Construction Consolidation Centres in North Kent

Needs Analysis and Feasibility Study

Report for:

Land Securities
SECBE
SEEDA
Wincanton

CONSTRUCTING EXCELLENCE
in the built environment

Construction Consolidation Centres in North Kent

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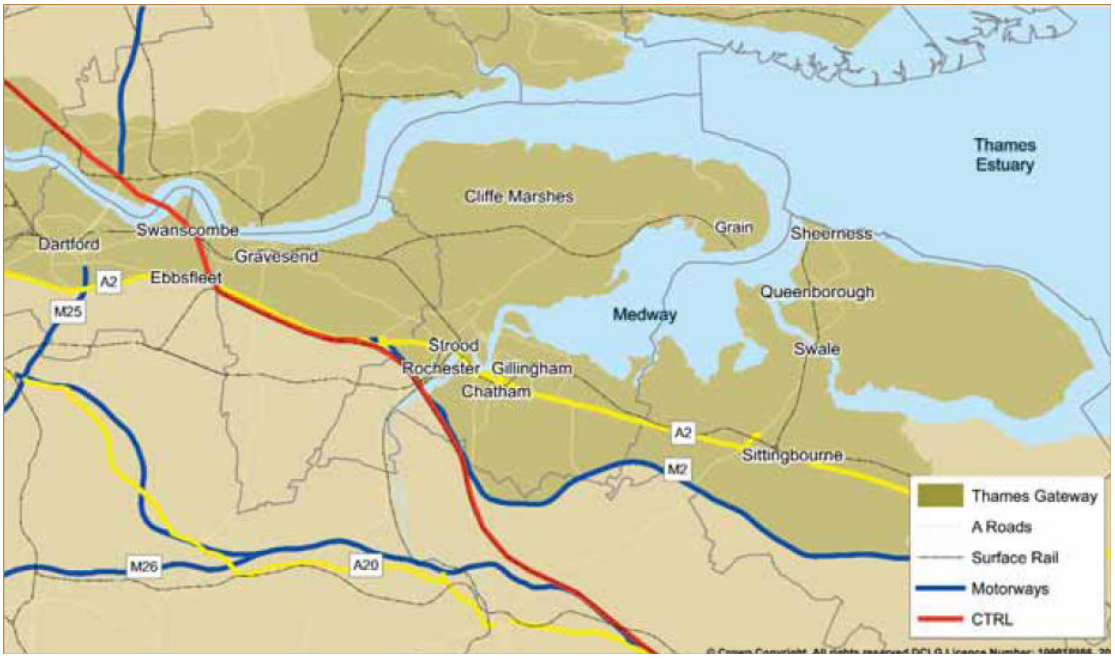
A Report for Land Securities, SECBE, SEEDA and Wincanton

Authors: Adrian Blumenthal and Adrian Young
Constructing Excellence, October 2007

Executive summary

This report examines the need for and feasibility of using Construction Consolidation Centres (CCC) to assist in the rapid regeneration of North Kent (the area north of the A2/M2 from Dartford to Swale) over the next 25 years. It highlights the immediate opportunity presented by Land Securities' developments centred on Ebbsfleet, in the context of the need for improved construction logistics in the whole sub-region from Dartford to Swale.



This is an opportunity to make the best use of all resources needed for construction – materials, equipment, transport, information, money and people. This means making logistics a mainstream activity in construction.

The analysis assumes:

- Development forecasts obtained from planning authorities
- Traditional forms and processes of construction
- A number of pallet equivalent units (PEU) to pass through the CCC for a given type of construction.

Methods of logistics

Logistics – *the art of applying timely resources* – is a fundamental tool for construction.

We have identified four main methods of logistics in construction, ranging from the SME builder who collects materials from the wholesaler in a white van to the business that co-ordinates a start-to-end process and tags information, people and material flows. Only about 5% of construction is supplied by this latter 'alternative' method.

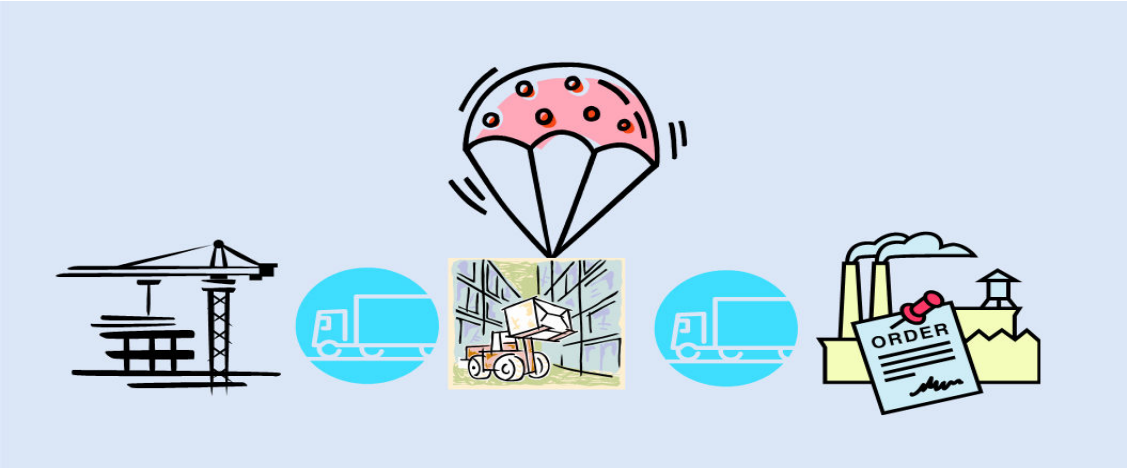
We have found seven modern techniques used in the alternative method:

- Logistics planning across full supply chain
- Consolidation centre
- Just-in-time delivery to workplace
- Fourth party logistics
- Logistics specialist on site
- Demand smoothing
- Integrated ICT system across full supply chain.

Although these techniques are widely used in manufacturing and retailing, only a few projects have adopted them for construction.

Benefits of consolidation

A consolidation centre is a distribution facility that receives materials, equipment and plant and delivers to the sites in consolidated loads.



The benefits of consolidation include:

- Up to 40% reduction in traffic, exhaust emissions and fuel used in local distribution
- Up to 6% increase in the overall productivity of the construction workforce
- Up to 20% reduction in haulier costs when delivering to congested areas
- Up to 15% savings in materials by eliminating waste caused by over-ordering, losses, theft and damage.

We estimate that a successful consolidation process that exploits these benefits would lead to an overall reduction in construction cost in the region of 8%.

The best known examples are at Heathrow airport and the London CCC at Bermondsey. Consolidation works well at Heathrow because the site is strictly controlled. However the London experience has not been so positive commercially, although it has demonstrated marked environmental improvements.

Need for logistics specialists

We have observed that the processes for ordering and calling off materials in the LCCC trial are little different from traditional logistics. Unless logistics specialists are engaged in ordering and calling off materials, it will not be possible to realise the benefits that consolidation offers the construction industry, such as reducing material losses and countering the over-ordering culture. In order to achieve change, it is necessary to identify the delivery cost in material bills and to give an incentive to every player in the supply chain to co-operate.

Drivers and barriers

Evidence from interviews and workshops show that clients, regulators and the supply chain are beginning to see consolidation as a means to improve programme certainty, contain cost, reducing waste and minimise the impact that construction logistics has on the environment. It is likely that increased regulation will be an important driver. However the barriers are many:

- Ineffective leadership
- Inadequate regulation of the transport system
- Lack of a clear business case for modern logistics in construction
- The construction industry's fragmented structure and its reluctance to change
- Lack of effective ICT infrastructure across supply chains
- Ineffective programme and process management
- Lack of conducive contractual arrangements and cost management.

Demand for materials and sites for CCCs

We have analysed the demand for construction materials in the North Kent over the next 25 years and we have modelled how CCCs in various locations could supply this need.

A single CCC to serve all the North Kent Thames Gateway Development is not a practical option. The North Kent development programme would be best served by the implementation of local CCCs, one for each of the areas considered – North West Kent, Medway and Swale. The CCC sites included in modelling demonstrate that they offer real opportunities and could be seriously considered as locations for CCC. The North West Kent area offers the greatest choice, while Medway and Swale have fewer options, although more sites may exist in all cases.

If a CCC is located close to the centre of its development area to meet the peak demand, the operating costs would be at their lowest. However, construction phasing will influence this cost and therefore a comprise location is probably best found in the interest of long-term costs.

Intermodal transport

Traditionally, construction materials are delivered almost entirely by road transport. Because of North Kent's proximity to the rivers Thames and Medway, and an existing mainline railway, we considered the potential for intermodal transport that might use delivery by rail or by sea. Although we have identified several sites that would be suitable as CCCs with intermodal hubs, we have concluded that there is, as yet, no convincing business case for developing CCCs of this type. This would change only if new Government policy created a substantial shift towards the economics of intermodal transport.

Financial model

The financial model for consolidation depends on fixed costs for the centre and variable costs related to throughput. On the basis of two models we examined, the unit cost is in the region of £15-20 per pallet for the optimum sized CCC. Selecting the optimum size has a significant impact on unit costs.

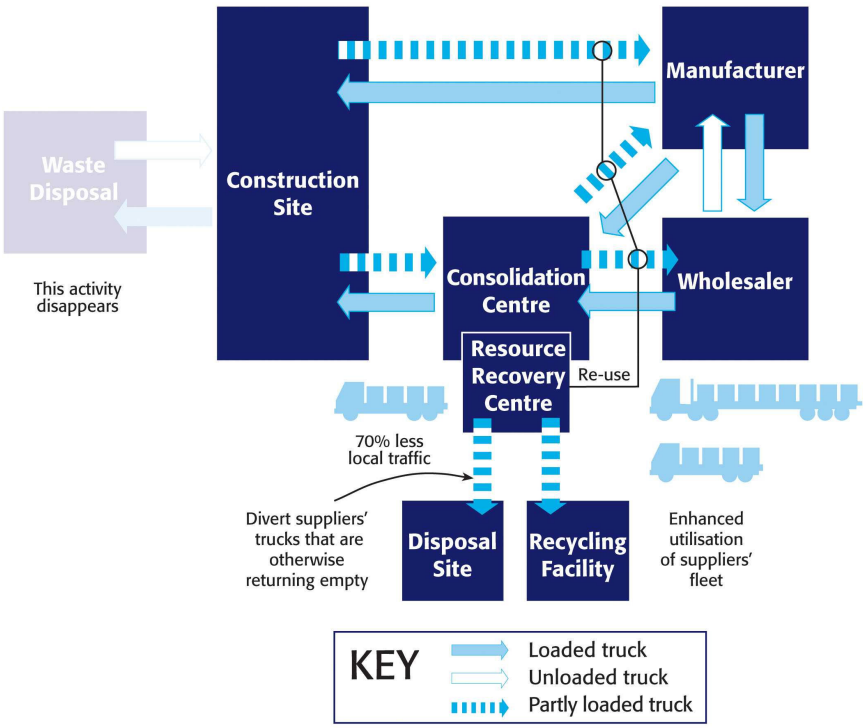
Business case

To make the business case for consolidation, the potential financial benefits (excluding the cost of complying with increasingly stringent environmental regulations) are of the order of 8% of construction cost, made up of productivity of the construction workforce, productivity of hauliers and avoidance of over-ordering and minimising waste. Depending on the form of construction, the cost of the consolidation service is in the region of 0.5% to 3% of construction cost. However, this business case is conditional upon engaging a logistics specialist to manage the supply chain and configuring commercial arrangements in the supply chain so as to favour co-operation and distribution of benefits to all stakeholders.

Because of the need to convince industry to invest in the new system, some pump-priming money may be needed from the Government which is relying on the redevelopment of North Kent to achieve its own objectives in the region.

Ancillary services

There are several ancillary services that may be more economical to establish, and which would probably deliver more effective services, if run in conjunction with the CCC. We concluded that facilities for **site security**, **welfare of the construction workforce**, **reverse logistics** and **building offsite** have a strong symbiotic relationship with the consolidation process. We are particularly impressed by the potential to integrate the logistics (delivery to site) and reverse logistics (removal of materials not needed) processes in a combined consolidation and resource recovery centre. This diagram shows how such an integrated service would increase utilisation of vehicles delivering to sites and eliminate the waste disposal vehicles that presently work independently.



There is also potential to offset the cost of operating a consolidation centre by offering **concessions for services** that could be based at the consolidation centre and would increase the utilisation of the centre's delivery fleet. Concessions could be offered for resource recovery, access equipment and scaffolding, and construction equipment and tools.

We are impressed by the imaginative proposals from SUSCON for a **skills academy** and from CCI International for developing an international **innovation and business hub** and we are convinced of the need for these facilities. However, we note that the site areas these ideas would demand are disproportionate to what is needed for the basic CCC and they would not be ideal neighbours for the light industrial activity in the CCC. There may also be a need to relocate or abandon the CCC because the business model is heavily dependant on throughput. This would make co-location with a skills academy and business hub less viable.

SUSCON is already negotiating for a site in North West Kent and it looks likely that a temporary site will be found in Ebbsfleet. In the event that a single site cannot be found, SUSCON may accept a compromise solution on more than one site.

Planning for the innovation and business hub needs to commence immediately. We see the long-term solution on a separate site, but it would be possible to provide temporary facilities at the CCC provided suitably generous office accommodation is provided.

Although there is a clear need for skills and **employment services**, and an innovation and business hub for construction companies, we concluded their dependence on the CCC would be indirect only.

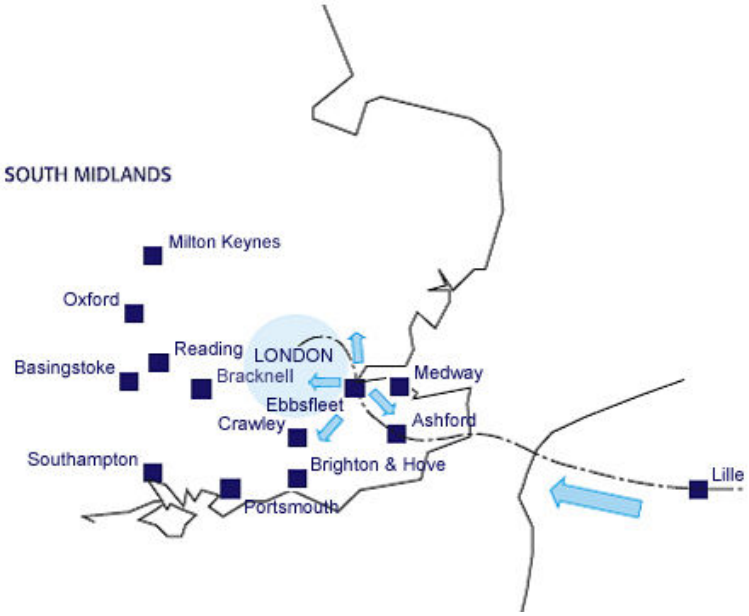
Regional application

Our initial impressions were that there could be a unified approach to improving construction logistics across the whole Thames Gateway. We are now of the view that this is unlikely to occur because:

- Logistics planning for the Olympics is well advanced, but wholly focused on that project.
- A consolidation centre should be seen as a local hub positioned as close as possible to the area it serves.
- It is necessary to cap travel time and distance from the CCC, meaning the idea of serving a large proportion of the Thames Gateway from one CCC is not feasible.
- There is no reason to plan consolidation centres in the context of the whole Thames Gateway because the factors that influence planning and design of a CCC are local.

Collaboration with foreign companies

We note that as activity increases within the SEEDA region, London and the East of England, there is no doubt that labour will transfer or travel longer to meet the demand elsewhere. This may lead to a resources vacuum in the North Kent area as illustrated below.



SEEDA is promoting the notion of the developing cross-channel trade with France, in particular the Lille region. On the inward investment side, the proposal is that, because it would be such a radical change in construction logistics, the CCC presents a focal point to attract French SMEs into the region. CCI International (the Lille Chamber of Commerce) raises the importance of French businesses being grouped together so that it is easier to them to be detected and selected by British clients and contractors. The question is whether the CCC could be a facilitating platform for SMEs as wells as well as a new logistics system.

The CCC is such a step change in how construction operates that it will make the local industry more competitive and willing to embrace innovative ways of working. Together with training in construction logistics, the CCC is an attractive model for the local industry to take abroad.

Recommendations

Strategy for consolidation

Overall approach

Provided the whole supply chain is involved in the change and proving the business case, consolidation has the potential to make logistics mainstream in construction. The need for consolidation and its implementation are local issues; but **strategic co-ordination** is essential to ensure that planners and developers recognise where consolidation and its associated modern logistics techniques would be effective.

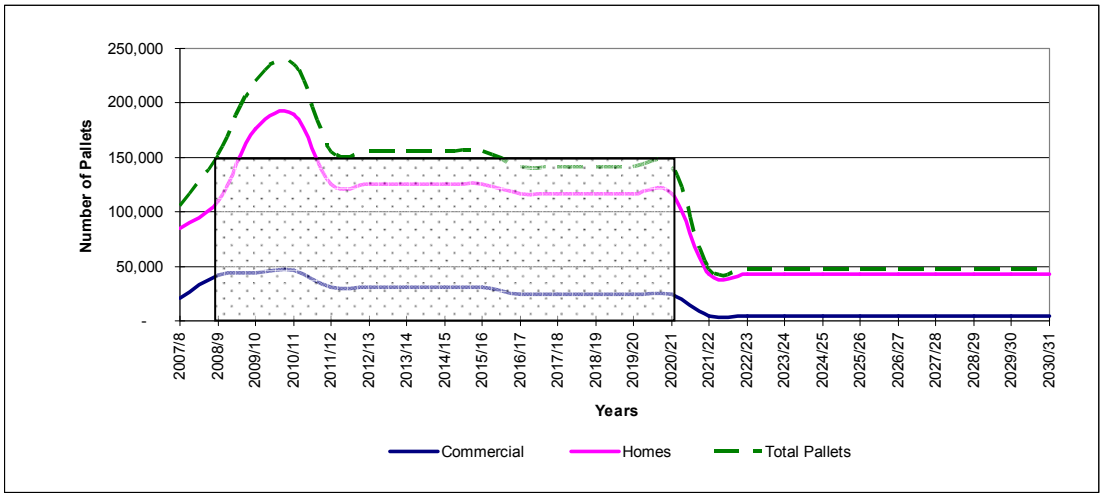
We agree with SECBE's strategy to establish and operate a CCC to serve Ebbsfleet Valley and Swanscombe Peninsula, and then roll out the solution to other demand centres in the South East of England.

Getting started

The best prospect for establishing construction consolidation in North Kent is to promote the solution with Land Securities who are enthusiastic. The demand forecast shows that, notwithstanding an early peak in demand due to other developments around 2010, Land Securities' requirements will increase steadily and plateau at about 2012. This output will last about 10 years and will be about two thirds of the construction in the district. The most likely viable solution will therefore be built around Land Securities needs. A CCC to serve Land Securities' needs alone would be viable. However, to serve the regional development objectives, it should be sized and operated in such a manner that it will serve the needs of the entire district. A warehouse of about 35,000 ft^2 (3,300 m^2) would service an annual throughput of about 150,000 PEU, in the ratio 2:1 Land Securities and others.

As an indicator of the scale of transport movements, the CCC would receive approximately 12 inbound deliveries per hour and despatch approximately 4 per hour to the sites.

The early peak demand for the district (240,000 PEU) is ahead of and considerably larger than Land Securities' needs. Designing the CCC for this peak is not recommended due to the short duration of this peak and the probable difficulty in gaining enough early support for the CCC. A centre sized for (say) 150,000 PEU, and operational from 2008 to 2021, would satisfy nearly all the demand in North West Kent for the next 15 years. This is shown below.



Proposed CCC serving NW Kent

In order to realise long-term benefits of the CCC and the ancillary services mentioned below, we recommend this CCC be regarded as 'permanent', in that it should have a 15-year life. Therefore it would need to be positioned where pressure to relocate it (caused by surrounding development) would be minimised. We have already identified several sites and further investigation may reveal more.

The CCC should be operated by a logistics specialist with a track record in operating a consolidation service (this need not be in construction) and access to knowledge of modern ICT systems that are already proven in the retail or manufacturing industries.

Ensure that sites served by the CCC engage a logistics specialist to oversee the ordering of materials and provide on-site logistics services to ensure just-in-time delivery to the work place.

Determine the need for ancillary services that might be offered as concessions and develop business models in consultation with specialist suppliers in each field. Focus initially on resource recovery.

Impact of building houses offsite

There is an important caveat here – Land Securities' intentions for building houses offsite. About 70% of their demand is based on traditionally built housing. Land Securites are concerned that the market may not be able to supply traditional housing in sufficient quantities; in which case they would need to seriously consider modular or panelised houses that would be built offsite. Such a decision would cause a large reduction in demand for materials suitable for consolidation. However, if Land Securities secured a modular supplier willing to invest in a local factory, then the CCC would be a useful buffer store for the factory. An early decision on this question is needed in order to determine the need for, size and location of a CCC in North West Kent.

Roll out

All immediate efforts should focus on establishing the first CCC in North West Kent. As soon as commitment is agreed, the next step is to identify other centres in the region that would benefit from a consolidation service. In no particular order, these include the rest of North Kent, Ashford, Southampton and Bracknell, as well as the neighbouring areas of the Thames Gateway. A feasibility study would be needed in each location to identify the key players, demand and suitable sites.

Intermodal transport

For the first CCC, ignore potential solutions involving rail and sea delivery. The factors affecting this decision may change for future CCCs, but it would need a significant shift in government policy and incentives to make intermodal solutions attractive.

Strategy for ancillary services

The first CCC in North West Kent should be designed to accommodate the ancillary services shown below.

Ancillary service	Potential use of CCC delivery fleet
Site security	Low
Welfare of construction workforce	Medium
Resource recovery	High
Access equipment and scaffold hire	High
Construction equipment and tools	High

All these services would be income generating if offered on a concession basis and were conditional on using the CCC fleet for delivery and recovery. Of these, the resource recovery would be the most lucrative. Therefore the location of a CCC needs to be considered in the wider perspective rather than as a CCC on its own.

SEEDA should promote the skills academy and innovation and business hub. Although these would be better sited independent of the CCC, temporary accommodation could be provided at a CCC for some of these services.

Further research

More work is needed to demonstrate how the business case for CCCs can be realised. We think that an 8% saving in construction cost is achievable. Given the tremendous impact this would have on the wider industry, government grants should be pursued to fund this work.

Environmental benefits

The environmental case is now well established (typically 40% reduction in local traffic and its effects) and no further work is needed. However, planners may reasonably request a Transport Statement before granting planning consent. This would be beneficial because it would ensure all transport considerations were properly accounted for in the design and siting of the CCC.

Productivity of construction workforce

Productivity studies have shown that a 6% improvement in productivity could be achieved with consolidation and improved on-site logistics. Analyse the value stream in order to assess the value of this improvement, how it accrues when processes change and how the benefit needs to be shared in order to achieve a sustained step change.

Productivity of hauliers

In conjunction with the procurement investigation (see below) conduct a survey of delivery times and costs. Ideally this should be done at the first opportunity on commercial and residential sites in North West Kent. Repeat the exercise once the CCC is implemented and new work practices are bedding down. Share the 'before and after' data with all stakeholders and devise an equitable share of the benefits.

Material waste

In conjunction with the procurement investigation (see below) conduct a survey of materials from the design outputs to installation and waste recovery. Identify the ways and quantities of waste generated (off-cuts, damage, theft, losses and so on). Determine the extent of over-ordering by comparing the quantity and value of materials actually needed (from the design outputs) with what is actually ordered. Ideally this should be done at the first opportunity on commercial and residential sites in North West Kent. Repeat the exercise once the CCC is implemented and new work practices are bedding down. Share the 'before and after' data with all stakeholders and devise an equitable share of the benefits. BRE, CIRIA, TRL and WRAP have various methodologies and services that may assist here.

