasticRoads?**

*KWS Infra believes in the feasibility of the idea and we're making substantial investments for further research on the PlasticRoad. This research will have to reveal whether the concept is feasible in practice.*

 **Q7. Won't the plastic be too slippery? What about wintertime?**

*There are several ways to tackle this problem. First, we will investigate whether we can make the plastic itself skid resistant. If this isn't possible, we could also apply sand or crushed stone to the surface of the PlasticRoad (by pressing or printing), thus providing the required roughness. Our goal is to integrate the roughness in the road itself.*

 **Q8. Is it bad for the environment? Won't friction and wear release (microscopic) plastic particles that are dangerous for man and environment?**

*Sustainability and the environment are of paramount importance to KWS Infra. We are investigating to what extent wear will occur. It's a potential risk that we're taking into account. We don't expect that loose particles will cause major problems with the PlasticRoad. A wear layer or special coating should be able to prevent this. Research will have to show how durable the material is and what the consequences are. We're looking for the most sustainable option.*

 **Q9. Is the PlasticRoad toxic in case of fire?**

*We can use a fire retardant or fire resistant coating to prevent this. Also, it's unsure how often this will be an issue and to what extent harmful substances will be released. We will research this. At first, we will look into the PlasticRoad as a bicycle path, where the chances of fire are considerably smaller (because there are no vehicles involved).*

 **Q10. How new is this concept?**

*The concept has never been seen before in this form and with this choice of materials. This leads us to conclude that the concept is truly unique. The idea for the concept was conceived by two of our colleagues: Anne Koudstaal and Simon Jorritsma.*

 **Q11. How was the idea conceived? (!)**

*The idea was conceived by looking at the problems that municipalities and we as contractors deal with. This includes societal problems, such as waste, combined with alternative materials for roads, as well as the future shortage of oil, which provides the most important component of asphalt: bitumen. Municipalities are looking for roads with little maintenance that last as long as possible. Other significant problems for municipalities are flooding (water storage), consolidations, cables and pipes. For contractors, asphalt is a great and sound product to build roads. However, contractors have to meet more and more demands concerning noise reduction, water permeability, and flatness. These questions and conditions were the inspiration which have led to the idea of the PlasticRoad.*

 **Q12. Why is a PlasticRoad more sustainable than a traditional road? (!)**

*The idea behind the concept is that the PlasticRoad is produced from 100% recycled plastic: plastic that is currently being incinerated. This allows plastic waste to re-enter the chain at a much higher level and greatly reduces its carbon footprint. Moreover, the innovation is in line with the Cradle-to-Cradle philosophy of KWS Infra. And we expect that a PlasticRoad can be recycled again at the end of its lifespan and made into parts for a new PlasticRoad (circular economy). For example: while a plastic bag lasts for a few days, a PlasticRoad lasts more than fifty years! This way, plastic remains in the chain much longer and the natural resources used to produce plastic will be used much more effectively.*

*The plan is to place the PlasticRoad directly on a surface of sand. This removes the need for a foundation, as well as the current heavy construction that no longer needs to be produced. This means less transport to the construction site, but also less transport from the location where resources are extracted to the production plant. This significantly reduces the number of transport movements involved.*

 **Q13. Is there enough available plastic?**

*A Plastic waste is a worldwide problem that gets increasingly more attention. An estimated eight billion kilograms of plastic is currently floating around in our oceans. And over 55% of all plastic waste is still being incinerated. In short, there is more than enough plastic for the construction of PlasticRoads.*

 **Q14. What kind of partners are you looking for?**

*KWS Infra is looking for partners that believe in PlasticRoad and want to further develop the idea with us. We feel that collaboration is the key to actually realising this idea. We*

are looking for partners in the plastics industry such as plastic recycling companies and producers of plastic. We are also looking for parties or research institutions (universities) whom have knowledge producing plastic. We also want to involve clients (municipalities, provinces, water boards, the state) in the development process to ensure that the final product fits their needs. KWS Infra is calling out to everyone that believes in this idea and might be able to contribute to its development to contact us. All applications will be assessed by KWS Infra based on their contribution and added value to the realisation of the project.

