



Sustainability lessons from PFI  
and similar private initiatives



# Contents

Introduction **1**



A55 Road Project, English/Welsh Border **3**



Barnhill School, Hillingdon **7**

Croydon Tramlink **11**



Pullar House, 35 Kinnoull Street, Perth **17**

The Cumberland Infirmary, Carlisle **22**



The Great Western Hospital, Swindon **28**

Summary Check Lists **35**



References **37**

## ACKNOWLEDGMENTS

This collection of case studies is one output from a one-year research project funded by the Department of Trade and Industry to promote: innovation and culture change; business improvement; construction process improvement; best practice; sustainability and social issues and safety and health issues in the construction sector.

Pullar House photographs © Keith Hunter Photography

# Introduction



These case studies are the output from a project to establish sustainability lessons from PFI and similar private initiatives.

The objectives of the project, which was funded by the DTI and undertaken by BRE, were as follows:

- To collect case study material that demonstrates how PFI and similar public/private approaches are delivering sustainability benefits. To disseminate this information so that the benefits may be replicated by development teams in future projects.
- To compare the sustainability performance of the selected PFI projects with projects in general, using the emerging indicators on the broader concepts of sustainability. Here aspects such as occupational effects, whole life costs, employment of local people, benefits to local society, development of supply chains, etc are included.
- To develop a methodology for specifying and assessing the functionality of buildings with particular reference to whole life value.

The complete outputs from the project were:

- The six case studies that are contained within this document. (The case studies are also available in summary form).
- An information paper detailing the opportunities to be exploited and pitfalls to be avoided and how to incorporate sustainability into the PFI process.
- A client guide to functionality.

The Information Paper No 13/02 'Sustainability lessons from private finance and similar private initiatives', and 'Getting it right: a client's guide to achieving functionality in construction' may be obtained from BRE Bookshop tel 020 7505 6622 or email [brebookshop@emap.com](mailto:brebookshop@emap.com).

Research in the form of structured interviews has been undertaken, and assessments made of the projects against Movement for Innovation (M<sup>4</sup>I) sustainability indicators. These indicators are still under development and data from this project will be used to refine the benchmarks.

The six case studies are as follows:

- A55 Road
- Barnhill School
- Croydon Tramlink
- Pullar House
- The Cumberland Infirmary
- The Great Western Hospital.



# Introduction

## THE M<sup>4</sup>I INDICATORS

The Movement for Innovation (M<sup>4</sup>I) is involved in a wide-ranging effort to improve the construction industry at all levels of performance. One of the key areas is the issue of sustainability. As part of the drive towards continuous improvement, the former DETR Construction Directorate, Research and Innovation programme sponsored the development by BRE of a sustainability indicator for M<sup>4</sup>I, based upon a self-assessment Sustainability Index.

The M<sup>4</sup>I sustainability indicator benchmark system is a dynamic system that compares the sustainability attributes of a project with those of the existing database of projects that have been analysed by M<sup>4</sup>I. Benchmarks are allocated for sustainability attributes in design, construction, environment, social and economic impacts.

At any point in time the project attribute (held within the database) with the highest score is allocated the 100% benchmark and that with the lowest score is allocated 0%. Thus a 50% benchmark represents the median of all projects analysed.

When analysing a new project it is thus possible for it to achieve a rating of greater than the 100% benchmark if it scores better than any other project currently held within the database. This project will of course be added to the database and form the new 100% benchmark for future evaluations.

The case studies were compared against these M<sup>4</sup>I indicators to provide a quantitative measure of their sustainability. Most of the case studies score above the 50% average benchmark score for sustainability in all of the five areas of design, construction, environment, social and economic. The 50% average benchmark score will change over time as more data is collected by M<sup>4</sup>I. These case studies give current good practice indicator scores for PFI/PPP projects and were selected for their innovation in this area.



# A55 Road Project, English/Welsh Border



## GENERAL DESCRIPTION OF PROJECT

This project involved the construction of a 7.5 mile length of dual carriageway completing the extension of the A55 trunk road across Anglesey. The road is a key route for cars and heavy goods vehicles travelling to and from the Holyhead to Ireland ferry crossing. The improved road has now been constructed and is in operation. It was designed to decrease accident rates and improve traffic flow. The old road passed through six villages and had a large impact on their communities. The area surrounding the road has many rich ecological habitats and sites of special scientific interest.