Procurement

A procurement specialist should examine a supply chain that Land Securities intends to keep intact, more or less, for a project involving a CCC. Map the entire process from the design drawings and specifications, through take off, ordering, manufacturing, assembly, call-off, delivery to site, on-site logistics, installation and waste recovery. Identify how the consolidation service (as recommended above) would affect each participant, and what changes in contracts and specifications, KPIs and incentives are needed to ensure a committed shift to consolidation.

A procurement specialist should advise on the business model for setting up and running the consolidation centre and ancillary services, including who would 'own' the centre and each service, contractual arrangements with operators and payment mechanisms.

Carry out a portfolio analysis so that the key types of material, prefabrication, etc. can be captured. From this, the supply chain specialist will then:

- Identify resource and capacity issues with regard to skills
- Identify key suppliers and lead times, together with the strategy for advising on delivery requirements and maintaining the equilibrium of a consolidation centre
- Advise whether a consolidation centre is the best option in the context of alternative methods
- Co-ordinate all aspects of information and material flows
- Provide management information on materials and work with the commercial team to improve cash flows.

Information and communication technology

An ICT specialist, together with a logistician, should identify the ICT systems in place at each step in the supply chain and the potential for the various systems to communicate. Identify gaps and interoperability issues. They should recommend a staged upgrading of the ICT systems in the supply chain that would ultimately converge on a complete ICT solution from design outputs to waste recovery. The IT Construction Forum would be a useful partner to facilitate this work, together with Wincanton.

Demand for resources to deliver sustainable construction

New methods and materials needed for sustainable construction may drive demand for increased and different resources and technologies. SEEDA needs to explore this further, taking particular account of the potential to increase two-way commerce for SMEs in France and England that have convenient access to the Channel Tunnel.

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1 Introduction

1.1 Our brief

The Government's plan to regenerate the Thames Gateway will see a massive and sustained increase in construction activity over the next 25 years. It is estimated that 40,000 new homes will be built along with associated infrastructure and accompanying 1.75 million m^2 of commercial development. It will be important to mitigate the environmental and social impacts of this construction activity by adopting modern construction methods. Construction materials consolidation is a modern technique that reduces the environmental impact of construction logistics, lowers the cost of distribution, increases productivity on construction sites and reduces material waste. Although consolidation is now standard practice in the manufacturing and retail industries, only a handful of early adopters in construction have tried consolidation.

The South East Centre for the Built Environment (SECBE) – in partnership with Land Securities, the South East of England Development Agency (SEEDA) and Wincanton – commissioned Constructing Excellence in May 2007 to analyse the need for and assess the feasibility of construction consolidation centres (CCC) in North Kent. Constructing Excellence engaged Peter Brett Associates (PBA) to determine the potential demand for construction materials in the study area, identify potential sites, model various scenarios and advise on the potential for intermodal transport (especially by water) in conjunction with consolidation centres.

The Thames Gateway stretches for 40 miles along the Thames Estuary from London Docklands to Southend in Essex and Sheerness in Kent. Three agencies are promoting its sustainable regeneration – London Development Agency (LDA) in Docklands, East of England Development Agency (EEDA) north of the Thames and South East England Development Agency (SEEDA) south of the Thames.

North Kent, the subject of this study, is defined as the area north of the A2/M2 shown in Figure 1 and Table 1.

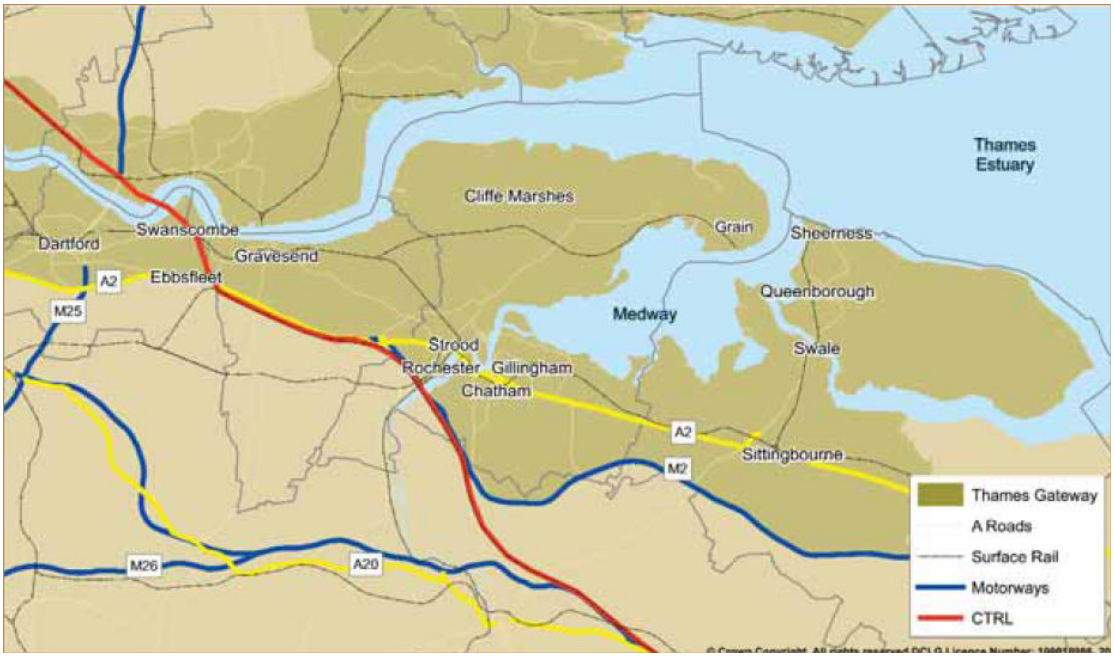

Figure 1: ***North Kent (source Thames Gateway Interim Plan Development Prospectus)***

Table 1: ***Development Boards and Local Authorities***

Development Boards	**Kent Thameside**	**Medway Renaissance**	**Swale Forward**
Local Authorities	Dartford Borough Council Gravesham Borough Council Kent County Council	Medway Council (Unitary)	Swale Borough Council Kent County Council
Principal development areas	Ebbsfleet (Land Securities) Northfleet (SEEDA)	Strood, Rochester, Gillingham & Chatham area	Queensborough Sittingbourne

The original brief is in Appendix 1. In consultation with SECBE's project manager, we omitted considerations of retail freight consolidation and agreed to a slightly amended brief, as follows:

Stakeholders – Interviews to establish interest, expectations, key success factors, and information and advice they can contribute to the project.

Regional and international initiatives – Consider links with regional and international bodies and initiates such as SEEDA, EEDA, GLC & France.

Drivers and barriers – Evaluate key and future drivers/limitations to CCC including but not limited to legislation, environment and business.

Ancillary services – Consider implementation and development of CCC operation, highlighting the range of activities that could be undertaken, from basic distribution facility to high capacity multi functional operation including reverse logistics, training centre, recycling, pre-construction assembly, etc.

Cost model – Produce an indicative cost model identifying capital costs, revenue projections, payback times, profit requirements of a commercial operator and identifying requirements for gap funding.

KPIs – Define key performance indictors and provide projections to demonstrate the possible environmental, time and cost savings attributable to a CCC, compared to the do nothing/business as usual scenario for the study area.

Demand – Assess demand for construction materials in the study area up to the planning horizons 2016 and 2026. Consider links to other local developments: SUSCON, Medway Renaissance, and Ebbsfleet.

Intermodal transport – Briefly assess the feasibility of utilising road, rail, air and marine transport. In particular, assess the opportunity, feasibility and benefit of utilising a waterside location for the CCC that can benefit from marine transport. Additionally provide a view on the role that seaborne freight is likely to play in future construction supply chain/logistics for the study area.

Market conditions – Gain a better understanding of requisite market conditions to sustain a CCC.

Locations – Consider the optimum geographical location(s) within the North Kent area, with regard to existing and future markets.

Scenarios – Recommend size and capacity of CCC operation, considering phased development in the short, medium and long term.

Business case – Provide the business case (or otherwise) for establishing a CCC in North Kent.

1.2 Stakeholders

The funding stakeholders and their main interests in the study are listed in Table 2. More detailed statements are in Appendix 2.

Table 2: *Funding stakeholders*

Land Securities	Land Securities is the UK's largest property company, owning more than £13.1 billion of commercial property. Land Securities is working in partnership with their joint land owners Lafarge Cement (UK) Ltd to bring forward development at Ebbsfleet Valley. Outline consent has now been obtained for the delivery of 17 million square feet of floor space consisting of residential, business, retail, leisure and community uses centred on the Ebbsfleet International Station at the heart of the Kent Thameside Regeneration Area. Up to 10,000 homes and 20,000 jobs will be delivered over the next 20 years.
SECBE	SECBE is a consortium of business leaders that informs policy and drives business-to-business learning and networking. It takes regional strategies and industry issues and develops action plans to improve business performance throughout the sector. SECBE is part supported by SEEDA. SECBE has a three-phase plan to exploit the potential of consolidation centres. Phase 1 is to establish an alliance of stakeholders from the public and private sector and to undertake this feasibility study. (This report concludes phase 1.) Phase 2 is to establish and operate a CCC to serve Ebbsfleet Valley and Swanscombe Peninsular. Phase 3 is to use the evidence from Phase 2 to prepare a strategic master plan for a network of CCCs in the South East. Other international consultancy opportunities will also be explored in this phase. We emphasise the need for SECBE to engage with the local authorities who can influence the market by planning controls, and management plans for transport and waste.
SEEDA	SEEDA's aim is to create a prosperous, dynamic and inspirational region by helping businesses compete more effectively, training a highly skilled workforce, supporting and enabling local communities, while safeguarding natural resources and cherishing the region's rich cultural heritage. SEEDA's Regional Economic Strategy has 14 explicit objectives grouped under global competitiveness, smart growth and sustainable prosperity. The step change in environmental impact and productivity offered by consolidation can assist SEEDA to achieve all its objectives, especially sustainable prosperity. These benefits are summarised in Appendix 2.
Wincanton	Wincanton operates logistics services across Europe and is the second largest logistics company in the UK. A key step in its strategy to diversify into construction logistics was to acquire RDL, a leading distributor of construction materials in the UK, in 2006. Wincanton now has considerable supply chain expertise in the construction industry. Wincanton has established skills in consolidation in other industries as well as supply chain management. It intends to apply these skills in the construction industry.

Although not a funder, Lafarge, one of the world's largest suppliers of construction materials, has extensive landholdings in North West Kent that offer potential sites for consolidation centres. It has interests in the Swanscombe Peninsula and Ebbsfleet including disused quarries and a cement factory nearing the end of its life. Through its Blue Circle brand, Lafarge has built a reputation for 'recycling' redundant sites in ways that enhance environmental impact and assist the regeneration of local communities. As a French multinational, Lafarge also has interests in promoting international construction commerce.

The funding stakeholders and invitees, including a delegation from Lille Chamber of Commerce, took part in a workshop hosted by Land Securities at The Observatory in Ebbsfleet on 12th June 2007.

The outcomes of this workshop are in Appendix 3.

Three key and prioritised themes for action emerged from this workshop:

- *Behaviour and culture*
- *Business case*
- *Exchange of knowledge.*

1.3 Assumptions, definitions and units of measurement

Although logistics embraces materials, equipment, information and people (some would even include money), this report deals mainly with materials. The proposed consolidation facilities could also be used for equipment and tools needed to construction.

The analysis is based on:

- Development forecasts obtained from planning authorities
- Traditional forms and processes of construction
- An assumed number of pallets for a given type of construction.

Once a development enters its delivery phase, the chosen forms and processes of construction will affect the number of pallets required and therefore the economics of consolidation.

Region means the South East of England (excluding London) as promoted by SEEDA.
Sub-region means North Kent, the subject of this report.
District means the development districts centred on Ebbsfleet, Medway and Swale.

Although this report generally uses metric units, the floor areas of CCCs are given in square feet (ft^2 or sq ft). This is a peculiarity of the British property sector. For an approximate conversion to square metres (m^2) divide by 10.

Table 3: Transportation units

PEU	Pallet Equivalent Unit	Materials handled on a 1.2m x 1.0m pallet. Some materials are handled on multiple pallets. Materials not on pallets are assessed as an equivalent number of pallets according to the area occupied on a truck.
TEU	Twenty-foot Equivalent Unit	A 6m x 2.4m x 2.4m container that will accommodate 12 PEUs, usually in one layer
Train	25 wagons each accommodating three TEUs	A train would accommodate at least 900 pallets
26T	Flat bed truck with maximum loaded weight 26 tonnes	A 26T truck will accommodate up to 14 PEUs
40T	Articulated lorry with maximum loaded weight 40 tonnes	A 40T 'artic' will accommodate up to 26 PEUs

2 Consolidation – a potential step-change

Consolidation is a process that has been developed in the retail and manufacturing industries. The distribution centre, as used in those industries, would normally serve a region; hence the term regional distribution centre. As we explain that later, construction consolidation centres are more likely to serve a district.

2.1 Logistics methods and techniques

Logistics – the art of applying timely resources – is a fundamental tool for construction. Well executed logistics is essential to achieve enhanced results measured by:

- Time to construct
- Build quality
- Economy
- Health and safety
- Environmental impact.

Flawed logistics, no matter how competent the constructors are, is the developer's nightmare.

From research we carried out with BAA, Transport for London, Wilson James, the Waste & Resources Action Programme (WRAP) and others, we have concluded that there are four methods of logistics used in construction, shown in Table 4.

Table 4: ***Logistics methods used in construction***

Method	Which is	Used by
Traditional		
Method 1:	The business goes to the supplier to pick up materials	About 10% of the industry
Method 2:	The business has materials delivered to site	About 50% of the industry
Method 3:	The business uses portfolio analysis to segment ordering processes and call off arrangements	About 35% of the industry
Alternative		
Method 4:	The business co-ordinates a start-to-end process and tags information, people and materials flows	About 5% of the industry

In the alternative method 4, we have found seven 'modern' techniques, shown in Table 5. One of these techniques is consolidation (shaded). These are modern in the sense that although they are widely used in manufacturing and retailing, only a few projects – mainly on 'difficult' sites – have adapted these techniques for construction.

Table 5: ***Modern logistics techniques***

Logistics planning across full supply chain	Constructors have professionally trained logisticians who can plan across the ranging, procurement, storage, distribution and back loading activities
Consolidation centre	A distribution facility for materials that receives materials, equipment and plant and delivers to the sites in consolidated loads
Just-in-time delivery to work place	A service of frequent deliveries in work packs, 'pulled' just in time for the trade to perform the next task
4th party logistics (4PL)	A service to co-ordinate other logistics providers where there is more than one supply chain
Logistics specialist on site	A service to receive deliveries and distribute materials, equipment and plant - just in time - so that operatives handle materials only when assembling or installing
Demand smoothing	A service to enable the peaks and troughs in demand to be evened out over a period of time

Table continued…

Integrated ICT system across full supply chain	An interoperable information system that tags and tracks materials through take off, manufacture, distribution, assembly and installation. Such a system makes the entire process trends from start to end and provides the matrix needed for continuous improvement.

Kuehne and Nagel, a global player in logistics, offers the array of logistics services shown in Figure 2. In the context of construction, "In-house Logistics" could apply to construction products suppliers, off-site assemblers or the construction site itself. Some of the services offered for "Inbound Logistics", "Distribution Logistics" and "Reverse Logistics" are actually practised in various ways by constructors and hauliers. But it is fair to say the construction industry has not yet widely embraced logistics specialists as members of the construction team. We suggest this is because the industry has misunderstood the potential business benefits and the logistics specialists have not yet made a sufficiently convincing case.

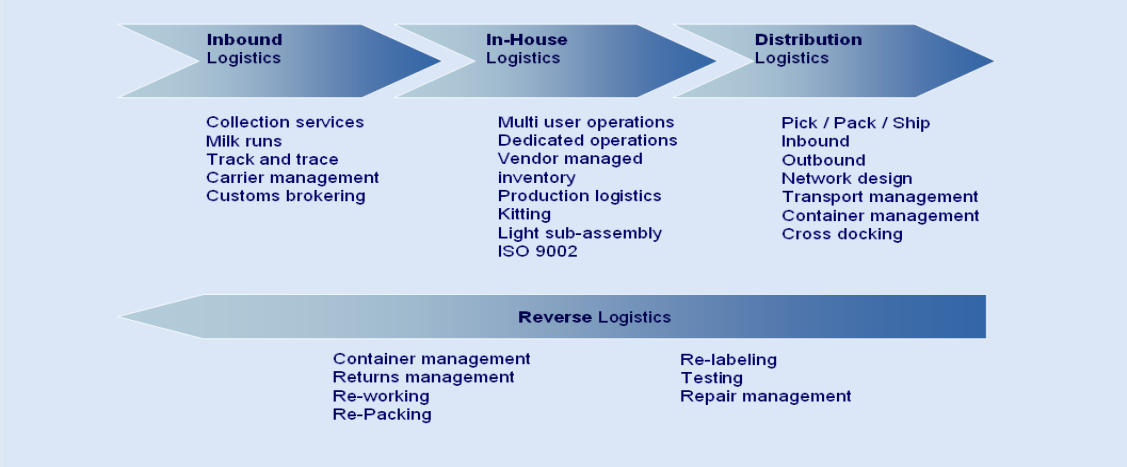

Figure 2: ***Logistics services (source Kuehne and Nagel)***

Reverse logistics means picking up returns, packaging or waste products following a delivery.

The concept of reverse logistics originated in retailing[1] where it is "the process of removing new or used products from their initial point in a supply chain, such as returns from consumers, over stocked inventory, outdated merchandise, packaging or waste. Implementing back-loading through reverse logistics can remove unnecessary mileage from a fleet's operation." By extending the idea to include physical waste, reverse logistics in construction would include removing 'clean' materials (those that are surplus to requirements and can be returned to the supply chain with minimal processing) and 'dirty' materials (those that need reprocessing before recycling to the supply chain or those that cannot be recycled and must be disposed of). The important point here is the potential to use logistics trucks (that generally leave the site empty) for reverse logistics.

We describe this in more detail under *Ancillary Services*.

A glossary of logistics terms is in Appendix 12.

[1] *Reducing the External Costs of the Domestic Transportation of Food by the Food Industry*, Modelling Report, Department for Environment, Food and Rural Affairs, May 2007

2.2 Current practice and its impact

For the estimated 85% of construction done using methods 2 and 3, the process is as described in Figure 3, although some method 2 contractors do not have bulk order arrangements. The important characteristics of this process are the number of trade contractors (T), the number of suppliers (S) for each trade and the number of deliveries (D) that each supplier makes to the site. The product T x S x D can amount to a very large number of uncoordinated deliveries, which leads to chaos at the gate and on the site.

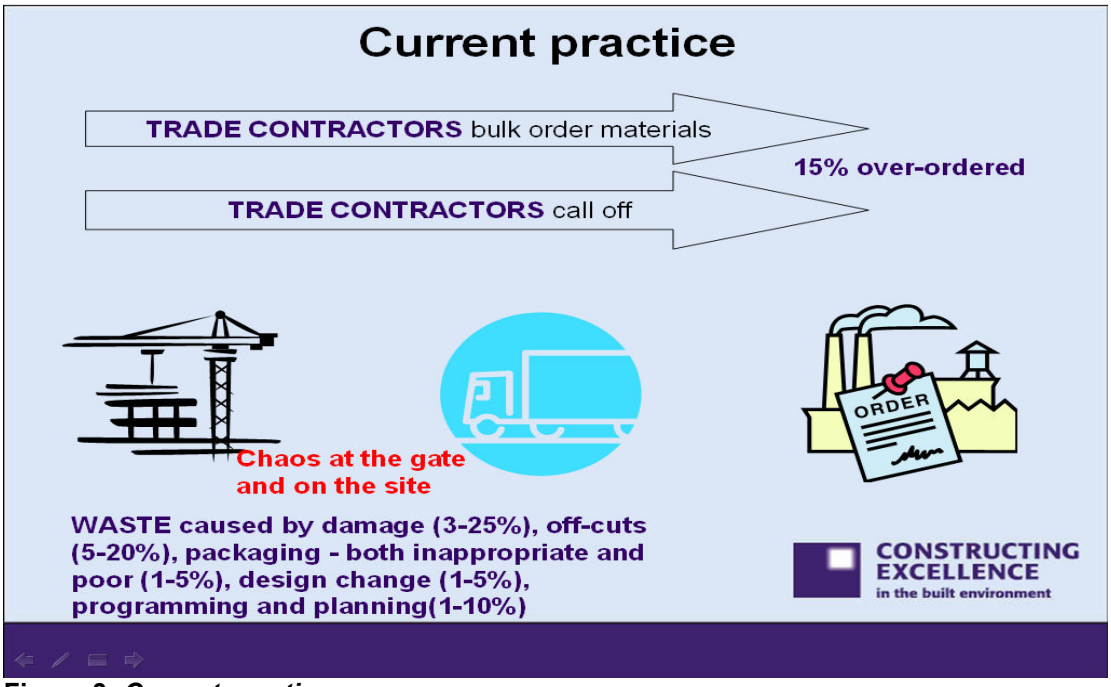

Figure 3: ***Current practice***

The chaotic distribution process has four main impacts:

- **Environmental** – The large number of uncoordinated deliveries gives rise to inefficient use of distribution resources, high emissions of CO_2 and other pollutants, noise, dust and nuisance in the vicinity of the site and inconvenience to neighbours.
- **Productivity of construction workforce** – Measurements by BSRIA show that material delays account for more than 10% of the working day on UK construction sites.
- **Productivity of hauliers** – Congestion and disorganisation at the site gate mean hauliers must allow for wasted time at the point of delivery, some of which is back charged to the contractor.
- **Material waste** – On average, about 15% (by value) of material supplied to sites is not actually incorporated in the works, up to 45% in some trades. A major component is due to over-ordering to compensate for materials lost, stolen or damaged.

The potential for a consolidation service to mitigate these impacts will depend on two factors:

- Degree of consolidation – this is affected by the mix of vehicles and discipline in the consolidation process
- Discipline of suppliers and site processes – this is affected by the commitment of suppliers and hauliers to the consolidation process.

Table 6 shows order-of-magnitude estimates of these effects.

Table 6: Potential for mitigating the effects of chaotic distribution

Environmental	Any reduction in traffic to site is an environmental gain. However, to assess the benefit it is necessary to take an overall view of all deliveries, whether direct or via the CCC. Measurements at the LCCC show deliveries that use the LCCC see a 70% reduction in traffic to site and associated emissions. For the most disciplined site there was an overall reduction of 40% in site traffic. This takes account of deliveries direct to site. One site had only 20% of its delivered via the LCCC.
Productivity of construction workforce	BSRIA's research suggests that a saving of 30 minutes a day is achievable with better on-site logistics.
Productivity of hauliers	Interviews with drivers delivering to the London Construction Consolidation Centre revealed that drivers saved about two hours by going direct to the LCCC rather than driving into the City of London (including loading and unloading time).
Material waste	15% of material supplied to sites is not incorporated in the works.

2.3 Evidence of modern logistics in construction

4th Party logistics

Manchester City Council, in association with Morrison and Wolesley, carried out a 4th party logistics operation with integrated ICT on a housing maintenance programme. The systems save the council up to 18% costs. This service is consolidation, but it is particularly useful in maintenance work because it regulates the supply of a fairly consistent set of materials.

The cost savings were accrued from not only better material consolidation but also savings in paperwork, order and invoicing. The logistics system used impressed vehicles and local stores. An operative would electronically receive an order to carry out some work. The operative would typically have the materials to do this or the materials would be available at a strategically placed store. The operative would then carry out the works, noting on a PDA the materials used. This information would produce a works complete note, invoice and order for the materials to be replaced. A service level agreement governed the minimum amount of stores in the vehicle and store. Electronic tracking could also dictate the amount of material types needed and be able to forecast when new or increased amount of materials could be required.

On-site logistics

Stanhope, the developer of Mid-City Place, recognised that distribution of materials on the site would be a critical issue for the construction manager, Bovis Lend Lease, and encouraged a fresh approach to logistics. Wilson James developed a strategy to reduce multi-handling and repeated moving of materials. The twin-track solution distributed materials to the workplace just in time for each task and created the Market Place, a single on-site distribution point for bulk materials and consumables.