You can sign up with Anne Koudstaal or Simon Jorritsma.

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#### **Q15. How will you collect the plastic?**

To collect enough material for the production of the elements for the PlasticRoad, we are looking to use plastic from the oceans. We can turn this waste into roads. We're also looking at the option of collecting plastic waste at incineration plants in Germany and the Netherlands. It is a waste to burn plastic, when it's possible to reuse it and give it a new, high quality utility.

#### **Q16. When will the first PlasticRoad be built by KWS Infra?**

At the moment we are working hard on the business case for the PlasticRoad. We are researching the best way to produce the PlasticRoad. As soon as the idea is proved to be feasible, we can quickly arrange a pilot. The City of Rotterdam has already offered a pilot location where we can test the PlasticRoad. The pilot will start as soon as possible.

#### **Q17. What is Infralingq?**

Infralingq is a special department and an independent think tank within KWS Infra that focuses on innovation, sustainability and smarter products.

#### **Q18. What other innovations is KWS Infra working on?**

KWS Infra is working on several technical and process engineering innovations.

A recent innovation is Flow With The Glow. A material that is based on photoluminescence and can be used to make road markings and guide rails visible in the

*dark without electricity. A good example of our process engineering innovations is the intelligent roller (smart material).*

*Recent innovations in the field of asphalt are KonwéCity, Sustainable ZOAB and the KonwéFlex. KonwéCity is a noise-reducing asphalt with a longer lifespan, sustainable ZOAB is a ZOAB-mix with 25% PR (old, reused asphalt), and Konwéflex is a crack-preventing layer of asphalt. Other examples: KonwéBio, KonwéCool, KonwéClear. Asphalt is greener and cleaner than some people may think. It is a natural product, consisting of stone, sand, and bitumen. On average, our asphalt consists of 50% recycled materials. Using the HERA-system we can even produce asphalt made of 100% recycled materials.*

 **Q19. What are the risks?**

*As with any innovation, it is necessary to take stock of the pros and cons. Every innovation may encounter problems in its early stages. It will have to meet current regulations. But for now, we mainly see many opportunities for the development of PlasticRoads.*

 **Q20. Can all types of plastic be used?**

*Any kind of recycled plastic can be used for the PlasticRoad. There are many different kinds of plastic that all have their specific properties. The PlasticRoad has to meet a number of functional requirements, just like traditional roads. Research with partners from the plastic and recycling industry will have to show which kinds of plastic and which combinations of plastic can be used.*

 **Q21. How does prolonged exposure to the sun/UV affect the material?**

*The civil engineering sector already produces and uses several products that are made from recycled plastic. Examples include timbering, scaffolding, sheet piling, bridges and light poles made of plastic material. These products have no problems with prolonged exposure to the sun or UV-light.*

 **Q22. The PlasticRoad consists of prefabricated parts. How will you connect these parts?**

*There are various ways to connect the prefabricated parts. Further research will have to reveal which method is the most suitable. This choice also depends on the final, optimal design.*

 **Q23. Connecting the prefabricated parts will leave seams. How will you deal with these?**

*In road construction, seams play an important role too. Examples are concrete roads and joints. KWS Infra has the necessary experience and knowledge to deal with this. With our knowledge as well as the knowledge of our partners, we want to minimise the effects of seams.*

 **Q24. Will the seams form a problem for water storage?**

*This is something that we will have to take into account when selecting the best way to connect prefabricated parts.*

 **Q25. PlasticRoad is a lightweight construction. Won't the construction start to float when groundwater levels are high?**

*This challenge is a potential risk that we will take into account in the development of the PlasticRoad.*

 **Q26. What are the first possible applications of the PlasticRoad?**

*We focus on urban areas and bicycle paths.*

 **Q27. Have there already been trials?**

*No. We want to develop a prototype with appropriate partners to test and perform experiments. The result will be a test area. Several parties, including the city of Rotterdam, have already offered a location for this test area.*

#### Core Sustainability Message VolkerWessels

VolkerWessels is building a better environment. But our activities are not silent and have impact on man, environment and society. With a team of fifteen thousand colleagues, we focus on achieving sustainable ambitions. This includes themes such as the supply chain, resource management, CO2 emissions, and energy consumption. We want to minimise the negative impact on the environment through awareness and by using smart techniques and concepts. We take responsibility for future generations and avoid waste as much as possible.