## THE DESIGN AND BRIEFING PROCESS

The consultation began in 1990, followed by a public enquiry for one part of the scheme in 1995 and another enquiry in 1997 for the remainder of the route. The public enquiry addressed environmental issues and interested groups, such as Friends of the Earth, were consulted. Plans were also discussed with the Environment Agency and Countryside Council for Wales amongst others.

The scheme was not originally conceived as a PFI project and procurement through the PFI was only considered after planning permission had been obtained. The Secretary of State decided that the scheme would be PFI funded at the time of the second public enquiry in 1997. There were four new PFI schemes identified in the National Audit Office Report at that time and the A55 became a trial PFI scheme.

By this stage the improved route had been agreed and an Environmental Impact Assessment and Statement had been produced. The route and documents were used to define the brief for the PFI tender process. A Highways Agency standard DBFO contract was used with penalty points for violations of the contract. The contract was for 30 years and was awarded in December 1998 to a consortium called UK Highways A55.

## FUNCTIONALITY ISSUES

### Background

The Euro-Route E22 in Wales used to follow the A55 trunk road along the North Wales coast to Bangor and then the A5 trunk road across Anglesey to the port of Holyhead. In recognition of the economic and social importance of this route, the Government decided in 1994 to extend the A55 dual carriageway across Anglesey.

### The Client Need

The general need was for improved traffic flow with safer driving conditions. The old A5 route ran through the communities of Caergeiliog, Valley and Holyhead to the main 'old' port entrance at Salt Island. The road width, traffic lights, pedestrian crossings, vehicles joining from side roads and a number of residential and commercial properties fronting directly on to the road restricted traffic flow. Outside the villages, many side roads and farm tracks join or cross the A5. In some places the sub-standard alignment of the A5 led to poor visibility and increased driving hazards. During the period 1991 to 1995 there were 2 deaths, 15 serious and 83 slight Personal Injury Accidents on the A5 between Bryngwran and Holyhead.



# A55 Road Project, English/Welsh Border

## The Functionality Drivers

The main Functionality Drivers for the Welsh Office were to:

- reduce journey times and operational costs for private and commercial road users including public transport
- assist economic regeneration
- enhance road safety and reduce road casualties
- provide relief from traffic related problems in communities along the A5
- take account of the environmental implications of the road scheme and include appropriate mitigation measures
- procure the scheme under the Private Finance Initiative to better enable delivery of whole life value for the public money being invested.

## The Construction Solution

The decision was made to build a new dual carriageway road across Anglesey. Features of the road, which addressed the functionality drivers, included levelling and straightening the road to improve visibility and safety. It now by-passed altogether the villages of Caergeiliog and Valley, improving quality of life for residents by reducing traffic flow to local access levels, improving air quality from reduced vehicle emissions and reducing noise. Care was taken to mitigate the effects of building a new road in an area of special scientific interest. One listed footbridge was demolished. It was recorded beforehand by archaeologists, and replaced by a new one to maintain pedestrian access across both the new road and an adjacent railway line.

## THE CONSTRUCTION PROCESS

The road was built in two years and completed in March 2001 despite problems with a very wet autumn and the restrictions caused by foot and mouth disease. Expensive engineering solutions were used in the construction phase including three major tunnels.

A standard DBFO contract was used with penalty points for violations of the contract. Penalty points for environmental issues were set at a higher level than for other issues. Should a contractor receive penalty points then they would be required to rectify the situation or more points would be awarded. If too many penalty points were accumulated then the contractor would be forced to stop and reassess, or potentially lose the contract.

Experiences were fed back to the DBFO contracts department at the Highways Agency. The department had an Agent Site Representative on site looking after the construction phase.

## OPERATIONAL FEEDBACK

The maintenance phase is due to last 28 years and the Highways Agency has appointed a representative to oversee proceedings throughout this period. Shadow tolls are in place in the road to count the traffic and revenue payments to the consortium are based on the number of vehicles. The contractor is paid monthly, based on estimated traffic flows, with an end of the year reconciliation of differences.