Although Wilson James' brief was confined to the site, it influenced, but did not control, deliveries to the gate. However from that point onwards, it took the distribution out of the hands of trade contractors. The headline results were stunning:

- Mid-City Place was completed in 57 weeks, 11 weeks ahead of the planned programme.
- The build rate was about 8,000ft2 per week, 60% ahead of the industry benchmark at that time.
- The building cost was £92/ft2, against the Davis Langdon Everest database benchmark of £115/ft2.
- There were 675,000 hours worked without a single reportable accident. This compares favourably with BAA's One in a million challenge to get reportable accident.

Consolidation

GSK and their WARE operation decided that the use of a consolidation centre would benefit themselves and their neighbours because construction deliveries ran though a highly populated area with schools. GSK became a better neighbour by using a CC at their Harlow plant to provide the consolidation service. The warehouse was approximately 15,000 ft^2.

So far, consolidation has been largely 'imposed' on the existing process, as shown in Figure 4.

Figure 4: ***Consolidation centre imposed on existing process***

It has been imposed in two senses; trade contractors have been told this is the new system and the processes they use to order and call-off materials do not appear to have changed very much to reflect the new method.

In other words, there has been insufficient collaboration with trade contractors, suppliers and hauliers to sell the business benefits and consistently apply new processes needed to realise these benefits. For this to be a success, trade contractors will need to be capable of extensive forward planning, with both project tasks and their supply chain.

The first documented CCC in the UK was the **Heathrow Consolidation Centre**, established in 2000 by the airport operator BAA, construction manager MACE and logistics contractor Wilson James. This centre consolidates materials for about £300m of construction annually in Heathrow Terminals 1, 2, 3 and 4. A case study by Constructing Excellence in 2004 found the centre had achieved:

- 99% of daypacks were complete and delivered to the right place at the right time.
- The rate of completing tasks as planned increased from 66% to 76%; about half this improvement was judged to be due to better distribution.
- The measured savings in distribution costs exceeded the cost of the consolidation service.
- There was a 40% reduction in delivery journeys within the airport.

For the construction of **Heathrow Terminal 5**, BAA focussed on improving distribution in three ways: consolidation, strict scheduling and marshalling of delivery vehicles, and off-site assembly. Despite its restricted site, T5 is widely regarded as a construction success story because it is within budget, on time and has had a low accident rate.

Transport for London

In 2005, Transport for London was sufficiently convinced that consolidation would improve the environment and reduce congestion in central London that it sponsored the **London Construction Consolidation Centre** (LCCC) over a two-year trial. The LCCC is a partnership of Transport for London, the developer Stanhope, the constructor Bovis Lend Lease and logistics contractor Wilson James, with quality monitoring by Constructing

Excellence. The LCCC is in South Bermondsey, outside the congestion zone. The largest project served by LCCC is the £150m Unilever House.

London's biggest transportation challenge is that, in order to maintain its position among the world's top cities, the demand on its roads will increase while capacity for freight will actually fall. Hence London is seeking ways to get commercial traffic off the roads but without stifling commerce.

The trial is nearly finished and interim findings show that its performance has met or exceeded all the expectations of the partners:

- The number of local journeys to the sites was cut by 70% for deliveries via the LCCC.
- The best overall reduction in journeys was 40% recorded at Unilever House. Bassinghall Street, as recorded by BSRIA, received only 15% of its deliveries via the centre. Bowbells House and Coleman Street are awaiting completion.
- Goods delivered to the consolidation centre arrived by[2] 40T articulated lorry (13%), 26T rigid lorry (49%) and a surprisingly high number of 'white' vans (39%).
- Delivery to the sites was almost entirely by 26T rigid lorry.
- Hauliers took, on average, 120 minutes less to deliver to the LCCC than it would normally take to deliver to an inner-London site.
- Delivery reliability to the site was 97% - the right materials at the right time and in the right place.
- Consolidation caused a 70% reduction in local CO_2 emissions for deliveries via the LCCC.
- The estimated reduction in construction programme of a large inner-London building was three months off the 20 months needed if deliveries had all been directly to the site.

Opportunities for improvement:

- The LCCC did not achieve its target dwell time of five days (that is the average time materials were stored in the warehouse). The average was about 15 days, which means the space occupied in the warehouse was three times that planned.
- There was a substantial amount of material left in the store after Unilever House reached practical completion. However, this did highlight the effect of over-ordering illustrates the potential to exploit reverse logistics.
- Trade contractors are not reporting appreciable improvements in cost of supply of materials to reflect the much easier delivery to the LCCC. This is a procurement question. It is necessary to establish what savings have been generated and how they could be shared.
- Despite delivering remarkable environmental benefits, the take up by other projects has been disappointing.

The trial has proven the environmental benefits of consolidation but has not yet demonstrated the full business benefits in a sufficiently convincing way to gain wide acceptance.

The best practice outside of BAA uses at best only three of the modern logistics techniques described in Table 2:

- **Consolidation** making **just-in-time** delivery to the site
- **Logistics specialist on site** making just-in-time delivery to the workplace.

2.4 Why consolidation alone is not enough

The LCCC is the best example of a construction consolidation process outside Heathrow Airport. It has been professionally managed and its performance is measured using a suite of key performance indicators. It is obvious from the KPIs that the LCCC itself performs what was expected; "it does what it says on the tin". But considering the business benefits that have arisen from consolidation in the manufacturing and retail industries, the LCCC has not

[2] *Construction Consolidation Centres – Assessment of the potential for London wide use*, Peter Brett Associates, January 2007

yet had a significant impact on the manufacturers, hauliers and trade contractors to realise its wider potential business benefits. What is missing?

Figure 5 shows that it is still the trade contractors placing the bulk orders and calling off deliveries, but without the logistics expertise needed to appreciate and realise the potential business impact of the consolidation centre. We call this the *construction approach*. It does not really address the full supply chain, starting with output from the designers and specifiers.

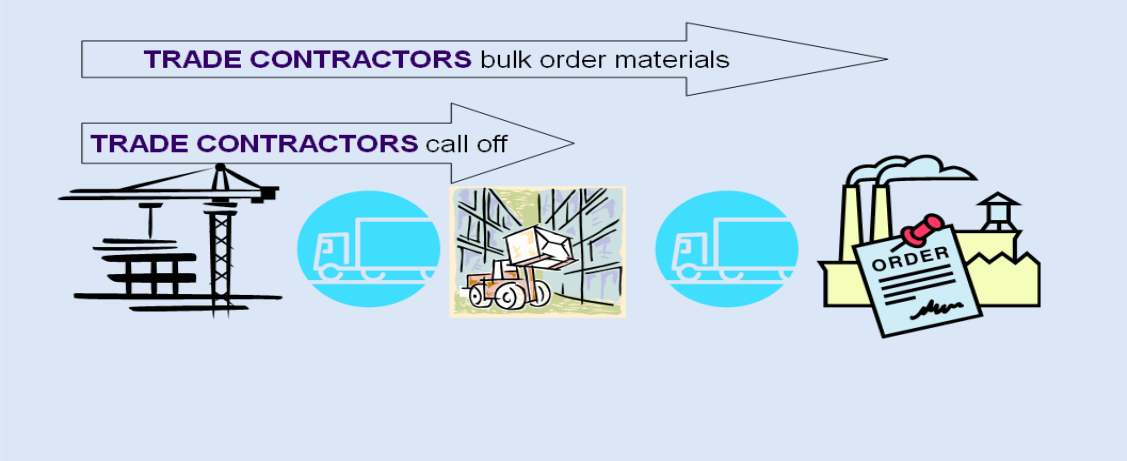

Figure 5: ***Contractor processes largely unchanged***

In order to release the business benefits still locked inside the consolidation centre, we propose that logistics specialists take control of ordering by working alongside the trade contractors, as shown in Figure 6. We would call this the *logistics approach*. Ultimately, it leads to the contractor ordering only what is needed for construction and tracking each item through the entire process from taking off quantities to installation.

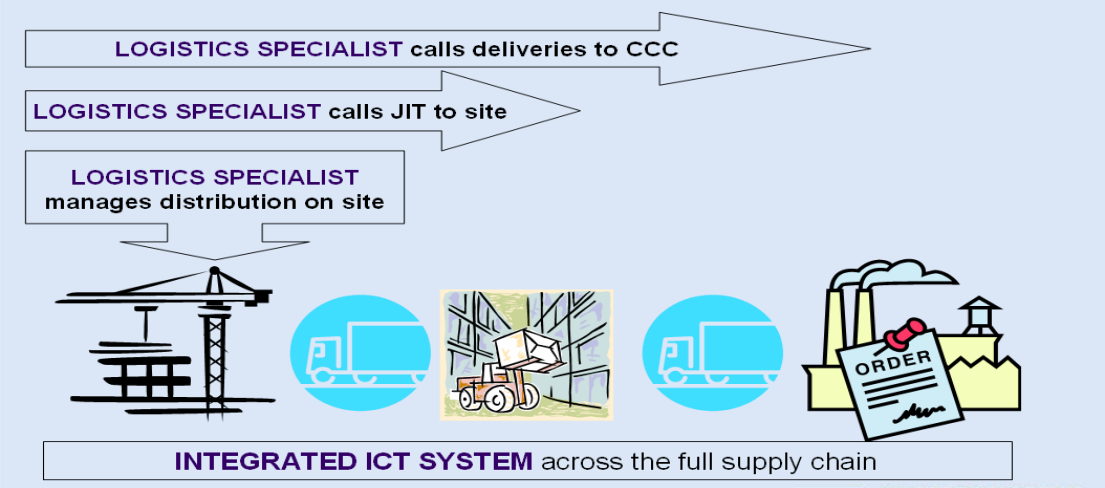

Figure 6: ***Consolidation centre with logistics specialist***

As well as managing the whole distribution process, a logistics specialist with a track record in manufacturing and retailing could deploy ICT systems modified to suit construction
This change would bring in the four dormant techniques from Table 2:

- Logistics planning across the supply chain
- 4th party logistics (4PL)
- Demand smoothing
- Integrated ICT system across the supply chain.

Consolidation, integrated with the other modern logistics techniques, would then be in a better position to deliver:

- Significantly less environmental impact
- A step-rise in site productivity

- Lower cost of distribution
- A step-fall in material waste.

The potential impact is estimated in Table 7.

Table 7: Potential benefits of delivery via a consolidation centre

Effect	Estimated benefit
Environmental	If 75% of materials were delivered via the CCC, there would be a 40% reduction in local traffic and emissions.
Productivity of construction workforce	Saving 30 minutes a day over an eight-hour day would increase overall productivity by 6% and reduce construction cost[3] by 3%.
Productivity of hauliers	A 10-20% reduction in the delivery cost looks easily achievable when delivering in congested areas. For low-value heavy materials such as masonry, delivery is a significant component of cost.
Material waste	Over-ordering is known to be a major factor in material waste. Eliminating one-half of material waste would cut material bills by 7.5% and construction cost[4] by 3%.

In order to realise all these benefits:

- *The trade contractors will need to be convinced that logistics specialists are sufficiently au fait with construction to be trusted with planning and managing the complete distribution system.*
- *Construction hauliers (most of whom do not yet have the expertise to deploy modern logistics techniques) will need to be convinced that it is in their interests to co-operate with a 4PL specialist.*
- *Material suppliers will need to introduce transparent pricing that separates the cost of the materials from the cost of delivery.*
- *Every player in the supply chain will need to see sufficient business benefit before co-operating.*

To ensure the CCC does not just become a store:

It may be necessary to adjust terms of contracts to ensure that hauliers are entitled to claim payment upon timely delivery to the CCC and trade contractors are entitled to claim payment when the materials are incorporated in the Works.

[3] Labour is typically 40% of construction cost.
[4] Materials are typically 40% of construction cost.

2.5 Sharing benefits

Experience from other programmes for industrial change, like Latham (1994) and Egan (1998) in construction, has shown that extensive change requires a 'win-win' for all to become part of the improvement.

Potential benefits for the construction industry in terms of cost and time reduction are offered in Table 8. For example, we suggest that profit (which is about 5% of construction cost) could increase by 8%.

Table 8: Benefits by cost attribute

Attribute/Costs	% 0f construction Cost	Potential benefit of this elements using effective logistics
Profit	5%	8%
Overhead	7%	-2%
Preliminaries	13%	-5%
Sub Contractors (if the company uses own labour then this would be split across other areas	Up to 80%	-10%
Labour	40%	-10%
Material	40%	-15%

The potential overall saving for a construction projects can be up to 8% of the project costs, although this saving would need to be compared to the cost of the centre.

In order to realise these benefits the contracts would need to ensure that benefits were shared across the supply chain where appropriate. This means considering not just each part of the supply chain, but also the incentives needed at every level of operation within participating companies in order to overcome behavioural and conceptual blockages. Suitable performance indicators, linked to incentives, would drive change. This is a basic principle of partnering as demonstrated by the many projects that have adopted the practices recommended in *Rethinking Construction*[5].

The benefits reduce as the practice becomes more common place.

2.6 Role of builders' merchants

The role of the builders' merchant in delivering the CCC service is a perfectly viable alternative idea. The supplier needs to be chosen with care. However the larger organisations such as Wolseley, Travis Perkins, Saint Gobain, and B&Q could carry virtually all the necessary equipment and materials needed to deliver housing and commercial properties. Obviously there are restrictions on the supply of custom-made parts such as steel, cladding, etc, but these could be delivered to a yard owned by the wholesaler.

The distribution centre would need to be sited within the construction zone in order to achieve the objectives of reducing local traffic and achieving reliable just-in-time delivery.

An advantage is that the wholesaler would be able to procure most materials needed. They would need to arrange extra space to receive materials from other suppliers and have a dedicated fleet to deliver to the sites. This would increase the variable cost of the wholesaler's operation, but not significantly so. We note that organisations such as Crown House Technology and Laing O'Rourke have 'supplier parks' and 'marketplaces' adjacent to some of their larger schemes so that they can manage deliveries, cost and layout of the construction logistics. Logistics gangs could operate from the supplier park to the work face.

[5] *Rethinking Construction, The Report of the Construction Task Force*, DETR, July 1998

The barrier to this method may be simply that there is not enough coverage of the parts required or the space. However, if a supply chain partnership were created, the merchant could leverage more buying power by sheer scale alone compared to the purchasing power of a large contractor or the fragmented supply chain of SMEs.

Typically 80% of the value of a project is supplied by Tier 2 and Tier 3 contractors and less than favourable terms compared to the creation of a project-wide that brokers all materials supply via a single merchant to the kerbside or work face. This would be more sustainable than current methods.

Another potential opportunity could be exploited when updating building methods to comply with higher standards, such as code 3, 4 and 5 houses. There may be a need for new supply chains that can deliver the required standards for carbon-neutral and carbon-free construction. As mentioned above, a single deal with the supplier to source the required new materials would give significant benefit.

3 Construction Logistics issues in North Kent

3.1 Drivers and barriers

The drivers for improving construction logistics are the traditional drivers of time and cost, but a new driver has emerged – the environment. There has been a noticeable increase in public concern about road transport, marked by questions about congestion, miles travelled, energy consumption and so on. The main impact of environmental regulation is to impose charges, on a polluter-pays basis. There are two possible reactions from the construction industry. One is to pass on these costs to the end user; the other is to improve its performance. This is where the impact of better logistics will come to the fore.

Constructing Excellence has produced a guide to environmental legislation[6].

Table 9 shows the drivers and barriers[7] according to the logistics method used.

Table 9: Drivers and barriers for logistics methods

Method	Drivers	Barriers
Method 1: The business goes to the supplier to pick up materials	Simple and flexible Requires minimal planning	No barriers – this is the entry level
Method 2: The business has materials delivered to site	Minimise own fleet and save time Suits larger organisation Potential use or return service	Inability or reluctance to plan ahead Insufficient continuity of workload
Method 3: The business uses portfolio analysis to segment ordering processes and call off arrangements	Potential to save money by strategic buying and simplified administration	Insufficient continuity of workload Lack of long-term strategy Larger organisation have inertia against change
Method 4: The business co-ordinates a start-to-end process and tags information, people and materials flows	Understand the process and hidden costs using the traditional methods Increasing environmental constraints Clients' expectations Potential saving in materials (up to 15%)	Set-up cost is perceived to outweigh the benefits. Sometimes set-up costs for innovations cannot be recovered under contractual arrangements. Unaware of business case Relationships that do not encourage shared risk, open book, etc.

Drivers for consolidation

It is important to recognise that some of the drivers for consolidation at Heathrow and central London would be less important in North Kent. For example, security and restricted site access are big factors at Heathrow airport. On the other hand, congestion and environmental impact are critical in central London.

Feedback from stakeholders in the LCCC shows how expectations are shifting across all groups, in response to all five performance criteria - time to construct, build quality, economy,

[6] *Pocket guide to environmental legislation (England and Wales) for the built environment*, Constructing Excellence in the North East, 2007

[7] Research Constructing Excellence has done with WRAP.

health and safety, and environmental impact. Table 10 summarises what is driving clients, regulators and suppliers to adopt consolidation.

Table 10: Drivers for consolidation

Clients	• Programme certainty • Cost • Control of the operation • Management and delivery of constrained sites
Regulators	• Operational impact – keeping the rest of place running while construction is going on • Efficient use of road space • $C0_2$ reduction • Enabling businesses to operate effectively • Balancing access to kerb space for all users • Construction logistics plans
Supply chain	• Material waste reduction • Reverse logistics • $C0_2$ savings • Transport waste reduction • Improve planning through the supply chain • Keeping products, information and materials flowing upstream and down stream

Barriers to Method 4 logistics (including consolidation)

The perceived barriers are many, summarised in Table 11 using the PEST analysis of the Political, Economic, Socio-cultural and Technological environment.

Table 11: Barriers to consolidation

Political barriers	These barriers are about ineffective **leadership:** • Are industry leaders prepared to share their data? • Who could be the third party to instigate this? • What hope if high profile organisations are not adopting it? and **regulation:** • Insufficient incentives to reduce waste • Lack of regulation demanding compliance • Lack of incentives to change
Economic barriers	These barriers centre on lack of clarity in the **business case:** • Lack of hard data about logistics generally • Need to know cost, payback and % impact on bottom line • Need for new financial models • Logistics costs are concealed along the supply chain • How large a programme is needed to justify change? • Confusion about who pays and who benefits • How to extract benefits for all stakeholders? • 30-40 trade contractors, each with own supply chain • Perception that merchants already operate 'consolidation' • New models needed for risk sharing but conditions of contract that do not promote partnering work against this
Socio-cultural barriers	These barriers are about the **structure** of the construction industry and **reluctance** to change: • Is CCC offered as solution to in ineffective supply chain? • Lack of persuasive evidence in favour of expending the effort needed to change the culture • Misunderstanding about how CCC works • Fragmented industry and procurement arrangements work against change • Insufficient collaboration to make it work
Technological barriers	These barriers mainly concern **ICT:** • Lack of effective ICT infrastructure across the supply chains • Insufficient skills and capabilities to deal with higher level logistics • Changes needed in mindsets.

Emerging from these drivers and barriers, it is apparent that leadership by clients, planning authorities and funding agencies is needed to influence change.

3.2 Regional context

Demand across the Thames Gateway

The development of the Thames Gateway is key to the Government's plans to boost the provision of housing in Britain. The redevelopment can be divided approximately three ways into East London, South Essex and North Kent sub-regions. The Thames Gateway includes the 2012 Olympic development centred on Stratford. Very approximately, the demand for construction in the three sub-regions will be similar in terms of volume and time scale.

Regional impact on planning consolidation centres

Although this report focuses on North Kent, it is apparent that the solutions should be applicable to the other locations. Our initial impressions were that there could be a unified approach to improving construction logistics across the whole Thames Gateway. We are now of the view that this is unlikely to occur because:

- Logistics planning for the Olympics is well advanced, but wholly focused on that project.
- A consolidation centre should be seen as a hub positioned as close as possible to the area it serves.
- It is necessary to cap travel time from the CCC, meaning the idea of serving a large proportion of the Thames Gateway from one CCC is not feasible.
- There is no reason to plan consolidation centres in the context of the whole Thames Gateway because the factors that influence planning and design of a CCC are local.

That said, the industry is likely to embrace consolidation more widely if it has proven to be effective in neighbouring districts, sub-regions and regions.

We expect the principal method of supply to the CCC will continue to be by road transport. The only convincing argument that might arise in favour of planning to serve the whole Thames Gateway would be if a more favourable regulatory framework emerged to bolster the economic case for deliveries by rail or by sea. If that were to happen, there would be a clear case for planning intermodal delivery systems that would be affected by the site and size of CCCs.

3.3 International context

We have considered two international aspects that might affect the planning of consolidation centres – supply of materials from abroad and collaboration with foreign companies.

Materials supplied from abroad

From the data in the Pearce Report[8], we have estimated that the value of construction products imported into the UK is in the region of 12% of the materials supplied. Although there is some use of air freight, most of this would come by sea. Evidence from the London Consolidation Centre showed that only 2% of materials arrived from identifiable ports, which suggests that most imported material comes via UK suppliers.

Unless there was a marked increase in materials imported directly, this factor alone would be insufficient to justify a waterside location for a CCC.

[8] *The Social and Economic Value of Construction*, nCRISP, 2003

Collaboration with foreign companies

We note that as activity increases within the SEEDA region, London and the East of England, there is no doubt that labour will transfer or travel longer to meet the demand elsewhere. This may lead to a resources vacuum in the North Kent area as illustrated in Figure 7. CITB Construction Skills has produced data which is freely available on the projected demand for labour and skills,

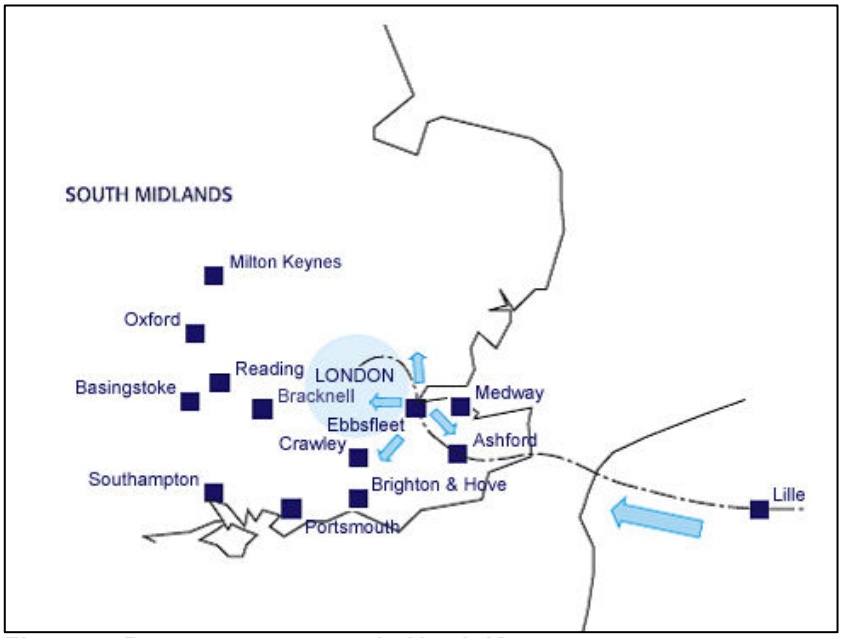

Figure 7: Resources vacuum in North Kent

Currently there is much travel from the extended European Union and this has brought mixed benefits. However France – our closest neighbour and perhaps most sustainable source of alternate of labour, services and technology – has not yet really become a player in the construction industry through the use of their SMEs.

As the county closest to the continent, Kent is probably the best positioned to take advantage of rail and sea connections. Accordingly, SEEDA is promoting the notion of the developing cross-channel trade with France, in particular the Lille region. On the inward investment side, the proposal is that, because it would be such a radical change in construction logistics, the CCC presents a focal point to attract French SMEs into the region.

This process needs to be facilitated by allowing companies on both sides of the Channel to understand one another's resources, processes and importantly values. From this the opportunities could be realised and explored.