**A leading authority on plastics resource management and recycling, founded in 1990 to instigate and develop UK plastics packaging recycling opportunities at the request of the industry, for the benefit of all. As a membership based organisation, RECOUP has worked tirelessly over the past 25 years to independently lead and stimulate the sustainable design, procurement, collection, handling, sorting and reprocessing of UK plastics packaging.**



Plastic is popular for many applications, but it is these wide-ranging applications and unique characteristics that also created barriers to finding practical and cost effective recycling solutions. In 1990, it was unclear what the barriers were, and how solutions could be identified, developed and implemented. It was this challenge that encouraged a number of companies from different sectors to work together. By working as RECOUP, in collaboration with the entire supply and recycling chain, many of the challenges have and will continue to be overcome.

Today Recoup is a forward thinking independent organisation drawing on the knowledge and expertise across its broad network to provide support and assistance at each stage of the recycling journey. Built on a network of members representing all parts of the plastic supply and recycling chain, the experience and depth of knowledge is also underpinned by the strength of its team and board members. This includes market leaders across each sector, and allows Recoup to add insight, initiative and value to projects across the plastics packaging recycling journey.

Wider networks are also maintained across various plastic, packaging, local authority, waste management and recycling trade associations and relevant government and non-governmental organisations.

RECOUP delivers a range of programmes and activities to a wide range of clients and organisations, working with many leading UK and international recycling groups to ensure that it assists the implementation of best practice and developments. Together with its valued membership network, contacts and clients, Recoup will continue to work across the industry to help shape a socially responsible plastics packaging recycling future.

Excellence in plastics waste and resource management is increasingly important for businesses requiring compliance with statutory targets and for local authorities seeking to offer best value services. Effective management of waste will improve the environmental reputation of plastics, enable low cost compliance, meet statutory needs and provide consumers with the service they expect.

The ever increasing pressure for this generation to take environmental responsibility and protect resources has led to the new circular economy proposals from the European Commission. The general direction is clear – better long term use of resources through the development of circular economy models. For plastic packaging to become a truly sustainable resource improved recycling will have a crucial role to play.

## Vision

Lead and inform the continued development of sustainable plastics recycling and protect plastic resources.

## Aims

- Maintain and increase plastics recycling.
- Improve positive view and visibility of plastic recycling.
- Retain and grow RECOUP network through funding and membership.
- Maintain balance, impartiality and position of the organisation.

## Charitable Objectives

- To advance the education of the public on the subject of recycling plastics so as to protect the environment.
- To preserve and protect the physical and natural environment for the public benefit through the promotion of waste reduction and recycling of plastics.

## The Development Of Household Plastic Bottle Recycling In The UK

**Once household plastic bottles had been identified as a primary recycling opportunity and key focus for RECOUP, work began to realise the potential. More than 25 years later, UK household plastic bottle collection has shown significant progress and is still monitored today through an annual RECOUP report.**

Early work included engagement with the collection authorities and potential material users to demonstrate the opportunity and identify early adopters of a plastic bottle collection programme. This required provision for the collection, handling and baling of this material for transport to a reprocessor, and a programme of education to encourage use of the system by consumers. This work was undertaken by a core RECOUP team but also supported by directors and members.