## DATA GATHERED

### Questionnaire

Data was gathered through an interview conducted with Ray Hooper the project manager for the Transport Directorate of the Welsh Assembly.

## SITE AND LOCATION

The road runs through rural and built up areas, there are areas of outstanding natural beauty and unspoilt countryside particularly on the Island of Anglesey.

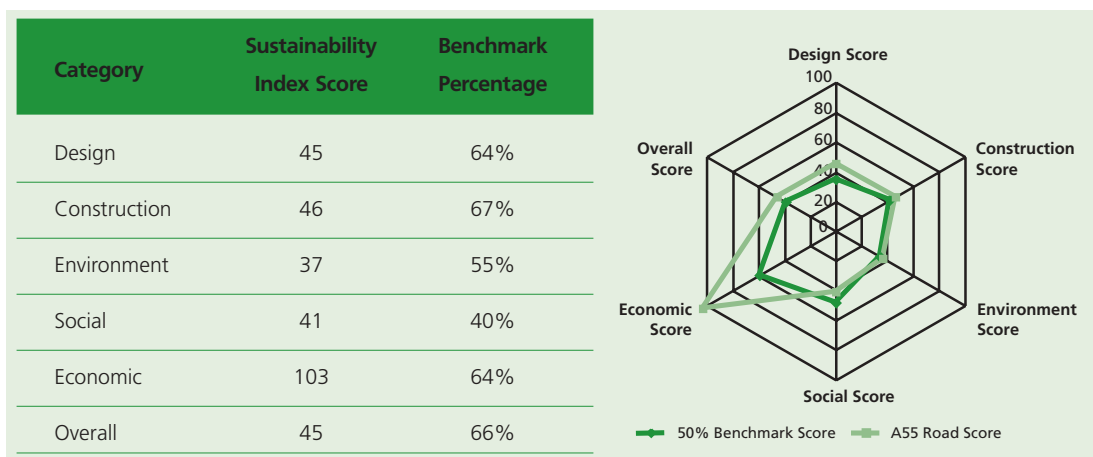
# A55 Road Project, English/Welsh Border



## STAGE WHEN SUSTAINABILITY INCORPORATED

The Welsh Assembly drove sustainability issues within the project and used an environmental advisor from the start of the project. Legislation also required that some of the preparation procedures include sustainability. The contractor was required to meet the Environmental Statement obligations set out. One of the core requirements was that the effects of the built road had to be no worse than those identified in the existing Environmental Statement. Feedback is being given to the Highways Authority to input into other projects. Much of the success of the project was based on trust in other parties involved.

## BENCHMARK SCORE



## IMPACT ASSESSMENTS

The existing road went through six villages and the new plans involved taking traffic away from all the village centres. The existing road had a very bad fatal accident record. There was a large public consultation exercise. The public's comments did influence the final route of the road. An Environmental Impact Assessment was produced for the scheme prior to it becoming a PFI project and Statutory Land Orders were confirmed.

The winning company after the tender process took over the project on a Design, Build, Finance, and Operate contract. The design for the road required them to confirm that environmental impacts would be no worse than those identified in the existing Environmental Statement. UK Highways A55 won the contract and they suggested altering the levels of the road to give an alternative vertical alignment. The road was both lowered and raised in places from the original design. This improved visibility and enhanced road safety. This required the consortium to carry out extra assessments of the environmental impacts of the changes and provide a report.

## ECOLOGY

There are two SSSI's in the area, one by the causeway to Holyhead and one on the inland sea on Anglesey which has a narrow sluice inwards and lag of two hours with the outgoing tide. The latter site is home to many wading birds. The causeway needed to be widened to run the new road alongside the railway line.

Hedges were constructed along much of the length of the road, using a traditional bank/hedge method. A bank, approximately 1.5 metres in height, was built of brick covered with earth then a hawthorn hedge was planted on top. The contractor employed a Cornish expert to build the walls and train the local people. The bank/hedge construction served to reduce noise, screen the road and act as a wildlife corridor.