We invited the Lille Chamber of Commerce (known as CCI International) to propose how this collaboration might evolve. It is important to appreciate that the Chambers of Commerce have a much higher commercial profile in France then their counterparts in the UK. Their paper, *A Cross Border Collaborative Partnership,* is in Appendix 10. The argument in favour of collaboration with European Union partners is now well rehearsed, so the question is, what are the merits of this particular proposal?

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The Lille proposal is to:

- Foster regional exchanges
- Work on common projects
- Facilitate a better access to future markets at both ends of the channel tunnel.

The French see the Thames Gateway as a magnet for their construction companies, in particular the SMEs. From the British point of view, encouraging this would have benefits

such bringing in specialist expertise and general labour to fill gaps in the Southeast without imposing yet further demands on local housing, as well as inward investment.

The Lille region claims to be particularly strong in the following sub-sectors:

- Site decontamination and converting
- Rainwater harvesting and water treatment
- New recyclable energies
- Waste treatment.

Coping with the region's industrial past has spurned a large number of eco-companies (some 600 in all, 60% of them employing 10+ people) and 80 research centres and labs in this sector.

There is a further advantage that the Lille paper does not mention. It is apparent that the consolidation centre would ease access for French suppliers delivering to North Kent sites. This is because it would be so much easier for French hauliers to deliver to one consolidation centre than to many construction sites needing local knowledge and the English language.

If construction consolidation proves to be successful in North Kent, the Lille link offers a way for British construction logistics suppliers to offer the service in France.

In summary, the practical steps offered by CCI International are to:

- Promote collaborative projects
- Enable SMEs to access markets by the 'piggybacking' on the actions by large companies (for example via Lafarge)
- Facilitate networking between British and French companies, large and small
- Assist the acquisition of technical and legal knowledge needed for British or French companies to work in the others' market
- Facilitate collaborative ventures between SMEs across the channel.

CCI International's *paper raises the importance of French businesses being grouped together so that it is easier to them to be detected and selected by British clients and contractors. The question is whether the CCC could be a facilitating platform for SMEs as wells as well as a new logistics system.*

On the export side, The CCC is such a step change in how construction operates that it will make the local industry more competitive and willing to embrace innovative ways of working. Together with training in construction logistics, the CCC is an attractive model for the local industry to take abroad.

3.4 Intermodal Transport

3.4.1 Intermodal Transport Alternatives

The North Kent segment of the Thames Gateway development programme is well placed in terms of potential intermodal transport for delivery and collection of materials and recyclates. The North West Kent, Medway and Swale areas have good access to water and rail facilities, but the exact location of these facilities will determine their true usefulness as intermodal interfaces

It should be noted that while intermodal transport can perform a role in moving materials and recyclates to and from specific consolidation centres, the road network will continue to provide the primary transport mode. As a result access to a consolidation centre by goods vehicles will, in truth, take a priority. For example, Hoo Junction provides a good opportunity for rail freight transport, but the facility does not have suitable road access for the traffic that is likely to be generated by a CCC.

One of the ideas discovered in our research was the potential to export contaminated soil, by rail or sea, for processing in France. This is not permitted under existing regulations unless the soil is returned for use in the UK. There may also be health and safety issues.

3.4.2 Opportunities for Rail

The likely scale of the redevelopment may justify the establishment of a new rail freight terminal, located within or close to the redevelopment areas. These facilities would be linked to Network Rail's North Kent line, which passes through the area.

3.4.3 The scope of the CCC

The rail freight terminal could serve a construction consolidation centre in or near the heart of the redevelopment. The role of the CCC could extend across the entire range of building materials used in the construction of developments (for example, shell and core, fit-out and mechanical and electrical). If this is the case rail the *modus operandi* could include a broad mix of materials ranging from bulk solids such as crushed rock, sand, cement, PFA and gravel, to semi-processed materials such as structural steel and re-bar, and finished goods such as bricks, roof-tiles and fixtures and fittings. The CCC could also handle out-bound materials such as spoil and any hazardous waste generated by site-clearance.

3.4.4 The role of rail in serving the CCC

Rail's role is likely to be confined to the movement of bulk materials trainload quantities of at least 500 tonnes payload per consignment. In terms of containers, this would mean a train (comprising 25 wagons capable of carry three TEUs) would have to haul 75 twenty-foot equivalent unit (TEU) containers each with a payload of at least 6.7 tonnes. For less-than-trainload (LTT) quantities, shared-user trains are used, but these generally prove uncompetitive with road on price and service quality. EWS is the only rail freight operating company in the UK offering a LTT service and this only to a limited number of destinations.

It is highly likely that for consignments of less than 500 tonnes (or 900 pallets), road will remain the only viable mode.

3.4.5 Existing rail-served CCCs

A rail-served CCC already exists serving Heathrow Terminal 5 and another is planned for the 2012 Olympics site. The possible North Kent CCC would share many of the characteristics of these facilities. The example of the railhead at Colnbrook, built to supply the construction of Heathrow Airport Terminal 5, shows that rail is a competitive mode for the movement of limestone and granite aggregate, cement, PFA and steel re-bar. Relevant features of these facilities include:

- Proximity: the rail terminal is close to the construction site which is supplied from it by road, using private roads where possible.

- Access by road as well as rail: it is not economic for all materials to reach the rail terminal by rail, so good road access from the highway network is essential

- On-site storage and processing: the inevitable break of bulk from train to lorry adds a cost to the use of rail which road (linking the originating location of the material with the site of end-use) does not incur. By using the site of break-of-bulk (that is the CCC rail terminal) for value-adding activities such as storage and processing, the overall net cost of rail becomes competitive. At Colnbrook, rail-borne cement, PFA and aggregates fed a large concrete batching-plant, while re-bar was shaped into forms for use in reinforced concrete structures.

3.4.6 Synergy between the CCC and other uses for the rail freight facility

It is likely that the principal role of the rail freight terminal will be to serve the needs of the CCC. However, there are other uses for the rail facilities which may support its financial case and provide a long-term role for them:

- *Serving other construction projects in the area*: the process of redevelopment of brown-field land in the area is expected to take up to twenty years, but will eventually be completed. The rail terminal has the potential to supply other construction projects in the vicinity, but beyond the site of original redevelopment. For example: the Heathrow T5 project is nearing completion and the demand for rail-borne materials has reduced accordingly from its peak in about 2004. However, it is planned to redevelop Heathrow Terminals 1 and 2 once T5 opens for use and this new project will generate a demand for construction materials that the Colnbrook rail terminal is well-placed to meet.

- *Serving port facilities in the area for handling aggregates:* the proximity of the redevelopment site to existing wharves on the south bank of the River Thames offers the opportunity to use the CCC's rail link to serve these facilities as well. It should be borne in mind that shipping will compete with rail for the supply of bulk materials to the CCC. Substantial quantities of marine-dredged sand and gravel (MSG) are landed at wharves along both banks of the Thames, as are land-won materials shipped from locations elsewhere in the UK and from across the Channel. It is likely that a CCC with such access would receive a significant proportion of its aggregates, sand and cement this way. However, some MSG is moved inland by rail, such as that landed at Angerstein Wharf, near Greenwich, which supplies rail terminals in and around central London. There is potential for the CCC rail link to receive imported aggregates and MSG and forward them to end-users in Kent and possibly beyond.

- *Serving port facilities for other freight:* rail access to commercial wharves also offers the potential for other sea-borne freight (both imported and exported) to be moved inland by rail. Existing rail-served ports in the vicinity include Chatham, Sheerness and Ridham Dock, which handle a variety of freight including assembled cars, steel coil, forest products and wire.

3.4.7 The selection of the site for the CCC rail freight terminal

A commercially viable rail terminal should fulfil a number of criteria which include:

- *Proximity to the rail network:* construction costs of new railway lines are high, so to minimise these, the rail facility will be sited close by or adjacent to an active railway line. In this case, this would be Network Rail's North Kent line that links Dartford to the west with Chatham and Maidstone to the east

- *Use of an existing rail-served site or connection:* this will reduce the high cost of installing a new connection with the main line

- *Flexibility:* the facility should be capable of adaptation to serve new traffic flows so that it may remain viable even when the original source of traffic has ceased

- *Road access:* a rail terminal receiving 2,000 tonnes of material per week (equivalent to two trainloads, a typical volume for a smaller site) could generate 200 lorry movements per week. In addition, a CCC will receive a considerable proportion of its materials by road. Good road access is essential for this number of lorry journeys to be handled

There are three potential rail sites in the North Kent sub-region; at least two sites meet all or some of these criteria:

- **The former Lafarge cement works at Northfleet:** This site was rail-served from the North Kent line. Although connections have been removed, we understand that recent re-signalling in the Northfleet area, associated with the Channel Tunnel Rail Link (CTRL) includes "passive provision" for a connection off the North Kent line which could serve a CCC in or close to the site of the former Lafarge cement works. This would reduce the costs of reinstating the rail connection, as would re-use of the track-bed of the former connection. Road access to the works site is good and the site is also served by water via

tidal wharfage. The latter offers the prospect of traffic flows other than those related to the CCC.

- **Chatham Docks:** The commercial port of Chatham has a rail connection with the Network Rail mainline between Strood to the west and Thanet to the east. This link was refurbished recently following a period of disuse and now handles imported steel products such as wire-coil, re-bar and rolled sections on an intermittent basis (typical for small ports such as Chatham). A rail-served CCC at the docks would be well-placed to supply the redevelopment of all the Chatham area as the docks have good road access to the surrounding area via the A289 dual-carriageway, as well as the A2 and the M2.

- **Ridham Dock:** This has the rail infrastructure in place but the level of development in the Swale area is unlikely to be sufficient to sustain a long term rail freight deliveries to a CCC located at the site.

3.4.8 Opportunities for Water

The proximity of the Thames and Medway rivers to the development sites would suggest there could be an opportunity to capitalise on water transport for the movement of some materials and recyclates. Along the river reaches are a number of jetties and wharves which could serve a CCC, for example Red Lion Wharf. However, such facilities would have to be an integral component of the CCC, because additional transfer costs will be incurred if materials/recyclates need noticeable transhipment from the quay to the CCC.

3.4.9 Water supply chain

A substantial amount of building materials arrive in the UK from foreign suppliers. Typically these are destined for a distributor who will either supply trade retailers or send materials direct to site. In this chain, the distributors, due to the large volumes they receive, carry out the 'break bulk' operation. Since the principle of a CCC is not to retain materials for any length of time (that is no longer than 5 to 7 days), receiving large volumes of materials in a single delivery is not feasible. However, receiving frequent deliveries of smaller loads by water (for example, in a container) could be a possibility. Such deliveries could be transhipped by barge from larger ports (for example, Tilbury, Sheerness) or arrive on short-sea shipping vessels. A key factor in such a supply chain is the origin of materials. For example, are the suppliers within easy access of a port; are they located in the UK or abroad; is there a substantial overland transfer to a port; what are the cost implications to the supplier/customer?

In receiving goods by water there is a potential difficulty – an imbalance of full containers arriving at the CCC compared with those leaving. If the facility acts as a Materials Recovery Facility (MRF) for construction site waste, it might be possible to export recyclates using some of the containers. This is dependent upon factors such as volume, the degree to which recyclates are processed (for example, wood being chipped, cardboard being sorted and bailed) at the CCC, final destination and cost. The alternative is empty containers will have to be shipped out of the CCC as storage would be an issue.

3.4.10 Large ports - barge transfer

On the Thames at present there are barges capable of transporting 28 TEU containers of waste at one time. Similar vessels (not necessarily as large) could also be used to move containers for materials deliveries. It is envisaged that barges would be loaded at larger Thames ports (for example, Tilbury or Sheerness) with containers first arriving either by deep-sea feeder, short sea or costal shipping services. It may be that if water-based supply chains were established, regular barge services could be introduced between the ports and CCC wharf.

3.4.11 Direct seaborne deliveries

Coastal and short sea shipping service vessels are capable of navigating the Thames and parts of the Medway. This raises the possibility of a CCC wharf receiving direct waterborne delivery services. However, in order to accommodate the vessels suitable wharf-handling equipment would be required, although some vessels might be equipped to perform self-discharging operations. During the research for this study it has been suggested that such

services regularly deliver relatively few containers (for example, 2 or 3) to smaller ports and this would be possible for a CCC wharf. The critical factors to this approach relate to the cost of such deliveries compared with road transport and the length of time required for the journey from supplier to the CCC. It was suggested that the use of costal shipping would be suitable for goods and materials regularly sourced from northeast England.

The equipment needed for handling water-borne cargo is described in Appendix 8.

3.4.12 Potential for a CCCs with intermodal capabilities in NW Kent, Medway and Swale

Notwithstanding the present commercial arguments against rail and sea borne transport, we reviewed the potential for a number of sites to offer an intermodal interface - that is rail, water or both with a CCC. Each area was considered separately such that the intermodal potential would be integral to a CCC serving NW Kent, or Medway or Swale. In total, three sites were identified from aerial photography, but have not been verified on the ground for suitability. By coincidence all offer both water and rail potential (see section on rail freight potential). The sites are in Table 12.

Table 12: Potential intermodal sites

Site	Geographical location	Modes handled
Northfleet	Lafarge Cement Works site	Water / Rail
Medway	Chatham Dockyard	Water / Rail
Swale	Ridham Dock	Water / Rail

3.4.13 Northfleet

The site forms part of the Lafarge's Thames side cement complex and has a working wharf (Bevans Wharf) and rail link, which is to be reinstated and connected to the north Kent line in the near future. Craneage is available on the wharf, removing the need for major strengthening and remediation work. A further feasibility study would be required to measure the true potential to exploit the site for a CCC.

3.4.14 Medway

Chatham Dock is owned by the Peel Group and has benefited from improved transport links, due to the re-commissioning of the rail connection into the docks and significant road improvements in the area. The dock is expected to handle 1.35 million tonnes of freight in 2007, has a variety of clients based on site, and can handle both coastal and short sea shipping vessels as well as barges. Warehouse type floor space is sited around the dock and a further feasibility study would be required to measure the true potential to exploit the site for a CCC.

3.4.15 Swale

Ridham Dock is located on the River Swale north of Sittingbourne and is easily accessed following the upgrading of the A249. The port is connected to the UK rail network and has ample open storage and 11400 square metres of warehousing. Vessels up to 5000 DWT can be accommodated and a wide range of cargo is handled including coal, aggregates, steel, timber, wood pulp, grain and scrap. A forty tonne capacity crane is available for handling containers and other heavy items. While the site offers good potential for a CCC, the total quantity of development in the area might not be sufficient to attract waterborne deliveries.

3.4.16 Feasibility of waterborne deliveries

As part of the study, Marine South East was asked to explore the feasibility of delivering materials by water. Their report is in Appendix 7. To ascertain whether water would be a viable option, they considered two scenarios: the delivery of 50,000 and 100,000 pallets of materials per annum from ports in the North East England.

Although the model[9] was somewhat simplistic, their report highlights the three critical factors – volume, distance and the cost of intermodal handling, and concludes that current commercial conditions do not favour waterborne deliveries.

Marine South East's analysis assumes ships that would supply 100,000 PEU annually on a weekly cycle. The preferred solution for the consolidation centre (See Recommendations, Getting Started) would distribute 150,000 PEU annually, that is 3,000 PEU weekly. Based on a dwell time of five days, the centre would have a capacity to store a little more than 3,000 PEU (an allowance is needed for peaks). Therefore, the weekly shipment of 2,000 PEU would deliver about 2/3 the capacity of the CCC. (Note that a fully laden train would deliver about 900 PEU, which is about 1/3 the capacity of the CCC.)

The weekly delivery in a large volume has an important impact on the size of warehouse needed at the CCC. The usual method of calculating the size assumes frequent inwards and outwards deliveries by truck. Therefore, compressing the inwards deliveries into one or two days (from a ship) would probably mean the CCC would need to be larger to handle the weekly peak in supply.

The model does not take account of real supplier locations and the cost of transportation to the port from the factory, or of transhipment if arriving from sea to the Humber (or any other assumed regular shipping point). If many shipping points are used (which is likely to be the case) the disadvantage of sea would get worse.

We know that a significant quantity of construction materials is imported (Pearce says about 12%). Where goods originate overseas, there may well be an argument for shipping direct to North Kent. Marine South East advises that the vessels should be either scheduled at that port or be quasi full (that is the port in North Kent would be the only destination).

The analysis shows that if you have enough cargo for a cargo ship, then the most critical factor is probably distance. In the case of the exemplar vessels, loads, and dedication, the break even point would be somewhere in Scotland. For example, bulk timber is routinely shipped by sea from northern Scotland to England.

Marine South East concluded that, *"at present, there is a convincing commercial argument against the use of coastal waterborne transport. Waterborne transportation as a routine method of bringing construction products to the North Kent CCCs is not recommended."*

In summary, there is as yet no convincing business case for developing consolidation centres in North Kent that would be served by sea-borne transport. This would change only if new Government policy created a substantial shift towards the economics of intermodal transport.

There may be a case for sea-borne transport of volumetric construction, for example, houses imported from factories abroad. A dock-side transfer yard would be needed. But the idea of a CCC would be redundant.

3.5 Market conditions to sustain consolidation

For a CCC to be sustained it requires market conditions that will ensure the construction industry will adopt their use in the supply of materials. Essentially there are two means to achieve this:

- Enforced use
- Derived benefits for the industry.

3.5.1 Enforced use

The responsibility to enforce the use of a CCC lies with the developer of a project or the local planning authority. Since the developer ultimately decides which primary contractor will carry out the development, it is in a position to stipulate how materials will arrive at the construction

[9] Further explanation in e-mail from Brendan Webster Associates, 1st October 2007

sites. This is approach BAA adopted for refurbishment and maintenance materials deliveries to Terminals 1 to 4. Generally no building materials are permitted to be delivered directly to a terminal by the supplier and first have to be deposited at a CCC at the airport. Both contractors and materials suppliers have to conform to this regime.

Local planning authorities are required to consider the wider impacts of developments taking place in their districts and can place conditions on a developer as part of granting planning permission. It is feasible that a condition could require a developer to introduce a system that prohibits suppliers' vehicles visiting the site, although at present we are not aware of such a condition being applied.

3.5.2 Derived benefits for the industry

The LCCC (Bermondsey) study has demonstrated that introducing a CCC into the supply chain can reduce levels of construction traffic going to a site and consequently reduce the nuisance to neighbours, and vastly improve the delivery reliability of materials to contractors. As a consequence efficiency gains are available to the transport companies delivering the goods (for example, not having to wait for a drop to take place or driving extra mileage in a congested urban area), the contractors as the materials are available when they are required, damage and pilferage is minimised, other wastage is reduced and presuming the build goes to plan, no overruns experienced. If these derived benefits were monetised, it would demonstrate the financial advantages that are available to the industry.

Ultimately such a CCC facility needs to be self-sustaining and the financial incentives for all stakeholders must be transparent.

3.5.3 Exploiting CCCs

There are two strategies by which CCCs can be exploited:

- Temporary facilities to serve one large or a cluster of developments for a defined (short) period and close when the construction work is finished
- A permanent centre located to serve a long-term development area and on completion of the initial construction remain to cater for further on-going smaller developments, and refurbishment and maintenance of existing buildings in the area.

However, the key to both strategies is the continuous demand for the supply of materials over the life of the CCC.

Both strategies can be applied to the North Kent sub-region and other parts of the Thames Gateway regeneration, since there are developments with explicit time horizons and an overarching regional strategy for the provision of thousands of dwellings and commercial floor space in the long term. As the location modelling will indicate later in our report, there are three distinct areas being considered; each has a long-term objective, but timescales and construction phasing are different.

The purpose of the CCC is an important factor, in that will it be used solely for the delivery of materials to the construction site, or will it serve a wider function by also acting as a returns point for construction site waste materials and provide recyclate-sorting capacity (that is reverse logistics centre). Such considerations will have implications on the CCC site size and hence set-up and operating costs.

The size of a CCC does not have to be extensive. The London (Bermondsey) CCC is approximately 4,650 m^2 (50,000 ft^2), but its operator estimates that it would be able to serve up to ten construction sites at one time. This implies that a single large development or cluster of the sites does not require a large CCC.

3.5.4 Temporary CCC

The key question here is, how long is temporary? In the case of CCCs, this is specifically related to the density of the development and the planned construction timeframe. Within each Thames Gateway area there are explicit developments that will deliver a varying scale of dwellings and commercial floor space within the next five years. However, the key factor to consider is, can any one development, or group of developments, justify the capital

investment of a CCC for the construction period? The chief considerations will be the proximity of the CCCs to one another and the functionality of the centre, as these will influence the overall site size and economics. Furthermore, since the activity of a CCC is quite intense (that is materials held for a relatively short period of 5 to 7 days), the availability of suitable sites has be taken into account, as well as other factors such as ease of access and local traffic conditions.

3.5.5 Permanent CCC

As mentioned above, the retention of a permanent CCC is for a much long period - for example, twenty-five years. It is likely to be larger than a temporary facility as one would expect it to serve a wider area. However, it will function the same as a temporary CCC, holding stock for no longer than 5 to 7 days. Permanency also augments the opportunity to include a reverse logistic function and select a site that could include an intermodal dimension. However, the Heathrow Terminal 5 (T5) logistics centre is a useful example in that it included rail freight access through a purpose built siding, and now that T5 is near completion the facility is being converted to a permanent CCC for the entire airport.

The regeneration of the Thames Gateway is quite unique in that it affords a construction programme for the next 25 years, although the developments vary across the region. However, importantly it presumes large-scale construction activity will continue over this period, a key factor in the provision of CCCs.
Other aspects such as the aim to minimise the impact of construction traffic and improving the efficiency of construction industry supply chains will support their greater use and implementation.

External pressures on transport costs, through the possibility of road user charging and predicted higher fuel costs will also contribute to the attractiveness of CCCs.

Aggregated these elements promote consolidation of materials at a point which can serve a series of developments, either through dedicated or multi-drop deliveries.

4 Consolidation analysis

4.1 Demand for materials

The Thames Gateway development programme encompasses land extending from East London eastward to the Isle of Sheppy in Kent and Southend in Essex. In total, 160,000 homes are projected to be built by 2016, as well as the provision of various forms of commercial property and floor space. The focus of this study is the development taking place on the Kent side of the Thames, in the areas of North West Kent (Dartford, Northfleet, Gravesend), Medway (Rochester, Chatham, Gillingham) and Swale (Sittingbourne, Queensborough, Faverhsam).

The forecasting comprises new dwellings (that is houses and apartments) and various commercial floor space (for example, for retail, industrial, leisure and business premises but excluding public works such as hospital and schools). Note that the forecasts do not include establishment infrastructure or ground preparation materials, although some elements such as paving, kerbs, pipes could exploit a CCC.

In order to estimate the quantities of materials to be delivered during the various construction stages, the numbers of dwelling were converted into a gross floor space measured in square metres (m^2); commercial development is customarily measured in m^2, such that no additional conversion was required. The average areas assumed for houses and apartments were:

- Houses = 75 m^2
- Apartments = 73 m^2

Determining the total area is an intermediary stage in the forecasting. In operating a CCC it is necessary to know the throughput unit (for example, weight, number of items, number of handling units). Since construction materials are delivered in the different handling units (for example, packages, pallets, items), it was decided to convert materials to Pallet Equivalent Units (PEU). Previous work on this topic has suggested that in the case of various forms of building, for every m^2 built *x* number of PEUs of materials are required. The PEU assumptions used in the study were:

- 0.45 PEU/m^2= All commercial building variations
- 1.0 PEU/m^2 = Apartments
- 1.50 PEU/m^2 = Houses.

The commercial figures are based on measurements in central London. We have not found any measurements for apartments and residential, so these figures are based on empirical assessments of the density of materials per unit floor area.

The form of construction is an important factor in assessing the number of pallets needed. Our estimates assume traditional construction. Modern methods of construction would involve much more off-site assembly. This includes sub-assemblies (such a service modules), elements (such as wall and floor units), and volumetric (complete building modules). As a general rule, modern methods of construction will generate fewer pallets. The larger the units, the more likely they would be unsuitable for consolidation.