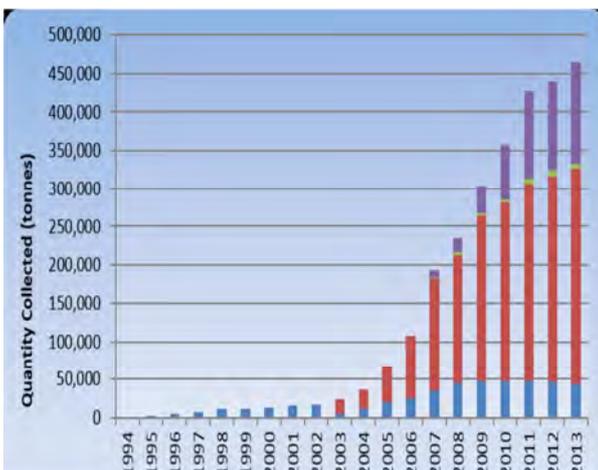
The significant increases in collections could simply not have been anticipated back in 1994, but it is through the annual survey that the impressive progress and story of plastics recycling from UK's households can be tracked. The first Survey was completed in 1994 by sending out questions to Local Authorities about their plastic collection services. A reported 3,150 tonnes of plastic bottles had been collected for recycling in total, with 900 plastic bottle collection points and kerbside bottle collections covering 300,000 households. This represented eight kerbside bottle schemes. There was also focus on optimising collection routes, managing quality through communications, and the development of basic material reclamation facilities (MRF) to effectively sort bottles, including implementation of state of the art automatic detection units.

### Developing The Opportunity

- Establishing collection programmes
- Installing handling and sorting facilities
- Working with reprocessors
- Communications and consumer engagement
- Developing markets for recycled materials
- Increasing system efficiency and reducing costs
- Establishing partnerships
- Research, innovation and technology
- Targets and legislative requirements
- Guidance and specifications
- Promoting evidence for success

After the success of these early schemes, collections grew steadily as Local Authorities became more aware of the opportunities and benefits of collecting plastic bottles. Sustainable markets developed, better handling and sorting infrastructure was installed, and the public became more familiar with recycling plastic bottles. Around this time it was also noted that adding plastic bottles to a collection service also boosted the collection of other recyclables such as paper and glass. Schemes and collection levels continued to grow through the 1990's. By 2003 24,000 tonnes of plastic bottles were collected for recycling annually, consisting of 18,000 tonnes from kerbside collection schemes and 6,000 tonnes from bring schemes – over three times more from kerbside schemes. At this time the landscape of household plastics collection began to change, and collecting mixed recyclables from households became commonplace. There has been a significant growth in the use of kerbside collection systems ever since, although bring schemes have maintained a presence in a number of areas as a supporting service.

From 2007, the collection of other rigid plastic packaging such as pots, tubs and trays was also monitored, and has shown rapid increases in recent years. Now commonly referred to as PTTs, this collection growth continues. As the collection offering has expanded, the popularity of alternating services, fortnightly collections and mixed recycling collections has also increased. More recently, the number of kerbside services has collecting household films is increasing. The PTT and film formats are following a similar development route to the plastic bottles, with increasing collections, provision for sorting, market development and communications being key elements, and RECOUP providing support and advice in these areas.



Since reporting began, the UK has collected over two million tonnes of plastic bottles and half a million tonnes of pots, tubs and trays for recycling. This equates to 50 billion bottles saved from landfill in the 20 year period 1994-2014. The job is not yet complete. There is still a need to further increase the collection levels both for the more traditional items such as bottles and pots, tubs and trays, and other items such as films and non-packaging plastics. The amount of bottles collected is not the only consideration with requirement for 'value recycling' also fundamental to the successful development of UK plastics recycling by ensuring appropriate material quality is supplied. Material specifications have been developed and used over many years to improve the communication between local authorities, their contractors and reprocessors.

## Resource efficiency case study: tar bound road planings

# A66 Little Burdon to Newton Grange resurfacing

**This case study demonstrates how assessing the volume, type and condition of existing pavement materials at an early stage in the project lifecycle can maximise materials resource efficiency.**

### Background

Site investigation undertaken as part of the £2.5m 'A66 Little Burdon to Newton Grange Carriageway Resurfacing Scheme' identified the potential to generate in the region of 9,000 tonnes of tar bound road planings during the excavation of the existing pavement material.

### Organisations involved

- Highways Agency (Client);
- A-one+ (Designer / Highways Managing Agent Contractor);
- Pavement Testing Services Ltd (Pavement Testing Sub-contractor)
- Hanson (Managed Works Contractor); and
- Roadstone Aggregates Ltd / BaseCon UK (Planing and Foamix Sub-contractor).

### Waste classification

Coal tar is classified as carcinogenic due to its high concentration of Polynuclear Aromatic Hydrocarbons (PAHs) - more than 15,000 times that found in bitumen. Consequently, waste tar bound road planings are considered to be hazardous waste (European Waste Code 17 03 01\* bituminous mixtures containing coal tar) where the level of coal tar is >0.1% w/w (1,000 mg/kg). Even when treated, normally by using a binding agent such as cold bitumen foam mix, they are still considered to be hazardous waste and their subsequent use in construction requires an environmental permit to be registered with the Environment Agency.

### Coal tar identification process

The presence of coal tar can have major implications to a construction project, due to the health and safety issues posed by handling the material as well as the additional cost that comes with the removal and disposal of a hazardous waste. The early identification of tar bound material can therefore act as an early warning to Project Managers and Designers involved in



**A66 pavement core (tar bound binder course can be observed between 100mm - 200mm). Photo courtesy of PTS Ltd**

highways maintenance projects and can be vital in reducing project costs and delays.

The scheme used an innovative core logging methodology, developed by the pavement testing sub-contractor in order to identify tar bound construction layers at the project feasibility stage. This uses a simple chemical indication process applied to each layer of the core allowing the operator to detect the presence of tar. This method has been validated on cores from a number of different sites and has been verified by UKAS accredited laboratory testing.

### Resource efficient approach

The original scheme design, based on a conventional pavement reconstruction, required removal of the tar bound planings and their disposal to landfill or treatment at a suitably licensed site. However, through employing a flexible and reactive tendering process, the project team were able to respond to a tender query which highlighted the potential cost saving of recycling the planings. The project team subsequently amended the scheme tender documents to ensure this option was considered.

The early identification of tar bound material enabled the project team to:

- undertake pre-contract discussions with the Environment Agency and Local Authority to clarify the regulatory position relevant to the re-use of

hazardous waste tar bound road planings in construction projects;

- ensure that all the necessary permits or exemptions for the operations were obtained prior to starting work on site; and
- delineate between tar and non-tar materials during the removal process.

### Ex-situ recycling (Foamix)

The tender assessment took into account the proposals developed by the contractors for managing these materials. Ex-situ recycling, in the form of 'Foamix', was selected by the project team in preference to conventional pavement reconstruction as it provided significant financial and resource efficiency benefits.



**Treatment of waste tar bound planings.**  
Photo courtesy of A-one+.

Foamix is a term commonly used to describe a cold lay asphalt base course which has been mixed with a binder consisting predominantly of foamed bitumen. Merrill, D *et al* (2004)<sup>1</sup> states that "*Foamed bitumen is produced by the injection of 1 to 2% cold water with air into hot penetration grade bitumen. This process produces a high-volume, low viscosity fluid with low surface tension; these properties enable the foamed bitumen to coat a wide range of moist, cold recycled aggregates*".

The Foamix used on the scheme included:

- asphalt waste containing coal tar - 87.5%;
- pulverised Fuel Ash - 8%;
- bitumen - 3%;
- Ordinary Portland Cement - 1.5%; and
- water.

Ex-situ recycling was undertaken by Roadstone Aggregates Ltd, at an old compound adjacent to the scheme, in accordance with the Environment Agency Regulatory Position Statement covering 'The use of treated waste tar bound road planings in construction operations'. This confirms that the Environment

Agency will not pursue an application for an environmental permit for the activity where:

- the waste tar bound road planings are treated at a suitably permitted facility;
- the treated planings meet the Specification for Highways Works Series 900; bituminous bound materials, before re-use;
- the subsequent movement of the treated planings is covered by a hazardous waste consignment note; and
- the relevant objectives of the Waste Framework Directive are met '...ensuring that waste management is carried out without endangering human health, without harming the environment and in particular:
  - (i) without risk to water, air, soil, plants or animals;
  - (ii) without causing a nuisance through noise or odours; and
  - (iii) without adversely affecting the countryside or places of special interest.'