By multiplying these factors with the total area for the relevant types of construction provides the demand in PEUs, which can be used as the main input to the logistics modelling.

A table showing the build up of these figures is in Appendix 5.

4.1.1 Development data

The data on predicted dwellings and other development in the areas being studied was provided by Kent Thameside, Medway Renaissance, and Swale Forward development boards. From this data it is estimated that 40,000 dwellings will be built by 2030 and 1.75 million m^2 of various commercial floor space provided.

To verify the data, cross-checks were made through other published source, contact with developers and in-house databases.

4.1.2 Materials consumption forecast

The data for each area was treated separately. The charts below (Figures 8 to 12) indicate the aggregated quantities of PEUs and are split between dwellings and commercial floor space. Some structures such as schools and hospitals are not included in the forecast, because at this time little data exists regarding their provision or the expansion of existing facilities.

It is useful to understand the scale of demand in terms of PEUs required for the whole of the North Kent region. Aggregating the forecasts for each area produces a combined total and this is shown in Figure 8.

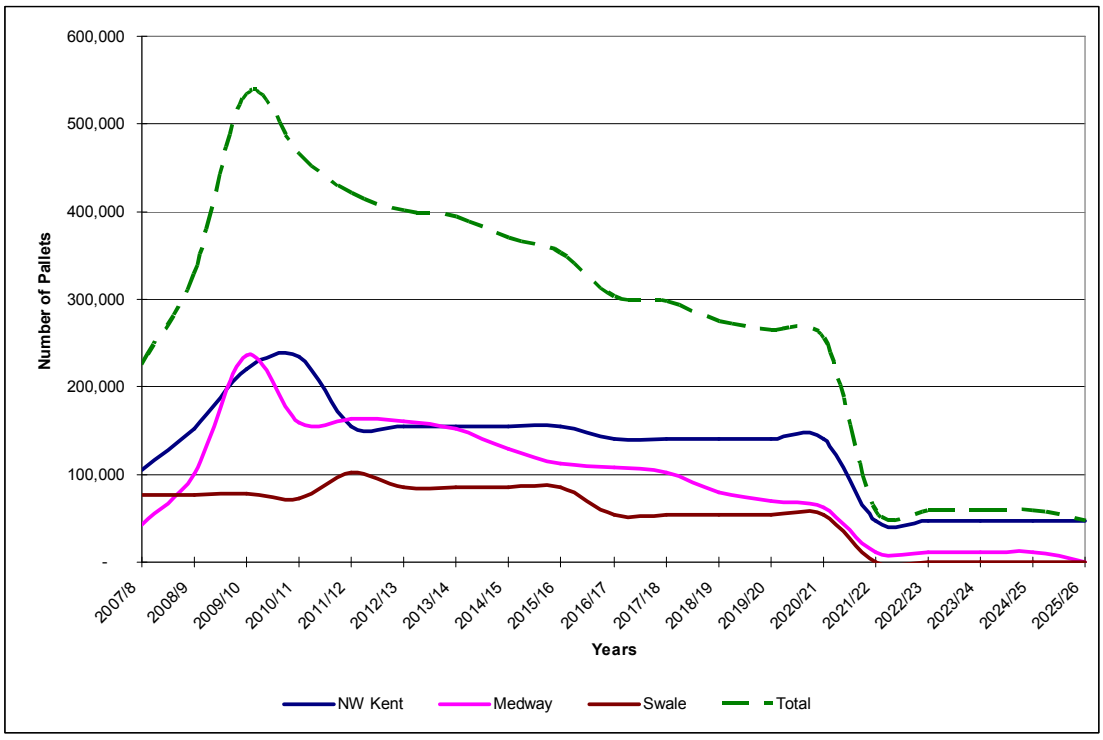


Figure 8: Forecast of materials for the whole North Kent sub-region

Since construction activity is already in progress at a number of development sites, it can be seen that peak demand is expected within the next four years. Interestingly, the analysis reveals that the scale of development, in terms of materials demand, for NW Kent and Medway is very similar - i.e. approximately 250,000 pallets for their peak demand periods.

While the study focuses on three time horizons for the forecasting (2008, 2016 and 2026), not all the data provided extends to the third date, 2026. Only the North West Kent data goes to 2026 and beyond (2030), while Medway is to 2024 and Swale to 2020. In the cases where data does not exist for 2026, the last year in the time series is used.

The data for **North West Kent** has enabled a forecast which extends to 2030 as shown in Figure 9. In terms of dwellings and the provision of commercial floor space, a concentration of construction is predicted to take place between 2008 and 2012. Therefore, the modelling carried out for this area is based on data for 2008, 2010 (peak year), 2016 and 2026, providing four strategies.

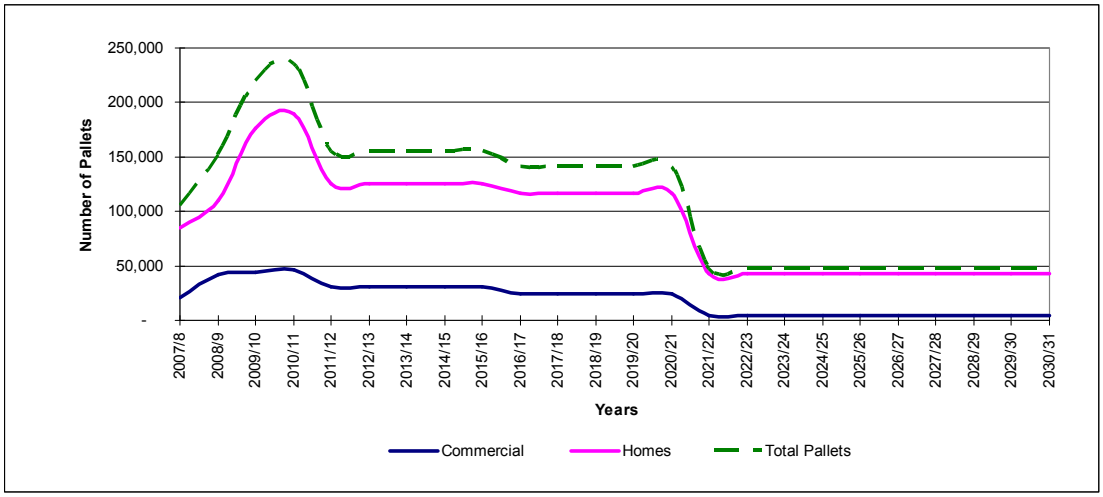


Figure 9: Forecast of materials for North West Kent - Pallets per year

Figure 10 shows that part of the North West Kent demand due to Land Securities' development in Eastern Quarry and Ebbsfleet only.

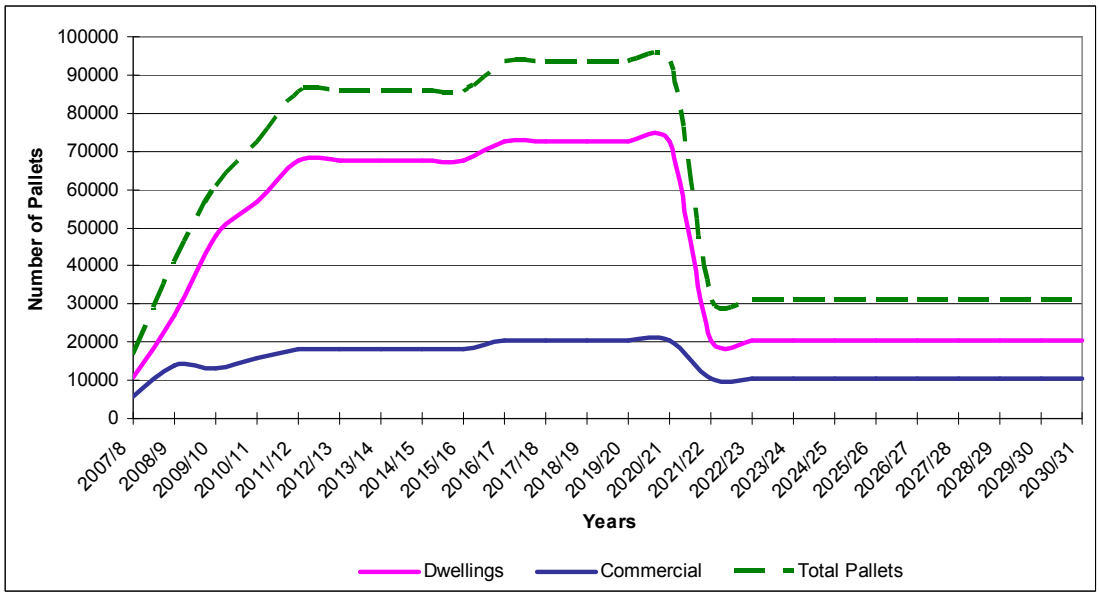


Figure 10: Forecast of materials for Eastern Quarry and Ebbsfleet only

These charts indicate the peak demand for Land Securities' developments would be about one-third the peak demand for the whole district, although the peaks occur at different times. However, comparing the total demands, the number of PEUs forecast for the period 2007 to 2030 in the NW Kent district is 2,668,247. Of this total, 1,314,115 are predicted for the Eastern Quarry/Ebbsfleet developments, which is equivalent to half of total demand for the district.

The data for **Medway** only enables a forecast which extends to 2024 as shown in Figure 11. In terms of dwellings a concentration of construction is predicted to take place between 2008 and 2010, while the provision of commercial floor space is evenly spread of a ten year period beginning in 2008. Therefore, the modelling carried out for this area is based on data for 2008, 2009 (peak year), 2016 and 2024, providing four strategies.

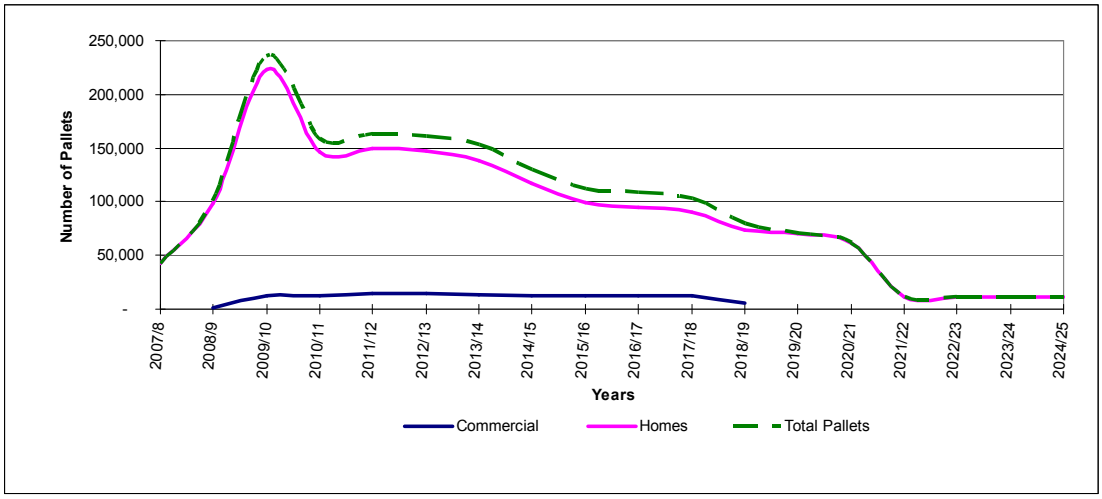


Figure 11: Forecast of materials for Medway - pallets per year

The data for **Swale** only enables a forecast which extends to 2020 as shown in Figure 12. In terms of dwellings the main construction period is predicted to take place between 2011 and 2015, while the provision of commercial floor space is already underway and noticeably declines after 2011. Therefore, the modelling carried out for this area is based on data for 2008, 2012 (within the peak period), 2016 and 2020, providing four strategies.

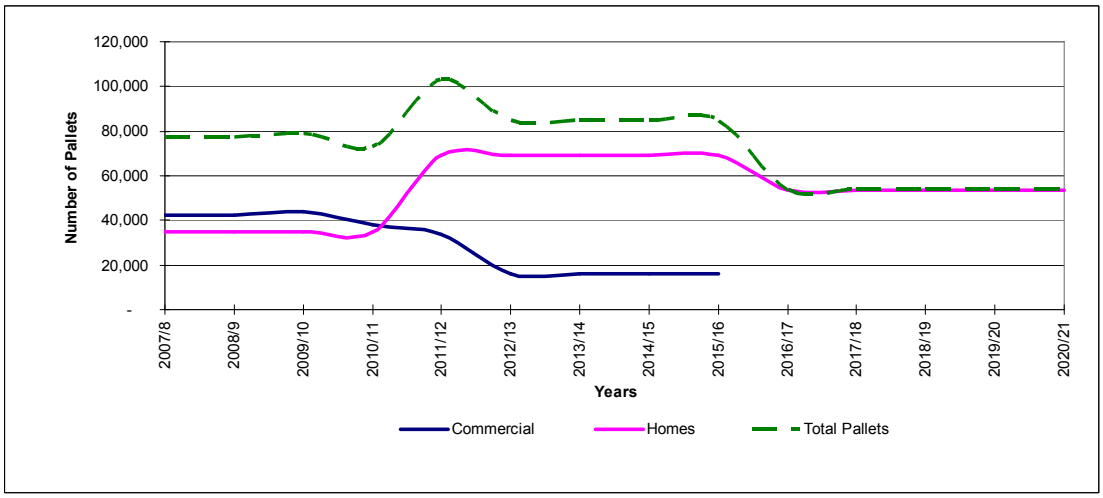


Figure 12: Forecast of materials for Swale - Pallets per year

4.2 Potential sites

We collected information regarding potential CCC sites through desk research and interviews with stakeholders. Selection criteria covered:

- Accessibility in terms of good roads.
- The CCC would be sited in an area that would not seriously impact on local residents - for example, away from residential areas or on an industrial estate.
- There is sufficient space to construct a CCC or there are warehouse buildings, present providing an opportunity to acquire one for CCC conversion.
- The site was likely to be retained as an industrial area with the Thames Gateway planning framework.
- For intermodal sites the necessary rail and/or port facilities exists.

4.2.1 North West Kent

This area extends from Dartford in the west to Gravesham in the east. There is a ribbon of commercial and industrial land along the Thames embankment (that is its northern edge),

some of which will remain under the planning framework and some that will be developed for residential use. Potential sites were considered in The Bridge commercial development, Crossways Business Park and on the Swanscombe Peninsular.

As part of **The Bridge** development there is a sizeable commercial area which could serve as a suitable location for a CCC. Good road access exists, with the site being position next to the Dartford Crossing, but while the site is also located close to the River Thames it is unlikely that a CCC could receive materials by water, as the jetties serve the Littlebrook power station and direct access appears limited. There is no rail link.

Crossways Business Park is on the east side of the Dartford Crossing provides suitable warehouse facilities and has good road access. There is the Thames Europort jetty, but this is used by a Ro Ro service and is unlikely to be available for waterborne deliveries. There is no rail link.

The **Swanscombe Peninsular** provides potentially three sites:

- The west embankment close to the disused Bell's Wharf and Whites Jetty, which have the potential to be brought back into use. Redevelopment planning is on-going for this area and building activity will not start before 2011. There is no rail link.
- An area of land on the eastern edge of the Ingress Park development and opposite the land currently occupied by the CTRL construction contractors and western side of cement works might be an option, although it is only accessible by road.
- Lafarge suggested that there may be a site at the edge of Church Path Pit, which is having its rail link to the North Kent line reinstated. This site might be able to link with receiving deliveries by water as there will be access to the wharf on the Lafarge cement works

4.2.2 Medway

The development in Medway is concentrated along the Medway River and the land immediately behind the shoreline - for example, Rochester, Chatham and Gillingham. In considering the Medway area we have identified three areas which would probably be able accommodate a CCC: Medway City Estate, Chatham Dock and a location at Chattenden. No locations were suggested by Medway Renaissance and the sites identified in the study are selected using desk research.

Medway City Estate is a commercial area bordering the north shore of the River Medway and supports light industry and distribution activities. There are a number of wharves providing the possibility of receiving deliveries by water. Road access to the surround network is good as the Medway Tunnel is close by.

Chatham Dock is located on the southern bank of the Medway estuary and supports a range of distribution activities, many of which receive commodities by water. The location is also served by rail and has good road access to the surrounding network.

Chattenden is situated to the north the Medway urban area, but is earmarked to be developed with a new residential development of 5,000 dwellings at Chattenden/Lodge Hill, a disused military facility. This location could provide a road based CCC on its southern tip which is close to the A228 trunk road.

4.2.3 Swale

The development planned for the Swale area represents the small construction activity for the study. Two potential sites have been identified, one in Sittingbourne suggested by Swale Forward and the other at Ridham Dock on the Swale, select through desk research.

The site in **Sittingbourne** lies about half a mile north of the town centre around Mill Way. The area is to be redeveloped but will include commercial and industrial property. Swale Forward thought that this location would be a suitable site as it could serve the immediate redevelopment in the town centre and is well located for road access to the Queensborough regeneration programme.

Ridham Dock is situated on the Swale and south east of the upgraded A249, a position about halfway between Sittingbourne and Queensborough. It has space in which a CCC could be established and would be able to receive materials by water. There is also a rail connection in place.

The map in Figure 13 shows all the developments and CCC location options that we have modelled in this study.

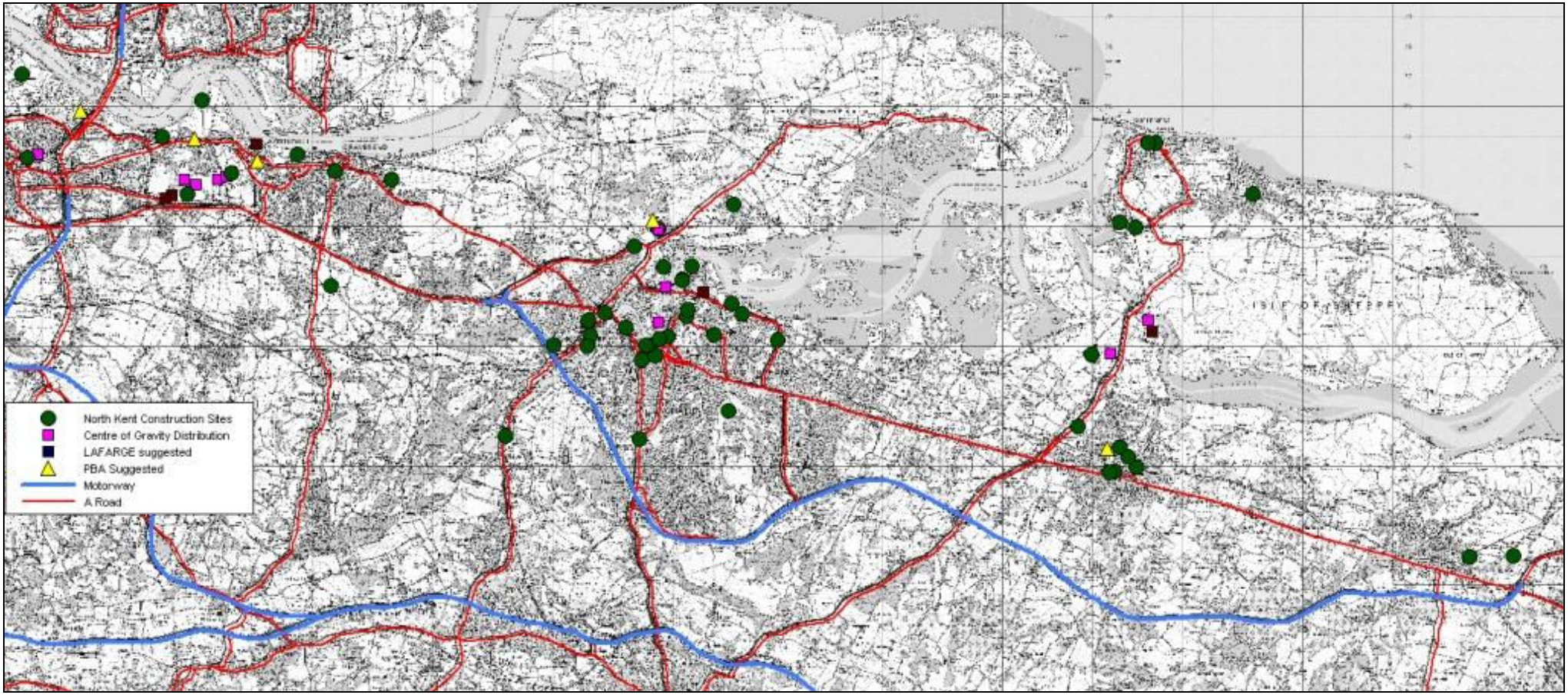


Figure 13: North Kent Developments & Construction Consolidation Centre Options

4.3 Scenarios

The modelling exercise was required to determine indicative locations for the CCCs serving the North Kent Thames Gateway regeneration areas.

An explanation of the model is in Appendix 9. The output for each run of the model is in Appendix 6.

4.3.1 One CCC serving the whole of North Kent

Using data for 2009, which is the peak year when most construction activity is predicted to take place across all developments in North Kent, the model suggested:

- A CCC of approximately 124,000 sq ft would be required.
- Total annual cost of operating the CCC would be about £7,500,000.
- 40,700 delivery trips would be made during the year.
- 680,000 delivery miles would be generated.
- 44 rigid lorries are likely to be needed.

The location of the CCC would be near the centre of Rochester (for example, Medway City Estate) which is not a sustainable position, given the volume of delivery traffic it would generate. Furthermore, the modelling does not take into account the number of supplier deliveries, which if based on the Bermondsey CCC experience (that is supplier deliveries accounting for approximately 80 per cent of all vehicle arrivals to the CCC) could amount to 170,000 commercial vehicles arriving at the CCC in the peak year. Also, the travel distance to the more remote sites would be too great to maintain reliable delivery time.

Transport comparison for one CCC vs. local CCCs

A strong argument supporting local CCCs *versus* a single CCC serving all North Kent relates to the level of transport activity that would take place in the case of the two options. Table 13 compares transport costs and CO_2 emissions

Table 13: Comparison of one sub-regional vs. district CCCs

Area	Peak year	Total KM [(1)]	CO_2 (tonnes) [(2)]	Transport cost
All Kent	2009	1,096,730	1,397	£2,071,423
NW Kent	2010	185,807	237	£579,456
Medway	2009	92,115	117	£476,966
Swale	2011	74,377	95	£257,001
Combined total			449	£1,313,422
Reduction			948	£758,000
[(1)] 1 ml = 1.6093 km				
[(2)] HGV produces 1.274 kg of CO_2 per km, assuming fuel consumption of 6 mpg				

A single CCC located in the Rochester area (CoG location) would incur a transport operations cost of approximately £2 million in its peak year (2009). However, based on CoG costs for the peak years for the CCCs serving their respective areas, the total transport operations cost would be significantly reduced, in essence a saving in the order of £750,000 (that is a 37% reduction). Furthermore, when aspects of environmental impact are taken into account (for example, CO_2 emissions), the analysis suggests that there would be a 32 per cent reduction in the level of CO^2 emissions. Even if the actual costs and quantities were not retained at this level, the percentage reduction is likely to remain the same for other years.

Another factor is the level of investigation that planners may require. The Department for Transport's Guidance on Transport Assessment[10] suggests a Transport Statement would be needed for a distribution warehouse >3000 m^2 (32,000 ft.²) and a (more rigorous) Transport Assessment for a warehouse >5000 m^2 (53,000 ft.²). It is likely that CCCs serving each district would not require any such study, while one large CCC serving the whole sub-region certainly would.
It became clear that a single CCC would not be practical solution to serve all developments, due to the sheer scale of the operation, the dispersion of the construction sites and the implications this would have on minimising construction related delivery traffic.

4.3.2 CCCs serving each district in North Kent

Having discounted a single location, the realistic approach was to consider CCC locations that would serve each distinct area. The model was run to determine the centres of gravity for each year and from these results a plausible long-term location was decided upon.

The modelling has been completed to include sites that were suggested by stakeholders and those judged to be of potential by the study team. For the three North Kent areas the locations are:

North West Kent

- Cement Mill site in Eastern Quarry (Lafarge suggestion)
- Swanscombe Peninsula South (Lafarge suggestion)
- Church Path Pit (Lafarge suggestion)
- Intermodal: Lafarge Cement Works (PBA suggestion)
- The Bridge (PBA suggestion)

Medway

- Intermodal: Chatham Dock (PBA suggestion)
- Chattenden (PBA suggestion)

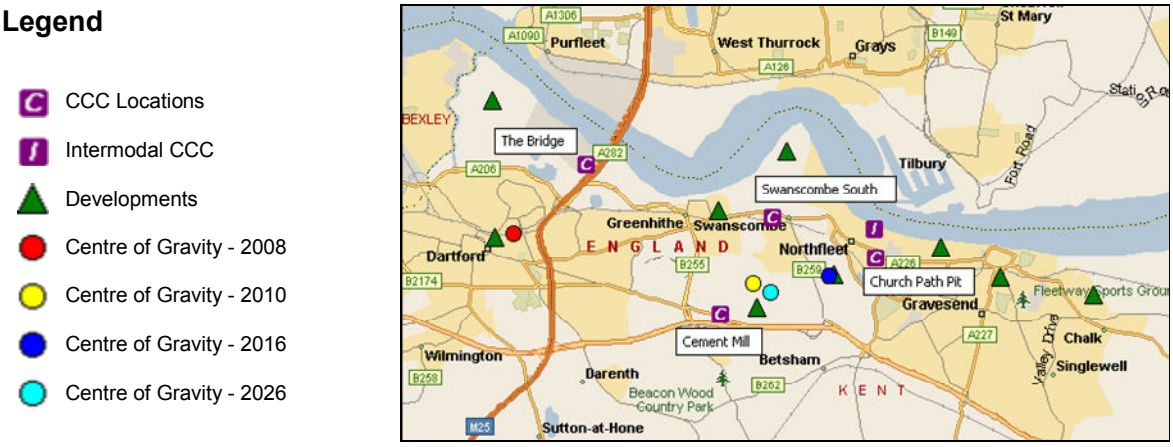
Swale

- Cooks Lane (Swale Forward suggestion)
- Intermodal: Ridham Dock (PBA suggestion)

4.3.3 North West Kent

The model was initially run to indicate the centre of gravity location for the CCC for the years being studied, which are shown as four coloured dots in Figure 15. These locations move for each year, since they are calculated using PEU quantities that change as the building programme progresses. This task established the theoretical CCC locations, which were then considered in conjunction with the stakeholder alternatives. Figure 14 illustrates all the options where the CCC could be located, in relation to the development sites. These should not be considered exhaustive as there may be other locations in the area not considered here which could be suitable.

[10] http://www.dft.gov.uk/pgr/regional/transportassessments/guidanceonta



North West Kent Developments

Figure14: Location diagram for North West Kent

The model was run for following years:

- A start year - 2008,
- The peak demand year - 2010
- An intermediary year - 2016
- A horizon year – 2026.

Table 14 to Table 19 provide a summary of the results, ordered by year for each of the CCC locations being considered. Table 16 shows the results of the initial CoG model runs which were used as guidance for identifying and plotting useable options.

Since the model seeks to minimise costs, it is important to note that the model adjusts the size of the predicted CCC (CCC Area (sq ft)) in each run, in order to optimise space in relation to materials demand. Thus over for the timeframe being considered, the suggested size of the CCC for North West Kent ranges from 11,000 to approximately 55,000 sq ft.

For the CCC to meet the peak demand it is necessary for the building to be similar to the predicted size. However, the implications for operating the CCC will be higher running costs per pallet during the periods approaching and passing the peak.

There are two facets that drive the total cost shown in the tables - delivery (transport) cost and CCC cost. The former is related to the levels of delivery vehicle activity, while the latter will change as size and PEU throughput fluctuate.

The tables summarising the results for each CCC location include a column that indicates the extent to which the cost per pallet will fluctuate. It can be seen that there is very little variation because they are directly related to the size of the CCC. However the column “Total cost / pallet with peak sq ft” indicates the per pallet cost if the peak CCC area was maintained. The results indicate that costs will be higher either side of the peak demand.

Table 14: Results of modelling for NW Kent area: CoG options

	CoG Distribution									
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist to Construction Site (mls)	Number of vehicles required	Delivery Cost	CCC Cost	Total cost	Total cost / pallet
CoG Distribution - 2008	8	10,995	151,462	35,291	4.61	9	**£377,720**	**£1,548,395**	**£1,926,115**	£12.72
CoG Distribution - 2010 (Peak)	14	17,310	235,301	54,825	3.17	14	**£579,456**	**£2,405,484**	**£2,984,940**	£12.69
CoG Distribution - 2016	10	10,560	140,967	32,845	2.57	8	**£308,078**	**£1,441,108**	**£1,749,186**	£12.41
CoG Distribution - 2026	8	4,146	47,209	11,000	2.46	3	**£103,766**	**£482,620**	**£586,386**	£12.42

Table 15: Results of modelling for NW Kent area: The Bridge option

	The Bridge										
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist to Construction Site (mls)	Number of vehicles required	Delivery Cost	CCC Cost	Total Cost	Total cost / pallet	Total cost / pallet with peak sq ft
The Bridge - 2008	8	10,995	151,462	35,291	4.36	10	**£390,241**	**£1,548,395**	**£1,938,636**	£12.80	£16.80
The Bridge - 2010 (Peak)	14	17,310	235,301	54,825	4.43	15	**£616,171**	**£2,405,484**	**£3,021,656**	£12.84	£12.84
The Bridge - 2016	10	10,560	140,967	32,845	3.68	10	**£390,675**	**£1,441,108**	**£1,831,784**	£12.99	£17.83
The Bridge - 2026	8	4,146	47,209	11,000	3.87	4	**£140,336**	**£482,620**	**£622,956**	£13.20	£41.97

Table 16: Results of modelling for NW Kent area: Church Path Pit option

	Church Path Pit										
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist to Construction Site (mls)	Number of vehicles required	Delivery Cost	CCC Cost	Total Cost	Total cost / pallet	Total cost / pallet with peak sq ft
Church Path Pit - 2008	8	10,995	151,462	35,291	3.66	10	**£416,081**	**£1,548,395**	**£1,964,477**	£12.97	£16.97
Church Path Pit - 2010 (Peak)	14	17,310	235,301	54,825	3.01	15	**£608,439**	**£2,405,484**	**£3,013,923**	£12.81	£12.81
Church Path Pit - 2016	10	10,560	140,967	32,845	2.64	8	**£311,143**	**£1,441,108**	**£1,752,251**	£12.43	£17.26
Church Path Pit - 2026	8	4,146	47,209	11,000	2.49	3	**£108,827**	**£482,620**	**£591,446**	£12.53	£41.31

Table 17: Results of modelling for NW Kent area: Cement Washing Mill option

	Cement Mill										
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist to Construction Site (mls)	Number of vehicles required	Delivery Cost	CCC Cost	Total Cost	Total cost / pallet	Total cost / pallet with peak sq ft
Cement Mill - 2008	8	10,995	151,462	35,291	3.99	10	**£402,053**	**£1,548,395**	**£1,950,449**	£12.88	£16.88
Cement Mill - 2010 (Peak)	14	17,310	235,301	54,825	3.44	15	**£588,764**	**£2,405,484**	**£2,994,248**	£12.73	£12.73
Cement Mill - 2016	10	10,560	140,967	32,845	2.83	8	**£318,912**	**£1,441,108**	**£1,760,020**	£12.49	£17.32
Cement Mill - 2026	8	4,146	47,209	11,000	2.87	3	**£111,101**	**£482,620**	**£593,720**	£12.58	£41.35

Table 18: Results of modelling for Medway area: Swanscombe Peninsula South option

	Lafarge Swanscombe Peninsula South										
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist to Construction Site (mls)	Number of vehicles required	Delivery Cost	CCC Cost	Total Cost	Total cost / pallet	Total cost / pallet with peak sq ft
Lafarge Swanscombe Peninsula South - 2008	8	10,995	151,462	35,291	3.61	10	**£399,960**	**£1,548,395**	**£1,948,356**	£12.86	£16.86
Lafarge Swanscombe Peninsula South - 2010 (Peak)	14	17,310	235,301	54,825	3.25	15	**£592,542**	**£2,405,484**	**£2,998,027**	£12.74	£12.74
Lafarge Swanscombe Peninsula South - 2016	10	10,560	140,967	32,845	2.31	8	**£311,156**	**£1,441,108**	**£1,752,264**	£12.43	£17.26
Lafarge Swanscombe Peninsula South - 2026	8	4,146	47,209	11,000	2.21	3	**£106,337**	**£482,620**	**£588,957**	£12.48	£41.25

Table 19: Results of modelling for NW Kent area: Lafarge Cement Works Intermodal option

	Intermodal: Lafarge Cement Works										
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist to Construction Site (mls)	Number of vehicles required	Delivery Cost	CCC Cost	Total Cost	Total cost / pallet	Total cost / pallet with peak sq ft
Intermodal: Lafarge Cement Works - 2008	8	10,995	151,462	35,291	3.67	10	**£418,013**	**£1,548,395**	**£1,966,408**	£12.98	£16.98
Intermodal: Lafarge Cement Works - 2010 (Peak)	14	17,310	235,301	54,825	3.09	15	**£613,981**	**£2,405,484**	**£3,019,465**	£12.83	£12.83
Intermodal: Lafarge Cement Works - 2016	10	10,560	140,967	32,845	2.64	8	**£315,474**	**£1,441,108**	**£1,756,582**	£12.46	£17.29
Intermodal: Lafarge Cement Works - 2026	8	4,146	47,209	11,000	2.46	3	**£109,395**	**£482,620**	**£592,015**	£12.54	£41.32

For each CCC location by year, the model assumes that the facility area remains constant and consequently only transport costs vary. Given the overall footprint of the North West Kent area is fairly compact, transport costs during the peak demand year only vary by approximately £28,000 between CCC options - that is The Bridge £616K and Cement Mill £588K (See Appendix 6 - North West Kent Tables).

With respect to an intermodal CCC, after studying the area and facilities it was concluded that only one location offered a possible intermodal capability - the Lafarge Cement Works. Since all distribution to the developments will be by road, the results of its modelled use are comparable with the 'road-based' locations. However, the advantage of the site would be realised for incoming goods from suppliers, when materials could potentially arrive by water and possible train as the site chosen will have both rail and water access.

In summary for NW Kent, the dispersion of the developments and the predicted build phasing means that the CCC locations considered in modelling offer similar levels of suitability.

However, a full appraisal of these and other sites would be required in order to decide upon final location. Importantly, the access will need to be carefully considered since for every delivery made to the development site a return journey is made. For example, if 12,000 deliveries are made from the CCC to building sites, a total of 24,000 out- and inbound trips

will take place. In addition there will be a similar or higher number of supplier deliveries taking place giving the potential for in excess of 48,000 vehicle movement in and out of the CCC.

4.3.4 Eastern Quarry & Ebbsfleet ONLY (Land Securities' developments)

One of the CCC location suggested by Land Securities was the Cement Washing Mill which is located on the southern boundary of the Eastern Quarry development. It is proposed that this area of land will be one of the last to be completed in the development and therefore offers a suitable location for the construction taking place in the area. This location has been included in the NW Kent scenario, as well as modelled purely for supporting the Eastern Quarry and Ebbsfleet developments.

Figure 15 illustrates the location of the CCC and the CoG alternatives, as predicted by the model. It can be clearly seen that the CoGs solutions 'move' as the different building phases start and finish.

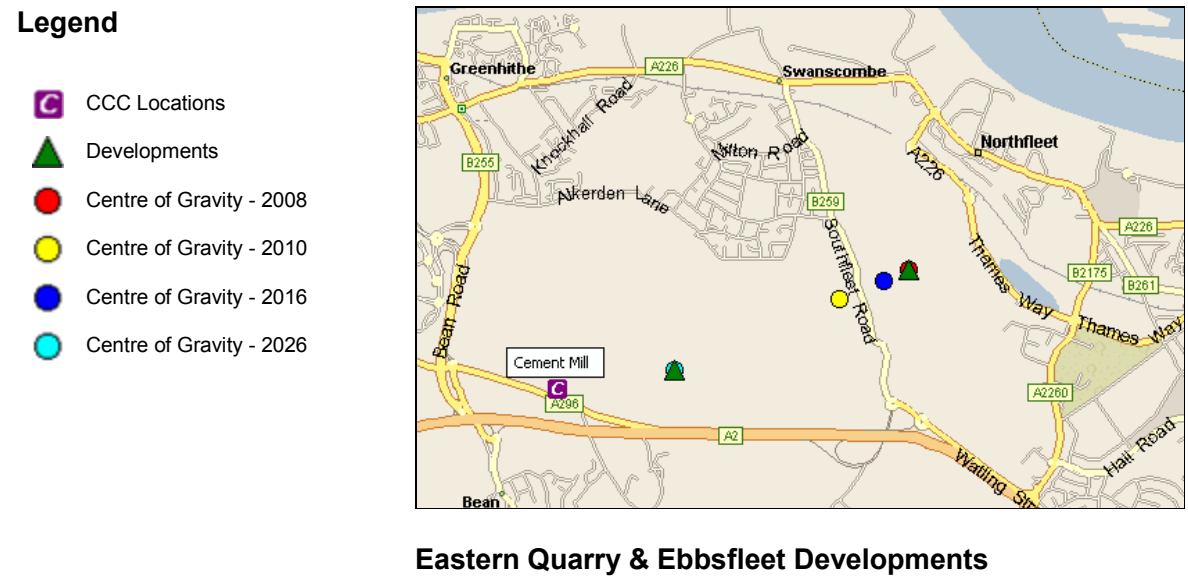


Figure 15: Location diagram for Eastern Quarry & Ebbsfleet

The model was run for following years:

- A start year - 2008,
- The peak demand year - 2010
- An intermediary year - 2016
- A horizon year - 2026

The peak demand for materials for these developments will be a period beginning 2016 and subsiding after 2020. The model has suggested that the size of the CCC will have to be approximately 22,000 sq ft, a size which has been corroborated by calculations carried out by Wincanton as part of their assessment for operating a facility in the area. Table 20 provides a summary of the key information in terms of changing demand and its impact on the facilities required and their associated costs.

Table 20: Results of modelling for Eastern Quarry & Ebbsfleet developments: Cement Mill option

	Cement Mill										
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist to Construction Site (mls)	Number of vehicles required	Delivery Cost	CCC cost	Total cost	Total cost / pallet	Total cost / pallet with peak sq ft
Cement Mill - 2008	2	2,919	40,870	9,523	1.75	3	**£82,513**	**£417,816**	**£500,329**	£12.24	£21.51
Cement Mill - 2010	4	5,197	72,760	16,953	1.16	4	**£133,088**	**£743,822**	**£876,910**	£12.05	£14.09
Cement Mill - 2016 (Peak)	4	6,670	93,319	21,743	1.16	5	**£171,112**	**£953,998**	**£1,125,110**	£12.06	£12.06
Cement Mill - 2026	2	1,723	22,822	5,317	0.56	1	**£38,815**	**£233,309**	**£272,124**	£11.92	£34.23

The decline in demand for building materials after the peak period should be treated with caution, since the original data only provided indicative figures regarding the number of dwellings and amount of commercial floor space to be built. For the modelling an average annual PEU figure was derived from the data and in reality there would be a smoother decline over the 10 year period between 2016 and 2026.

In summary, the Cement Washing Mill site would be a suitable location if serving only the Eastern Quarry & Ebbsfleet developments, due to its close proximity to both sites. A key disadvantage to the site is inability to provide intermodal access to supplier deliveries.

4.3.5 Medway

The demand for materials across the Medway developments is similar to the NW Kent area, peaking at approximately 235,000 pallets in 2009. Most of the planned development will take place in the centre of the urban area within the proximity of the waterfront and its surroundings, although 3,000 dwellings are earmarked to be built at Chattenden. The dispersion of the developments for the Medway area is illustrated in Figure 16.

Running the model to determine the CoG locations produced three outcomes that would not in be useable in practice. From the examination of nearby alternative sites, only Medway City Estate offered any potential, but this is located on the north central peninsular and as such might not be suitable when the expected levels generated of construction traffic are taken in account. As a result the options for CCC locations in Medway are, at this stage, limited to two alternatives, one located away from the centre of the area at Chattenden and the other providing an intermodal capability at Chatham Dock.

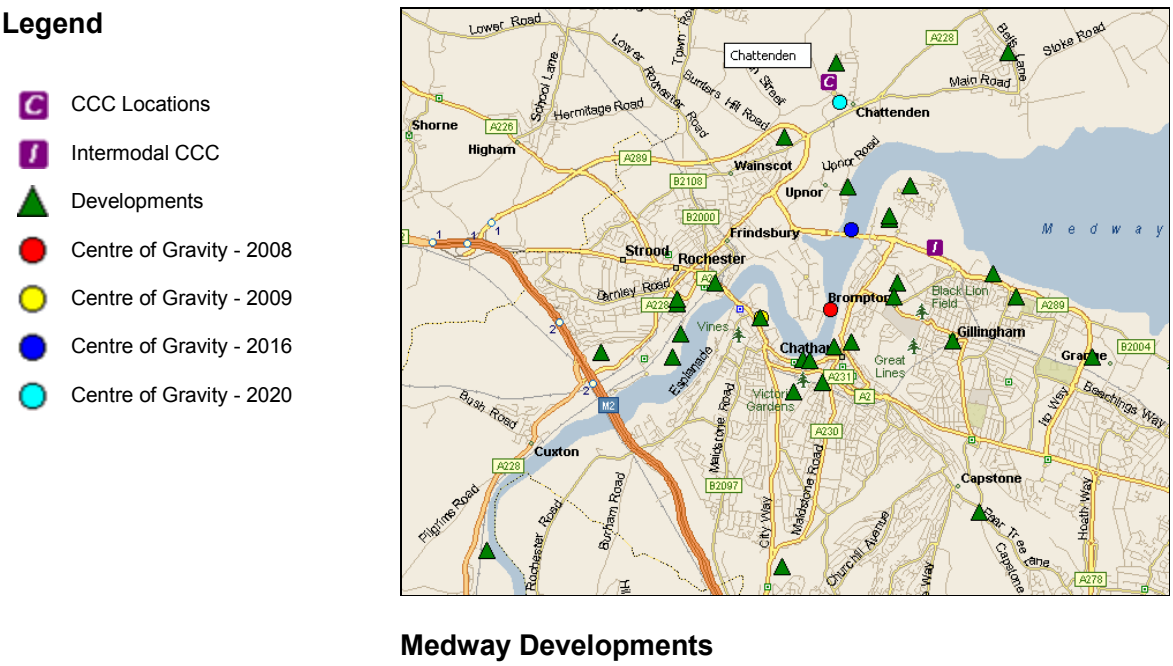


Figure 16: Location diagram for Medway

The model was run for following years:

- A start year - 2008,
- The peak demand year - 2009
- An intermediary year - 2016
- Last year of available data - 2020

In order to handle the peak demand for pallets the model suggests that the CCC will need to be about 55,000 sq ft in size. A summary of the key information related to the two modelled locations is provided in Tables 21 and 22.

Table 21: Results of modelling for Medway area: Chattenden option

	Chattenden										
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist to Construction Site (mls)	Number of vehicles required	Delievery Cost	CCC Cost	Total cost	Total cost / pallet	Total cost / pallet with peak sq ft
Chattenden - 2008	24	8,551	100,280	23,365	3.22	7	**£269,090**	**£1,025,163**	**£1,294,253**	£12.91	£22.64
Chattenden - 2009 (Peak)	25	17,689	235,448	54,859	3.09	14	**£572,633**	**£2,406,981**	**£2,979,614**	£12.66	£12.66
Chattenden - 2016	12	8,260	107,789	25,115	2.52	6	**£231,974**	**£1,101,921**	**£1,333,895**	£12.38	£20.93
Chattenden - 2020	3	4,420	61,875	14,417	1.59	3	**£82,192**	**£632,546**	**£714,738**	£11.55	£31.82

Table 22: Results of modelling for Medway area: Chatham Dock Intermodal option

	Chatham Dock Intermodal CCC										
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist to Construction Site (mls)	Number of vehicles required	Delievery Cost	CCC Cost	Total cost	Total cost / pallet	Total cost / pallet with peak sq ft
Intermodal CCC - 2008	24	8,551	100,280	23,365	2.11	6	**£237,752**	**£1,025,163**	**£1,262,915**	£12.59	£22.33
Intermodal CCC - 2009 (Peak)	25	17,689	235,448	54,859	2.15	13	**£521,808**	**£2,406,981**	**£2,928,789**	£12.44	£12.44
Intermodal CCC - 2016	12	8,260	107,789	25,115	1.58	6	**£223,176**	**£1,101,921**	**£1,325,097**	£12.29	£20.85
Intermodal CCC - 2020	3	4,420	61,875	14,417	1.56	3	**£87,573**	**£632,546**	**£720,119**	£11.64	£31.90

As with the NW Kent assessment, the compactness of the Medway development area means that the model suggests the cost differences between the Chattenden and Chatham Dock locations are relatively small - that is it would cost approximately £51K more in the peak year if the CCC was located at Chattenden. Therefore, from the modelling either location could be regarded as offering real potential but would require a full feasibility study to establish the best option.

4.3.6 Swale

In terms of the amount of development taking place, Swale has the least when compared with the two other areas. Furthermore, there are two distinct blocks of development taking place in the Sittingbourne area and at Queensborough. In addition there are two development sites located in Faversham, although one is already in progress.

The initial run of the model to determine the CoG locations for the area provided results that omitted the Faversham sites, as the quantity of pallets and the distance from the core of the Swale area development made them uneconomical to allocate to the CCC locations it calculated.

With regard to the options provided by the model, the theoretical locations shown in Figure 17 corresponded closely with the alternatives the study team were considering, in that the central Sittingbourne location was suggested by Swale Forward and Ridham Dock was the obvious intermodal option. These two options were then considered further.

Figure 17: Location diagram for Swale

The model was run for following years:

- A start year - 2008,
- The peak demand year - 2011
- An intermediary year - 2016
- Last year of available data - 2020

The peak year for materials demand is 2011 and to handle the 105,000 pallets the model suggests that the CCC would need to be approximately 25,000 sq ft in size. A summary of the key information related to the two modelled locations is provided in Tables 23 and 24.

Table 23: Results of modelling for Swale area: Cooks Lane, Sittingbourne option

	Cooks lane										
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist. to Construction Site (mls)	Number of vehicles required	Delievery Cost	CCC Cost	Total cost	Total cost / pallet	Total cost / pallet with peak sq ft
Cooks Lane - 2008	14	5,899	70,212	16,359	3.46	4	**£131,500**	**£717,774**	**£849,274**	£12.10	£15.73
Cooks Lane - 2011 (Peak)	14	8,330	105,574	24,599	2.13	7	**£258,801**	**£1,079,285**	**£1,338,085**	£12.67	£12.67
Cooks Lane - 2016	8	5,169	69,353	16,159	3.72	5	**£182,223**	**£708,995**	**£891,218**	£12.85	£16.62
Cooks Lane - 2020	5	2,429	30,983	7,219	5.73	3	**£104,253**	**£316,732**	**£420,986**	£13.59	£61.25

Table 24: Results of modelling for Swale area: Ridham Dock Intermodal option

	Ridham Dock Intermodal CCC										
CCC Runs	No of Construction Sites	Construction Site Deliveries	Pallets	CCC Area (sq ft)	Av Dist. to Construction Site (mls)	Number of vehicles required	Delievery Cost	CCC Cost	Total cost	Total cost / pallet	Total cost / pallet with peak sq ft
Intermodal CCC - 2008	14	5,899	70,212	16,359	3.49	3	**£128,087**	**£717,774**	**£845,861**	£12.05	£15.69
Intermodal CCC - 2011 (Peak)	14	8,330	105,574	24,599	2.99	7	**£274,499**	**£1,079,285**	**£1,353,784**	£12.82	£12.82
Intermodal CCC - 2016	8	5,169	69,353	16,159	3.64	5	**£176,593**	**£708,995**	**£885,588**	£12.77	£16.54
Intermodal CCC - 2020	5	2,429	30,983	7,219	3.93	3	**£85,091**	**£316,732**	**£401,823**	£12.97	£60.64

Over the entire timeframe for the Swale area, greater demand for materials is forecast for the Isle of Sheppy developments. Therefore, overall the Ridham Dock location appears to be a more cost effective option, as it is reasonably equidistant from Sittingbourne and Sheppy. However, to establish which option is most suitable a full feasibility study would be required.