### Resource efficiency benefits

Ex-situ recycling delivered a number of significant resource efficiency benefits, compared to a traditional design option of a primary aggregate hot mix asphalt base course:

#### ■ wastage rates and material demand

Ex-situ recycling avoided approximately 9,000 tonnes of hazardous waste requiring off-site disposal, and the subsequent import of the same volume of new construction materials.

#### ■ embodied carbon in materials / products

The use of the cold recycled bound material resulted in a calculated 28%<sup>2</sup> (169 tonnes) embodied carbon<sup>3</sup> saving due to reduced bitumen content and lower mixing temperatures.

#### ■ increased lifespan

The treated material was placed at a depth of between 150mm and 300mm. This depth ensured that future patching schemes would not require the removal of the tar containing Foamix material.

<sup>1</sup> Merrill, D *et al* (2004). *A guide to the use and specification of cold recycled materials for the maintenance of road pavements* TRL Report TRL611.

<sup>2</sup> Emissions Factor Ref: University of Bath's Inventory of Carbon and Energy (ICE) V1.6a (Hammond and Jones, 2008).

<sup>3</sup> Carbon is used as shorthand for carbon dioxide equivalents

- significant cost savings

Avoiding sending the tar bound planings to landfill which would have cost in the region of £1.3m.

- reduced vehicle movements

Ex-situ recycling avoided an estimated 2,325 tonne-kilometres (tkm) – eliminating over 490 tonnes of carbon from the schemes carbon footprint<sup>4</sup>.

## Lessons learnt and key learning for future projects

- placing emphasis on assessing the volume, type and condition of existing pavement materials, at an early stage, provides the greatest opportunity of developing solutions that avoid disposal of materials to landfill;

- neither the project team nor the local Environment Agency Office had previously dealt with tar bound road planings on such a scale and detailed discussions were required regarding the interpretation of the relevant legislation. In addition, because the environmental permit for the Foamix plant was new it needed to be issued by the Local Authority (rather than the Environment Agency) which required additional discussion between the contractor and the Local Authority and Environment Agency over the wording of the permit;

- ex-situ recycling was undertaken at an old compound adjacent to the highway and it was agreed with the Environment Agency that this compound could be classed as part of the site. The significance of this was that as the material was being treated 'at the place of production' this precluded the need for hazardous waste consignment notes for moving the tar bound materials to and from the batching plant;

- the scheme generated useful primary data (e.g. cores, Foamix samples, leachate data) to assist the European Pathway to Zero Waste Project with developing the ongoing Quality Protocol (QP) for 'Asphalt Waste Containing Coal Tar'. The QP will define the standards which asphalt waste containing coal tar must achieve (to be considered a non-waste) to encourage its use as recycled aggregate. The Environment Agency's position statement is an interim position, pending the outcome of the waste QP process, which will be withdrawn once a decision is made whether to give a Quality Protocol or not; and
- greater awareness and understanding of hazardous waste regulations in relation to tar bound materials within client, regulators, designers, and contractors would help to ensure a resource efficient approach.

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<sup>4</sup> *Emissions Factor Ref: Department of Energy and Climate Change (DECC) et al (2011) GHG Conversion Factors for Company Reporting.*

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## Asphalt at Lexmark parking lot is first in North America to use recycled toner

At a glance, the pavement put down last week outside Building 032/035 in Lexington looks no different than typical asphalt, except that it is possibly a little blacker, and the process of making it is only slightly changed. But for Lexmark, it represents a solution to an old problem — what to do with leftover toner — and for the asphalt and printer industries, it could mean a major development in sustainability.

Put simply, the asphalt contains toner captured from what remains in recycled printer cartridges and the natural waste that comes during toner manufacturing.

The parking lot on Lexmark's Lexington campus, on the north side of Building 032/035, is the first commercial application in North America of a product called TonerPave®, which literally uses the same toner powder used in Lexmark printers to make asphalt — and possibly make it better.