4.3.7 Summary of modelling exercise

As part of the modelling exercise we considered nine CCC locations. An initial run of the model established that it was not practical for a single CCC to serve the whole of North Kent, as it would require a CCC of approximately 125,000 sq ft in size and a fleet of 44 delivery lorries, which would generate over 81,000 in- and outbound movements per year, with half of the delivery trips would being over 9 miles long. Furthermore, supplier deliveries would amount to a further 170,000 commercial vehicles arriving at the CCC in the peak year.

The CoG locations calculated by the model were only used for guidance, but if they were close of a location being considered as an alternative by the study team they were investigated more closely. However the overall size of the development areas and dispersion of the individual construction sites has led to the model producing results that suggest there is very little cost differentiation between the options tested.

The CCC location alternatives chosen for inclusion in the scenarios are:

- Based on useable sites that offer good access for delivery vehicles,
- Based in areas which will not unduly impact upon local residents,
- Able to serve the area for a long period.

All the options considered in the modelling will be subject to fluctuation in demand and the size of the facility should, in theory, meet that peak. However, the peak could only last for one year which implies a compromise in size will be required or other projects that demand building materials will be needed to supplement it primary role.

The modelling carried out in the study has established that:

A single CCC to serve all the North Kent Thames Gateway Development is not a practical option.

The North Kent development programme would be best served by the implementation of regional CCCs - in this case one for each of the areas considered.

If a CCC is located close to the centre of its development area to meet the peak demand, the operating costs are likely to be at their lowest. However, construction phasing will influence this cost and therefore a comprise location is probably best found in the interest of long-term costs.

Deliveries of materials by water and rail are not yet viable options. Due to the operating characteristics of these modes they are unable to compete with road for the materials volumes estimated in the study.

The CCC sites included in modelling demonstrate that they offer real opportunities and could be seriously considered as locations for CCC. The North West Kent area offers the greatest choice, while Medway and Swale have fewer options, although more sites may exist in all cases.

4.4 Consolidation service – financial model

Data for the financial model has come from two sources – industry inquiries made by Peter Brett Associates and an analysis by Wincanton on the demand in Eastern Quarry and Ebbsfleet Quarry (the Land Securities development).

The cost of a consolidation centre is made up of three components:

- Fixed cost of the CCC
- Variable cost in the CCC per pallet handled
- Variable cost of delivery per pallet handled.

The fixed cost of a consolidation centre would include:

- Management and clerical staff costs
- Office equipment and systems costs
- Site general expenses
- Warehouse supervisory costs
- Warehouse fit out costs (spread over and replaced every 5 years)
- Rent
- Rates
- Water
- Heat / light / power
- Security
- Equipment contracts
- Cleaning
- Material handling equipment depreciation (spread over 5-year contracts).

Variable cost would include insurance. Ownership of materials passes from the supplier to the purchaser (trade contractor) upon delivery to the CCC. While the goods pass through the consolidation process, they are in the care of the operator of the CCC who must insure the goods in its care until delivery to the trade contractor at the site.

PBA's analysis is in Appendix 6. They have considered four locations:

- North West Kent (Dartford and Gravesham)
- Eastern Quarry and Ebbsfleet only (the Land Securities development within NW Kent)
- Medway
- Swale.

Figure 18 shows the estimated annual cost of providing a consolidation service for the peak demand in the four locations,.

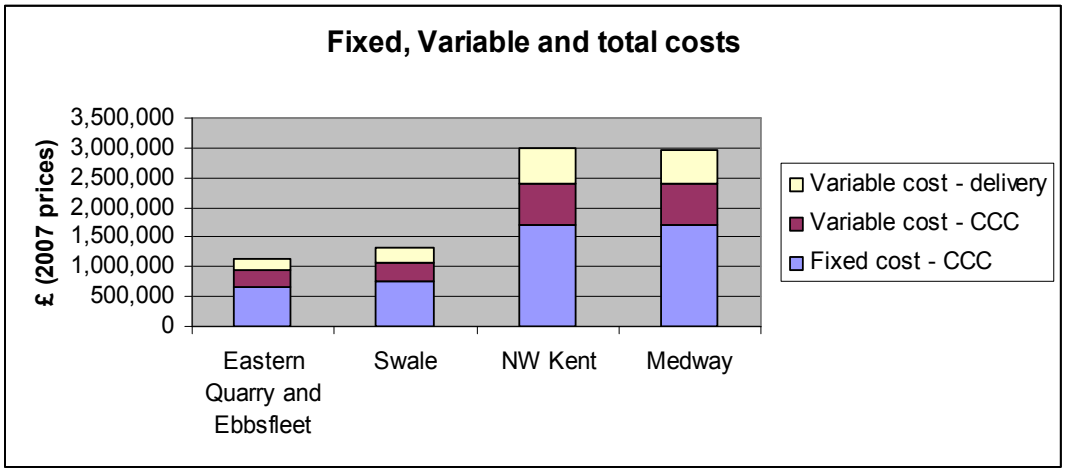


Figure 18: Fixed, variable and total costs

The data supporting this chart is in Table 25.

Location	Eastern Quarry and Ebbsfleet	Swale	NW Kent	Medway
Pallets	93,319	105,574	235,301	235,448
CCC area (ft^2)	21,743	24,599	54,825	54,859
Fixed cost – CCC (£)	674,033	762,569	1,699,575	1,700,629
Variable cost – CCC (£)	279,957	316,722	705,903	706,344
Variable cost – delivery (£)	171,112	258,801	588,764	572,633
Total annual cost (£)	**1,125,102**	**1,338,092**	**2,994,242**	**2,979,606**
Total cost per pallet (£)	**12**	**13**	**13**	**13**
Fixed cost per pallet (£)	7	7	7	7
Variable cost per pallet (£)	5	5	6	5

Table 25: Fixed and variable costs

The cost from PBA's model is typically about £13 per pallet. But note these figures are derived from consolidation centres sized to suit the peak demand. If this size is fixed, the unit cost can rise significantly for lower throughputs. Figure 19 illustrates this effect using data from Eastern Quarry and Ebbsfleet. Here unit costs could be as high as £35. This suggests the need to downsize or abandon the CCC below a minimum economic threshold in throughput.

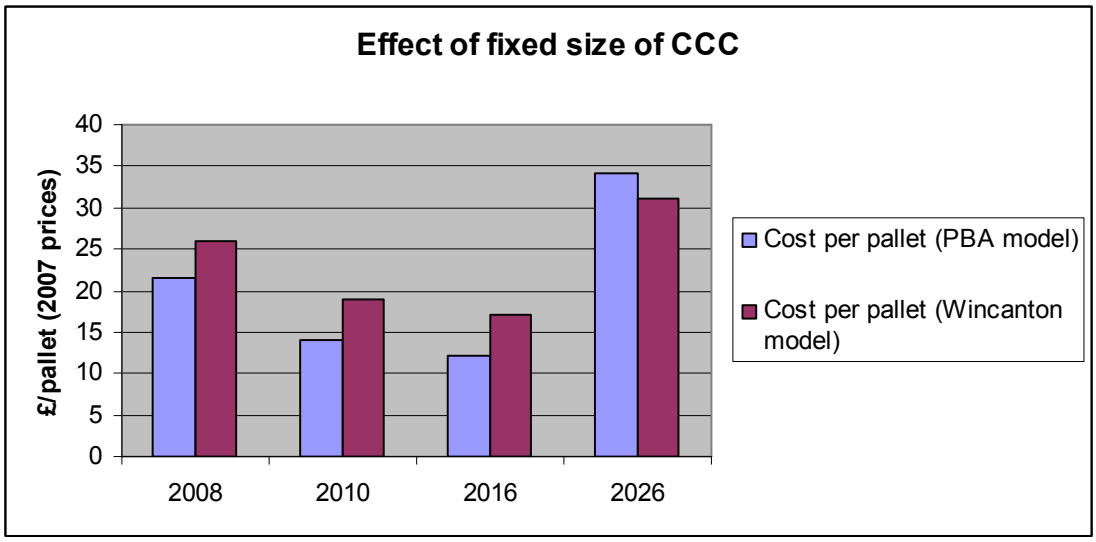


Figure 19: Effect of fixed size of CCC

Wincanton's model produces higher unit costs, but they say the service would include a supply chain management service that is not included in PBA's figures. We notice that for the 2026 demand, the Wincanton model (which has been worked out from first principles) suggests a lower unit cost than the PBA model (which is less sophisticated).

On the basis of these models, the unit cost is in the region of £15-20 per pallet for the optimum sized CCC.

Selecting the optimum size has a significant impact on unit costs.

The cost of the consolidation service could be reduced by offsetting income from concessions for ancillary services based at the CCC.

It is evident from the various analyses PBA has done that, provided the CCC is located towards the centre of gravity of the demand, the variation in delivery cost is small. Hence the exact positioning of the CCC is not critical.

Assuming the unit cost is in the region of £20/pallet, the estimated impact on construction costs would be as shown in Table 26. For example, the cost of consolidating materials for commercial buildings would be £20/pallet x 0.45 pallets/m^2 = £9/ m^2. Dividing by the construction cost of £2,000/ m^2 gives 0.5% of construction cost.

Table 26: Impact on construction cost

Construction type	Construction cost[11] £/m^2	Pallets/m^2	Consolidation cost £/m^2	% of construction cost
Commercial	2,000	0.45	9	0.5%
Apartments	1,500	1.0	20	1.3%
Houses	1,000	1.5	30	3.0%

The question arises, what savings can be obtained on suppliers' delivery costs to offset these 'additional' costs of handling by the CCCs? Suppliers are generally tight-lipped about delivery cost. "It's included in the price," is the usual response. The only way to get to the bottom of this would be for a large contractor to interrogate a sample of suppliers who are willing to 'open the books'.

Although the cost of consolidation is less than the potential savings, experience in London shows that it will be difficult to justify this expense – even though there are substantial environmental benefits – because the financial benefits may not be immediate and financial data may not be sufficiently transparent. Even if the largest developer in North West Kent (Land Securities) were persuaded to adopt consolidation and fund it from the project, this would account for just over one-third the cost of the service needed to serve North Kent.

Pump-priming money may be needed from the government (whose plans rely on the development occurring to achieve its own objectives in the region).

[11] Construction costs estimated from *Building Magazine's 2007 Cost Models* which exclude demolitions and site preparation, site abnormals, furniture, fittings and equipment, external works and services, contingencies and design reserve, professional fees and VAT

4.5 Consolidation service – key performance indicators

Key performance indicators for a consolidation centre are not those typically applied to a construction project. The UK construction Industry standard Economic KPIs allow measurement and comparison to the UK construction industry. Table 27 offers a list of KPIs, purpose of the measurement and a metric for each KPI. This not an exhaustive list, however it is designed to produce information based on low maturity and to develop the correct working collaborative model to achieve the benefits mentioned elsewhere.

Table 27: KPIs for consolidation

Performance attribute	Purpose of the Measure	Metric
Stock turns	The amount of stock turned in the CCC Improvement in the stock turn (currently 52 that is one per 5 day week) is the factor of sizing the facility	Inventory days of supply
Floor space utilisation	Governing the amount of space each trade contractor should occupy and with cost	£ stock/m^2
Supply chain costs	The costs associated with operating the supply chain	1. costs of goods sold 2. total supply chain management costs 3. value added productivity 4. warranty returns, reverse logistics 5. processing costs 6. demand/planning costs 7. total delivery costs 8. supply chain finance costs 9. inventory carrying costs 10. material planning costs 11. product data management costs
Supply chain delivery reliability	The performance of the supply chain in delivering the correct product, in the correct conditions and packaging, in the correct quantity, with the correct documentation to the correct customer	1. delivery performance 2. fill rates 3. perfect order fulfilment 4. supplier delivery performance 5. perfect order fulfilment
Supply chain responsiveness	The speed at which a supplier provided products to the customer	1. order fulfilment lead times 2. 12m/3m/1w forecast accuracy 3. order management cycle time 4. in stock position 5. construction plan adherence 6. re-plan cycle time 7. shelf stock keeping unit accuracy
Supply chain asset management efficiency	The effectiveness of an organisation in supporting material demand satisfaction. This includes the management of all assets, fixed and working capital	1. cash to cash cycle times 2. inventory days of supply 3. asset turns

Contrast this proposed set of KPIs with the following KPIs used at the LCCC where the emphasis was on environmental impact:

- Supplier vehicle types delivering into LCCC
- LCCC vehicle types out to site
- Unplanned deliveries received into LCCC
- Call offs made which had more than 24 hours notice
- LCCC productivity
- Comparison of call offs (with control project not served by LCCC)
- Cost per pallet
- Reason for unsuccessful call offs
- LCCC usage by project
- LCCC vehicle movements
- LCCC CO_2 emissions
- LCCC hours worked.

4.6 Deployment over time

There is an almost infinite number of scenarios for the deployment of CCCs in North Kent over the next 25 years. Here we look at some of the choices that may arise.

The main variables that affect the siting of a CCC are:

- The total demand for construction materials
- The distribution of sites in relation to the CCC
- The environment in which the CCC is located.

The CCC should not influence building design or location. It must adapt to changing circumstances. Operationally, a CCC will work in any warehouse building that is high enough for high-level racking and with a floor suitable for forklift truck. Therefore it should be relatively easy to relocate the operation. However, ancillary services that are co-located with the CCC will make it more difficult to relocate.

As explained in Financial Model, the demand may vary considerably and this has a marked impact on the unit cost of delivering the service. The choices include:

- Size the CCC to suit peak demand and rent out unused portions for other light industry when demand is lower. Wincanton cited an example of doing this.
- Size the CCC to suit a low level demand but on a site large enough to accommodate the peak demand. Then extend the warehouse if necessary.
- Change the size to suit demand by moving the operation to a more suitable sized warehouse.

As the consolidation analysis shows, the economics of distribution is not particularly sensitive to location, provided the CCC is positioned within the demand zone and not outside it. Hence, a redistribution of sites within the demand zone is unlikely to justify relocating the CCC. However, if the surrounding environment changes, for example, if the CCC becomes enveloped by an expanding housing estate, this may justify relocating.

While relocating an entire warehouse is technically possible (due to its steel construction), this is unlikely to be an economic solution unless no further use can be found for an existing building or it is no longer compatible with its surrounding environment. As a guide, SPONS estimate the cost of a distribution centre at about £350/m^2. A facility sized to suit the peak demand for the Land Securities developments only at Ebbsfleet would be about 2,000m^2; hence the construction cost would be about £700k.

5 Ancillary services

5.1 Local needs

Potential stakeholders in ancillary services took part in a workshop hosted by Kent-Thameside Development Board at their office in Northfleet on 28th June 2007. The workshop looked at the symbiosis of each service with consolidation.

The detailed outcomes of this workshop are in Appendix 4.

Site security would include perimeter and gate security, visitor reception, inspecting deliveries, communication systems and liaison with emergency services.

The construction boom in North Kent will be a magnet for criminals and will create demand for security services specialising in construction sites.

Welfare of construction workforce would include setting up, operating and maintaining facilities for ablutions, lockers, meals and first aid.

It will be necessary to attract and retain a competent workforce in order to sustain the high rate of construction.

Skills and employment would include a training and employment referral service for trade, supervisory and some professional occupations in construction and support services, as well as services post construction such as retail and business.

Both employers and potential employees would benefit from this service.

The Learning and Skills Council forecasts[12] that employment in the skilled construction and building trades in North Kent will grow by 25% over the period 2004-2014. LSC says: "New construction materials and building practices will also create a demand for different types of skills and training. The increasing use of pre-fabrication, particularly in social housing and civil engineering projects, is leading to a growth in semi-specialist assembly roles. Whilst these jobs may not be highly skilled, they often require workers who are generalists and know a little about a range of construction trades."

SUSCON's proposal for a Skills Academy looks ambitious (see Appendix 11). However, considering there is little spare capacity in existing construction training provision in North Kent as well as the needs highlighted by LSC, it addresses a definite need. The project is entering phase 3 (Confirmation of project, fund raising and partnerships). Interim operation is planned from a mobile facility near Ebbsfleet. Construction is planned from mid 2008 and operation from 2010. A key factor in the success of vocational training programmes is convenience of travel. Therefore it may be desirable to distribute the facilities across the sub-region in order to gain maximum take-up.

Experience from Bluewater shows that a site near the construction site and accessible by local people has successfully satisfied the needs or employers and local people. Because of this experience there is now considerable expertise emerging across North Kent. Potential partners would include the many organisations listed in SUSCON's report.

Reverse logistics would include picking up returns, packaging or waste products following a delivery.

Reverse logistics was pioneered in the retail sector to deal with returned goods. It will be increasingly important as the European directive on electronic goods takes effect.

[12] *Sector Study Series No. 3 – Construction*, LSC, 2006

A well organised reverse logistics system has great potential to increase the re-use and recycling of products. Potential materials would be 'clean' (suitable for immediate re-use or recycling) or 'dirty' (processing needed to enable re-use or recycling). The existence of a reverse logistics service that includes a Resource Recovery Park (RRP) would also heighten awareness of over-ordering and may reduce this effect. The types of vehicles and containers, facilities for segregating and sorting, and ICT systems would be critical operational factors.

Building offsite would include pre-assemblies, building elements and modular buildings.

Historically maligned because of its 'portacabin' image, building offsite is emerging as an effective way to build a large number of buildings efficiently.

Cost remains a disincentive because of expensive set-up and transport. However the demand for large numbers of houses in North Kent, coupled with limited supply of conventional houses, signals the tipping point is nearer. Designs need to look less 'modular' in order to gain buyer acceptance.

Soil remediation would apply only to non-hazardous waste that can be treated (remediated) before re-use.

The volumes of non-hazardous soil needing remediation are vast. For example, consultant Jacobs Babtie forecasts that in the period of accelerated development up to 2016, the volume of non-hazardous material generated in Dartford and Gravesham alone would be some 6 million tonnes. Much of this would need to be remediated off site, preferably at regional hub sites. Such a service may attract 'business' from remote sites. While this may be good for the local economy, there would be negative impacts due to the increase local traffic.

An innovation and business hub would be the focal point to attract skilled workers and SMEs, promote innovation and best practice, and as a knowledge exchange between British and French companies.

Drivers for this service include the push for sustainable construction and SEEDA's desire to promote North Kent as a destination for international investment.

The workforce and specialist skills needed may be unobtainable locally. The obvious solution would be to attract consultants and contractors into North Kent. But large scale relocation of a construction workforce to North Kent would exacerbate demand for housing. Hence, encouraging specialists to commute from London or even North West France seems the preferred solution.

Subsequent work on potential business models suggests that ancillary services might be run on a concession basis. This would provide income to the CCC operator as well as further alleviating local traffic that would otherwise occur if the services were supplied independently. The scope of potential concessions includes:

- **Resource recovery service**
- **Access equipment and scaffold service**
- **Construction equipment and tool hire service.**

All could use the CCC's vehicles for delivery and recovery.

5.2 Site requirements

Table 28 offers an estimate of the land needed for the ancillary services, in order to understand the relative scale of each service.

Table28: Site requirements

Potential service	Site area needed	Comments
Construction consolidation centre	0.5 ha	Peter Brett Associates assess peak annual demand for Eastern Quarry and Ebbsfleet at about 90,000 pallets annually. This would need a warehouse of about 22,000 ft^2, provided average dwell time does not exceed 5 days. Allowing double this area for circulation and parking, suggests a site about 45,000 ft^2, which is about 0.5 hectares.
Site security	< 0.1 ha	Small office and store only
Welfare of construction workforce	< 0.1 ha	Small office and store only
Skills and employment	6.5 ha	SUSCON proposal
Reverse logistics	0.2 ha	SEEDA advise that a resource recovery park is more likely to be 'virtual' than a single site. The estimated area assumes a receiving, sorting and dispatch facility that utilises the CCC's delivery fleet.
Building offsite	2.5 ha	Off-site specialist Terrapin has recently built a factory to supply 2,000 houses annually on double shift working, They say single shift output 1,000 houses annually would be viable and there would be interest from the build offsite sector to do this, provided there is continuous demand over some years. Allow 90,000 ft^2 factory plus double that area outside for circulation and storage. Adequate storage is important in case sites cannot take immediate delivery. This suggests a site about 270,000 ft^2, which is about 2.5 hectares.
Soil remediation	10 ha	Size will depend on the size and number of donor sites contributing to the hub site.
Innovation and business hub	2 ha	The minimum size[13] that a commercial developer is likely to consider is about 5 acres, but there are many variables that include the demand, existing access and services, and the developer's objectives.

[13] Conversation with David Sims, Land and Planning Director, Lafarge

5.3 Potential symbiosis with construction consolidation centre

It is important to distinguish between demand for local services and those services which have an operational symbiosis with a consolidation centre. Table 29 shows our assessment, which draws on the opinions of the Ancillary Services Workshop.

Table29: Operational symbiosis with consolidation centre

Potential ancillary service	Symbiosis	Comments
Site security	Medium	There is evidence that a logistics contractor could also offer security as an ancillary service (or contract out this service). The impact of additional facilities would be low. It would make a lot of sense to provide this service to the same sites serviced by the CCC.
Welfare of construction workforce	Medium	Same as site security.
Skills and employment	Medium	Although the CCC is a potential focal point for construction-related activities, Land Securities observes that vocational and skill training needs to be on site and not in a factory environment. On the other hand, LSC argues that more work will be pre-fabricated (in factories). The area of land needed for SUSCON's proposal is so large that it could not be realistically viewed as 'ancillary' to a consolidation centre, being about 20 times the size of what is needed at Ebbsfleet. Nevertheless, there is potential for service to co-ordinate on-site or in-factory training and to provide an employment brokerage service especially to those sites serviced by the CCC. This could be done from an office shared with CCC personnel.
Reverse logistics	High	There would be advantages in back loading the CCC's delivery fleet, provided waste containers are compatible with flat-bed trucks used for material delivery. The resource recovery centre (RRC) could be a similar building, annexed to the consolidation centre. Segregation could be done either at site or at the RRC. If processing is done at the RRC, it may be more economic to do the whole segregation, sorting and processing at one location. The RRC may need to be operated by a licensed contractor. However, given the many similar activities, this could be managed by suitably qualified members of the CCC team. Distribution of recovered materials for reuse, recycling and disposal could be achieved by diverting trucks that normally leave the CCC with a backload to a resource recovery contractor.

Table continued…

Building offsite	High	Terrapin agree there is good synergy with the CCC for use as a supply buffer.
Soil remediation	Low	There is no scope for economies of back loading in the transportation because the types of trucks needed are different (flat bed for logistics and dump trucks for soil). The area of land needed is so large that it could not be realistically viewed as 'ancillary' to a consolidation centre, being about 30 times the size of what is needed at Ebbsfleet. A soil remediation hub would probably not be a good neighbouring activity.
Innovation and business hub	Low	There is a strong argument for establishing an innovation and business hub along the lines suggested by CCI Lille (see Appendix 10). However, the symbiosis with construction consolidation is low from an operation point of view.

Of these potential ancillary services, we suggest integrating waste recovery into the CCC on the grounds that there is considerable transportation capacity that could be harnessed. This would have profound environmental benefits and potential offsetting revenue because the waste recovery service could be offered as a concession.

Figure 20 shows the exiting transport arrangements at a conventional construction site without consolidation. Note that virtually all vehicles are underutilised by up to 50% because they either come to or go away from the site unloaded. This does not reflect the overall fleet utilisation. For example, Wincanton report 70% utilisation of its construction fleet, where this means 70% of miles travelled are laden. But utilisation in the immediate vicinity of construction sites would be not much better than 50%.

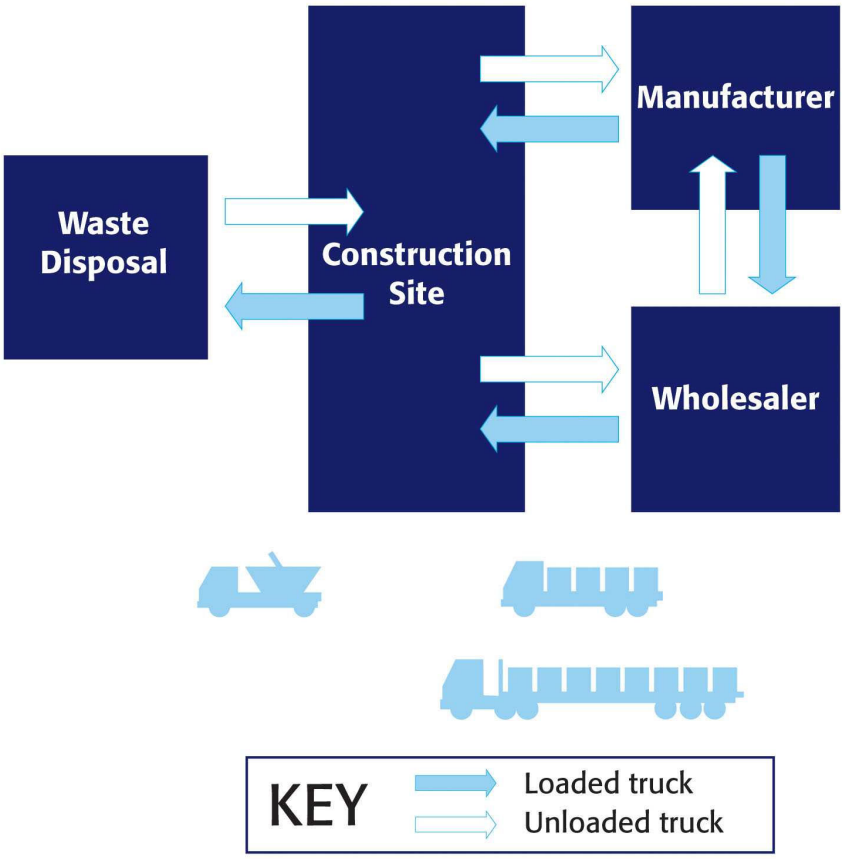


Figure20: Existing transport utilisation

Figure 21 illustrates what happens when a CCC is introduced. While it is true that there will be significantly less local traffic (provided deliveries actually go via the CCC) it does little to address the problem of underutilisation. However, note that the CCC vehicles delivering to the site could return with waste, provided it was placed in suitable containers.

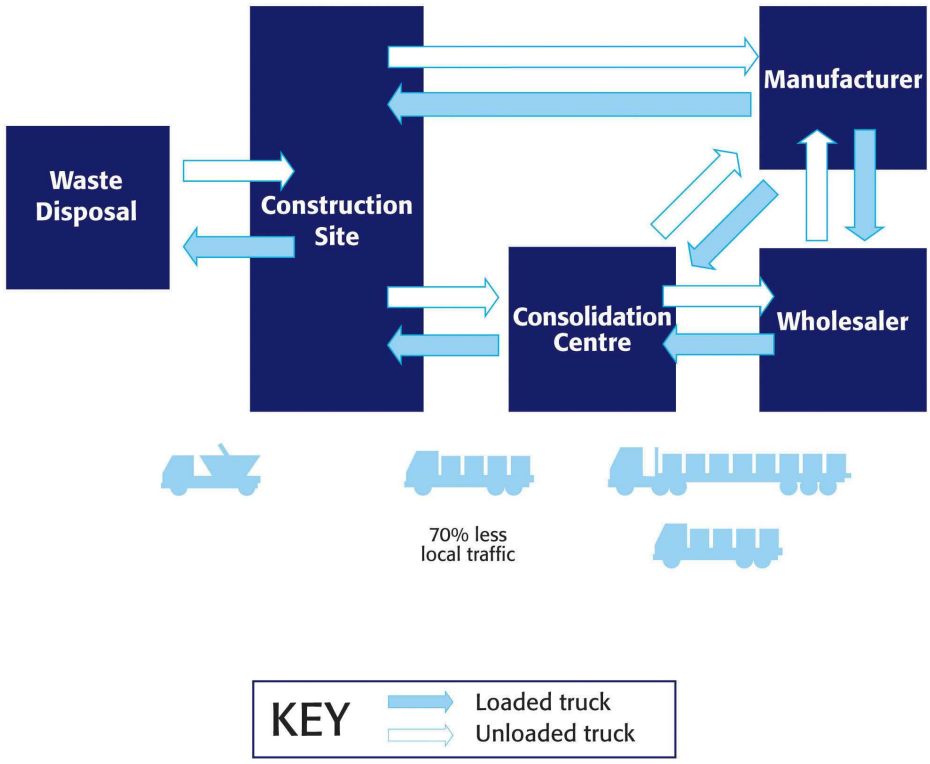


Figure 21: Transport utilisation with consolidation centre

Data from a central London site served by a consolidation centre shows that, over a full year, there were:

- 3,030 vehicles delivered into the consolidation centre
- 903 vehicles delivered from the consolidation centre to the site
- 741 vehicles took away waste from the site.

The number of waste vehicles is surprisingly large and is about 80% of the number of deliveries from the CCC. While about half of these were waste contractors' 'dustcarts', they are nevertheless all local vehicle journeys that could be eliminated if the CCC fleet took away the waste.

Figure 22 shows the improvement in fleet utilisation when waste recovery and some processing happen via the CCC. There is even potential for some back loading for trucks delivering to the CCC because waste needs to be returned to the local resource recovery network.

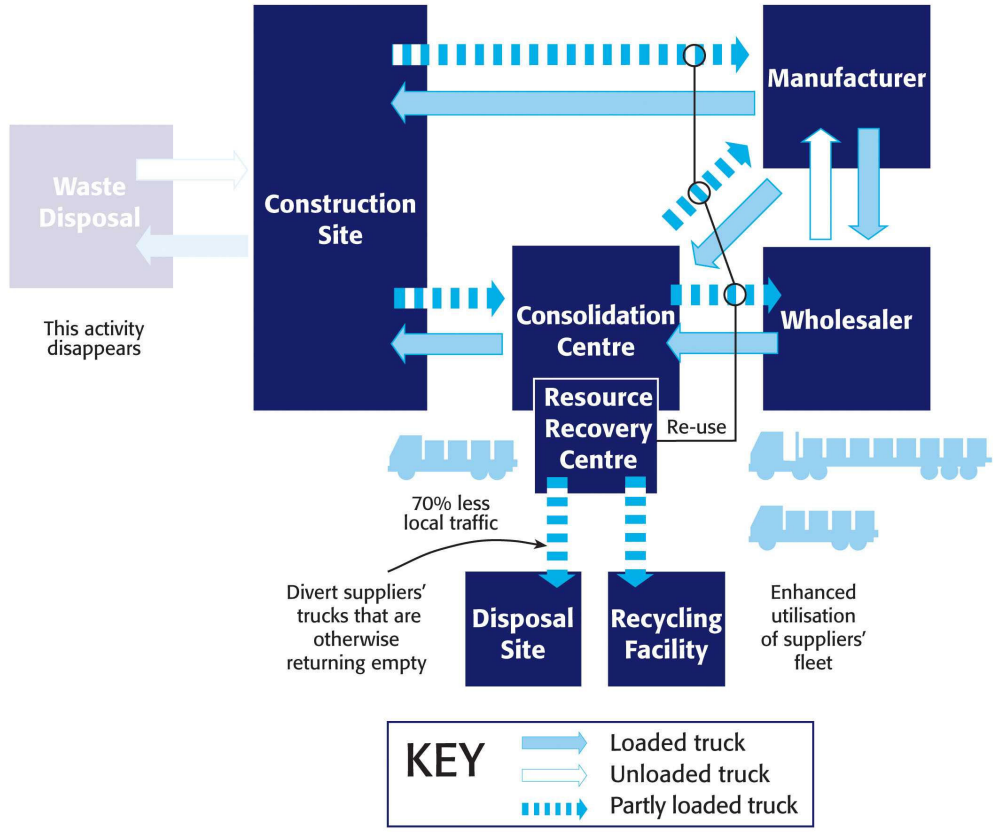


Figure 22: Transport utilisation with consolidation and resource recovery centre

An important issue here is licensing to carry and process waste. The Environment Agency advises that the operation would need a Waste Management Licence to treat, keep or dispose of the waste at the centre. Hauliers would have to be Registered Waste Carriers.

If the CCC is performing the waste management function, it would clearly need to have a Waste Management Licence. The regulations may not explicitly cover the co-location of distribution facility and resource recovery facilities, hence it is not absolutely clear what the licensing situation would be if the CCC was only a carrier. This, as well as the planning considerations, would need to be examined in some detail to ensure this business model is viable.

5.4 Dependencies

Table 30 shows our assessment of whether an ancillary service has a direct dependence, an indirect dependence or no dependence on a consolidation centre from an operational point of view.

Table30: Dependence on consolidation centre

Direct dependence on CCC	
Site security	The site requirement is low and the service could be economically provided by the CCC operator.
Welfare of construction workforce	The site requirement is low and the service could be economically provided by the CCC operator.
Reverse logistics	Operationally, there is a strong argument for optimising the use of the CCC's delivery fleet by back loading with waste. However, a new type of container that could be handled in the same way as a pallet is needed.
Building offsite	Operationally, there is a strong argument for using the CCC as the material 'supplier' and the CCC fleet for delivery. However, because the site needed is about five times that needed for consolidation it would be necessary to plan for this when selecting a site for a CCC.
Indirect dependence on CCC	
Skills and employment	There is some limited potential for using the CCC itself as a training facility (especially for logistics), but the site required for the full-blown SUSCON proposal far exceeds that needed for the CCC. It would be possible to house a less ambitious proposal in an annex to the CCC and it would be necessary to plan for this when selecting a site for a CCC.
Innovation and business hub	Operationally, there is little to be gained from co-locating such a hub with the CCC. And the light industrial activity in the CCC may not be an ideal neighbour for a business hub. Nevertheless, it would be possible to house a modest proposal in an annex to the CCC and it would be necessary to plan for this when selecting a site for a CCC.
No dependence on CCC	
Soil remediation	The operation needs are quite different from the CCC and the scale far exceeds what would be needed for a CCC.

6 Business case

6.1 Logistics services

Experience at the LCCC shows that the business case for consolidation alone is not convincing enough to attract users to the centre. The business benefits outlined in this report were not realised on projects using the LCCC because there were insufficient incentives to encourage the supply chain to change its practices, change control issues and, in some instances, poor communication.

The benefits that could be obtained from a consolidation process, along the lines described in this report, are:

- **Environmental:** If 75% of materials were delivered via the CCC, there would be a 50% reduction in local traffic and emissions. Strong discipline would be needed to achieve this, together with training of SMEs and suppliers to work with the logistics specialist on planning and forecasting material needs.

- **Productivity of construction workforce:** Following several studies of construction productivity, BSRIA states that operatives would save 30 minutes a day. Over an eight-hour day would increase productivity by 6% and reduce construction cost by 3%. In order to achieve this, more effort is needed to plan the phasing and timing of works, study the behaviour of operatives in relation to materials, identify causes and effects on productivity, and set up systems to identify and accrue savings.

- **Productivity of hauliers:** A 10-20% reduction in the delivery cost looks easily achievable. For low-value heavy materials such as masonry, delivery may be a significant component of cost. More transparent relationships are needed to realise these savings, together with redistribution of some process and event risks.

- **Material waste:** Over-ordering is known to be a major factor in material waste. Eliminating one-half of material waste would cut material bills by 7.5% and construction cost by 3%.

The potential financial benefits (excluding the cost of complying with increasingly stringent environmental regulations) are of the order of 8%, made up of productivity of the construction workforce, productivity of hauliers and avoidance of over-ordering.

Depending on the form of construction, the cost of the consolidation service is in the region of 0.5% to 3%.

However, this business case is conditional upon engaging a logistics specialist to manage the supply chain and configuring commercial arrangements in the supply chain so as to favour co-operation and distribution of benefits to all stakeholders.

6.2 Ancillary services

*We see a business case for integrating **site security** and **welfare of the construction workforce** into the CCC.*

Although we have not analysed the cost of these services, we conclude that:

- These services will not demand much space at the CCC and would be compatible activities
- A central service from the CCC is likely to justify the investment that would increase the level of service compared to what a number of smaller operators could provide
- There would be economies of scale by consolidating these services.

The future cost of complying with environmental regulations will require imaginative ideas. The new Waste Management Plans will highlight this need.

*We offer the **reverse logistics centre** that utilises existing vehicles as a viable solution. But this requires investigation by a specialist waste manager and a logistician to test its viability.*

***Building offsite** looks like an inevitable response to the scale of construction proposed in North Kent as it is unlikely the conventional supply will be sufficient. This requires investigation by a specialist in offsite building and an architect.*

We are less convinced about the business case for integrating **skills and employment** services and an **innovation and business hub** into the CCC. We are impressed by the imaginative proposals from SUSCON and CCI International and are convinced of the need for these facilities. However, we note that the areas these ideas would demand are disproportionate to what is needed for the basic CCC and they would not be ideal neighbours for the light industrial activity in the CCC.

SUSCON is already negotiating for a site in North West Kent and it looks likely that a temporary site will be found in Ebbsfleet. In the event that a single site cannot be found, SUSCON may accept a compromise solution on more than one site.

Planning for the innovation and business hub needs to commence immediately. We see the long-term solution on a separate site, but it would be possible to provide temporary facilities at the CCC provided suitably generous office accommodation is provided.

*There is potential to offset the cost of operating a consolidation centre by offering **concessions for services that could be based at the consolidation centre** and would increase the utilisation of the centre's delivery fleet. Concessions could be offered for resource recovery, access equipment and scaffolding, and construction equipment and tools.*

7 Recommendations

7.1 Strategy for consolidation

7.1.1 Overall approach

Provided the whole supply chain is involved in the change and proving the business case, consolidation has the potential to make logistics mainstream in construction. The need for consolidation and its implementation are local issues; but **strategic co-ordination** is essential to ensure that planners and developers recognise where consolidation and its associated modern logistics techniques would be effective.

We agree with SECBE's strategy (as explained in "Stakeholders") to establish and operate a CCC to serve Ebbsfleet Valley and Swanscombe Peninsula, and then roll out the solution to other demand centres in the South East of England.

7.1.2 Getting started

The best prospect for establishing construction consolidation in North Kent is to promote the solution with Land Securities who are enthusiastic. The demand forecast shows that, notwithstanding an early peak in demand due to other developments around 2010, Land Securities' requirements will increase steadily and plateau at about 2012. Based on forecasts, this output will last about 10 years and will be about two thirds of the construction in the district. The most likely viable solution will therefore be built around Land Securities needs. A CCC to serve Land Securities' needs alone would be viable. However, to serve the regional development objectives, it should be sized and operated in such a manner that it will serve the needs of the entire district. A warehouse of about 35,000 ft^2 (3,300 m^2) would service an annual throughput of about 150,000 PEU, in the ratio 2:1 Land Securities and others.

As an indicator of the scale of transport movements[14], the CCC would receive approximately 12 inbound deliveries per hour and despatch approximately 4 per hour to the sites.

The early peak demand for the district (240,000 PEU) is ahead of, and considerably larger than, Land Securities' needs. Designing the CCC for this peak is not recommended due to the short duration of this peak and the probable difficulty in gaining enough early support for the CCC. A centre sized for (say) 150,000 PEU, and operational from 2008 to 2021, would satisfy nearly all the demand in North West Kent for the next 15 years. This is shown in Figure 23.

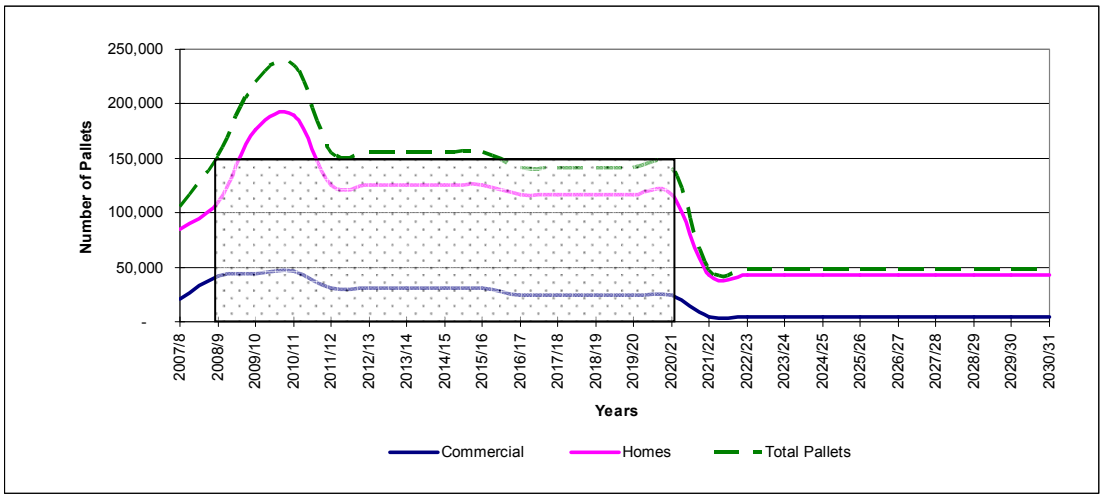


Figure 23: Proposed CCC serving NW Kent

[14] Assumes inbound vehicles carry, on average, 5 PEU and a consolidation factor of 3

In order to realise long-term benefits of the CCC and the ancillary services mentioned below, we recommend this CCC be regarded as 'permanent', in that it should have a 15-year life. Therefore it would need to be positioned where pressure to relocate it (caused by surrounding development) would be minimised. We have already identified several sites and further investigation may reveal more.

The CCC should be operated by a logistics specialist with a track record in operating a consolidation service (this need not be in construction) and access to knowledge of modern ICT systems that are already proven in the retail or manufacturing industries.

Ensure that sites served by the CCC engage a logistics specialist to oversee the ordering of materials and provide on-site logistics services to ensure just-in-time delivery to the work place.

Determine the need for ancillary services that might be offered as concessions and develop business models in consultation with specialist suppliers in each field. Focus initially on resource recovery.

7.1.3 Impact of building houses offsite

There is an important caveat here – Land Securities' intentions for building houses offsite. About 70% of their demand is based on traditionally built housing. Land Securites are concerned that the market may not be able to supply traditional housing in sufficient quantities; in which case they would need to seriously consider modular or panelised houses that would be built offsite. Such a decision would cause a large reduction in demand for materials suitable for consolidation. However, if Land Securities secured a modular supplier willing to invest in a local factory, then the CCC would be a useful buffer store for the factory. An early decision on this question is needed in order to determine the need for, size and location of a CCC in North West Kent, or whether the role of the CCC will have to be broader, that is to assist in the prefabrication process.

7.1.4 Roll out

All immediate efforts should focus on establishing the first CCC in North West Kent. As soon as commitment is agreed, the next step is to identify other centres in the region that would benefit from a consolidation service. In no particular order, these include Medway, Ashford, Reading and Bracknell, Basingstoke, Southampton and Portsmouth, Crawley and Gatwick, Brighton, Oxford and Milton Keynes, as well as the neighbouring areas of the Thames Gateway north of the Thames. A feasibility study would be needed in each location to identify the key players, demand and suitable sites.

7.1.5 Intermodal transport

For the first CCC, ignore potential solutions involving rail and sea delivery. The factors affecting this decision may change for future CCCs, but it would need a significant shift in government policy and incentives to make intermodal solutions attractive.

7.2 Strategy for ancillary services

The first CCC in North West Kent should be designed to accommodate the ancillary services shown in Table 31.

Ancillary service	Potential use of CCC delivery fleet
Site security	Low
Welfare of construction workforce	Medium
Resource recovery	High
Access equipment and scaffold hire	High
Construction equipment and tools	High

Table 31: Recommended ancillary services

All these services would be income generating if offered on a concession basis and were conditional on using the CCC fleet for delivery and recovery. Of these, the resource recovery would be the most lucrative. Therefore the location of a CCC needs to be considered in the wider perspective rather than as a CCC on its own.

SEEDA should promote the skills academy and innovation and business hub. Although these would be better sited independent of the CCC, temporary accommodation could be provided at a CCC for some of these services.

7.3 Further research

More work is needed to demonstrate how the business case for CCCs can be realised. We think that an 8% saving in construction cost is achievable. Given the tremendous impact this would have on the wider industry, government grants should be pursued to fund this work.

7.3.1 Environmental benefits

The environmental case is now well established (typically 50% reduction in local traffic and its effects) and no further work is needed. However, planners may reasonably request a Transport Statement before granting planning consent. This would be beneficial because it would ensure all transport considerations were properly accounted for in the design and siting of the CCC.

7.3.2 Productivity of construction workforce

Productivity studies have shown that a 6% improvement in productivity could be achieved with consolidation and improved on-site logistics. Analyse the value stream in order to assess the value of this improvement, how it accrues when processes change and how the benefit needs to be shared in order to achieve a sustained step change.

7.3.3 Productivity of hauliers

In conjunction with the procurement investigation (see below) conduct a survey of delivery times and costs. Ideally this should be done at the first opportunity on commercial and residential sites in North West Kent. Repeat the exercise once the CCC is implemented and new work practices are bedding down. Share the 'before and after' data with all stakeholders and devise an equitable share of the benefits.

7.3.4 Material waste

In conjunction with the procurement investigation (see below) conduct a survey of materials from the design outputs to installation and waste recovery. Identify the ways and quantities of waste generated (off-cuts, damage, theft, losses and so on). Determine the extent of over-ordering by comparing the quantity and value of materials actually needed (from the design outputs) with what is actually ordered. Ideally this should be done at the first opportunity on commercial and residential sites in North West Kent. Repeat the exercise once the CCC is implemented and new work practices are bedding down. Share the 'before and after' data with all stakeholders and devise an equitable share of the benefits. BRE, CIRIA, TRL and WRAP have various methodologies and services that may assist here.

7.3.5 Procurement

A procurement specialist should examine a supply chain that Land Securities intends to keep intact, more or less, for a project involving a CCC. Map the entire process from the design drawings and specifications, through take off, ordering, manufacturing, assembly, call-off, delivery to site, on-site logistics, installation and waste recovery. Identify how the consolidation service (as recommended above) would affect each participant, and what changes in contracts and specifications, KPIs and incentives are needed to ensure a committed shift to consolidation.

A procurement specialist should advise on the business model for setting up and running the consolidation centre and ancillary services, including who would 'own' the centre and each service, contractual arrangements with operators and payment mechanisms.

Carry out a portfolio analysis so that the key types of material, prefabrication, etc. can be captured. From this, the supply chain specialist will then:

- Identify resource and capacity issues with regard to skills
- Identify key suppliers and lead times, together with the strategy for advising on delivery requirements and maintaining the equilibrium of a consolidation centre
- Advise whether a consolidation centre is the best option in the context of alternative methods
- Co-ordinate all aspects of information and material flows
- Provide management information on materials and work with the commercial team to improve cash flows.

7.3.6 Information and communication technology

An ICT specialist, together with a logistician, should identify the ICT systems in place at each step in the supply chain and the potential for the various systems to communicate. Identify gaps and interoperability issues. They should recommend a staged upgrading of the ICT systems in the supply chain that would ultimately converge on a complete ICT solution from design outputs to waste recovery. The IT Construction Forum would be a useful partner to facilitate this work, together with Wincanton.

7.3.7 Demand for resources to deliver sustainable construction

New methods and materials needed for sustainable construction may drive demand for increased and different resources and technologies. SEEDA needs to explore this further, taking particular account of the potential to increase two-way commerce for SMEs in France and England that have convenient access to the Channel Tunnel.