“We were trying to find a way to reuse and recycle toner for the past 10 years,” said John Gagel, corporate manager, sustainability. “TonerPave® is an efficient and effective manner in which to recycle toner. We're now demonstrating that we have a solution that can be utilized in a sustainable manner. It's part of the circular economy.”

TonerPave® was developed by Lexmark's long-time sustainability partner Close the Loop, an Australian-based company that recycles printer cartridges from Lexmark and other companies at its plants in Melbourne, Australia and in Hebron, Kentucky in USA.

According to industry statistics, about 13 percent by weight of used toner cartridges is toner powder.

Rob Burkholder, program manager for supplies sustainability, said Lexmark has been working on toner re-use, but no other post-market solution could be found for it except in a “waste-to-energy” scenario, in which the toner is used as fuel in industrial furnaces.

Lexmark contacted Close the Loop to see whether it could help.

“We needed something that would add a tangible benefit to the end product,” said Dean Vukovic, Close the Loop's US Director of Business Development.

He and Steve Morriss, Founder and Director at Close the Loop, said their company has been working on a high value reuse application for waste toner for almost 15 years. “Our team found that toner is predominantly a high grade engineering plastic very similar to polymers currently used to make quality asphalt surfaces, but toner alone is not the answer.” said Morriss. Close

## TonerPave® Case Study

the Loop developed an asphalt additive, a composite incorporating waste toner and other recycled materials called Modified Toner Polymer (MTP). This new additive improves the asphalt quality and performance, with an environmental benefit of producing low carbon asphalt at no additional cost. Thus was born TonerPave®.

By the numbers, for each 1,000 pounds of asphalt, there is 50 pounds of binder. In the new product, 5 pounds of the binder is MTP, of which 4.75 pounds, or 95 percent, is recycled toner.

The product has been used in Australia since last year; the Lexmark parking lot is the first commercial use in North America.

Besides Close the Loop, Lexmark is partnering on the 032/035 project with general contractor Denham Blythe, paving company APM and asphalt mixer The Allen Co., all of which are based in Lexington. At Lexmark, Paul Ackerman, energy manager, is the project manager.

APM President Peter Kramer said, “We like to be sustainable in any way we can be. We look forward to these opportunities. We were excited to learn about the TonerPave® process and use in this project in particular — but also would like to use in future on other jobs as the performances prove themselves out.”

To provide a side-by-side comparison, the south eastern side of the parking lot is paved with standard, non-toner asphalt as a control. On the surface — literally — the TonerPave® asphalt looks a little blacker. There’s no other visible difference. In applications in Australia, TonerPave® has been found to stiffen asphalt, helping to prevent rutting and cracking.

If long-term observations of TonerPave® continue to bear out the results from the past year, it could prove to be an asphalt improvement for equal value.

Burkholder said there are high hopes that TonerPave® is “the solution” for the sustainability issues around toner. Gagel added that TonerPave® will be specked out for future use at Lexmark.



## Waste Electrical and Electronic Equipment (WEEE)

The UK has a target to recycle more than 45% of all WEEE in 2016 (WRAP <http://www.wrap.org.uk/sites/files/wrap/WEEE%20recovery%20in%20the%20UK.pdf>). There are facilities called Approved Authorised Treatment Facilities which can deconstruct WEEE and recover the component materials to be used in other products. In the process, various treatment methods are used to separate different materials. These methods include physical breaking of the equipment to using mechanical methods such as agitating through a sorter to grade material.

On the highway network there is currently a large amount of electrical and electronic equipment. In addition, as an organisation Highways England is likely to have computers, monitors and other similar equipment in offices. These items will need replacing as they become obsolete. The great recovery (<http://www.greatrecovery.org.uk/>) is an initiative which aims to encourage designers to design their products to be reused or remanufactured and for easy deconstruction for recycling.

Below is an example of the process that WEEE could go through to be re-manufactured or recycled and to keep as much material as possible in the value chain. There are many organisations that offer this service.