# A55 Road Project, English/Welsh Border

The new road also included badger and otter crossings. A full time environmentalist and an ecologist were employed by the contractor alongside the Welsh Assembly's own ecologist.

## PROJECT STATUS

In operation

## WASTE AND MATERIALS

The road was both lowered and raised in places from the original design. The consortium had to carry out extra assessments of the environmental impacts of the changes and provide a report. They proposed to reduce the height of embankments and decrease cuttings and give an equal earthworks balance to reduce waste going to landfill. Planning consent was granted for spoil tips. The old road was kept as a heritage site.

## POLLUTION

It has to be noted that traffic count has increased since the improvement of the road therefore increasing emissions to the atmosphere from car use in this area. Ferry companies working from Holyhead are also predicting increases in passengers. To meet this demand Irish Ferries now employ the largest car ferry in the world on this route and P & O Stena are set to follow. This will further increase traffic volume but with much improved flow.

## SOCIAL ISSUES

The contractor used a majority of local labour in the construction phase and trained labour to carry out new bank/hedge construction techniques.

## ARCHAEOLOGY

Archaeological desktop surveys were carried out on the route of the road to identify possible areas of interest. On site surveys were then carried out on these areas before construction could begin. Various artefacts were found.

## LESSONS LEARNT, PITFALLS AND OPPORTUNITIES

This project was an original PFI trial scheme and it is commendable that environmental considerations were a major factor in the design of the project. (There is a legal requirement to carry out an Environmental Impact Assessment). Within this context it must be noted that the improvement of a major arterial route with probable increases in traffic flows and pollution levels would have a major environmental impact on the region.

Considering the above, the brief for the road improvement included the need to reduce accident rates, improve traffic flows and lessen the impact that this arterial route had on the six villages that the original road passed through.

The imposition of a penalty points scheme that encouraged contractors to seek solutions that minimised environmental impacts with the possibility that the contract could be lost if a certain 'points threshold' was breached is cited as a good example of an environmental motivator.

Consideration of ecological issues within the project specification and the detail to which the contractor was prepared to work to ensure that ecological impact was minimised can be cited as a positive outcome.

# Barnhill School, Hillingdon



## GENERAL DESCRIPTION OF THE PROJECT

This new school was required to meet demand for pupil places in the Borough of Hillingdon, Greater London. The grant maintained school was a new build project on an existing school site. A consortium named Jarvis Projects won the tender for the work. The school has been built and has been in operation for two years. The contract was worth approximately £15 million.

## THE DESIGN AND BRIEFING PROCESS

As this was a new school the then Department for Education and Employment (DfEE), (now the Department for Education and Skills), performed the full client role. Often for such developments local input would be provided by the incumbent head-teacher. The arrangement worked well, however, as DfEE were able to take an entirely objective and detached approach to the requirements in their output specification.

## FUNCTIONALITY ISSUES

### Background

A new school was needed to meet a growing demand for pupil places for educating local children in the 11 to 18 age groups.

### The Client Need

Hillingdon London Borough Council needed to provide new space within the Borough for educating 1450 school children between the ages of 11 and 18.

### The Functionality Drivers

The required facilities included:

- an assembly hall
- a dining hall
- catering facilities
- library
- special needs unit
- information technology suite
- large sports hall
- teaching areas for humanities, maths, science, English, modern languages, art and technology
- facilities suitable for breakfast club and after school clubs for the pupils, starting at 0700 hrs and ending in the evening
- an indoor environment that was stimulating and exciting, and avoided looking institutional
- circulation areas providing ease of movement
- an outdoor environment to create stimulating external spaces for the pupils to learn, play and relax in safely, while also enabling supervision.



# Barnhill School, Hillingdon

The Private Finance Initiative was used as the procurement route in line with Government policy to achieve better whole life value for public money. Government policy also requires that all public procurement should be environmentally, economically and socially sustainable as far as possible.

DfEE guidelines for the construction of new schools had to be adhered to. This included a requirement to achieve a SEAM (Schools Environmental Assessment Method) rating of at least level B.

## The Construction Solution

A new school with a floor area of 12,000 square metres and able to accommodate 1450 pupils was built under the Private Finance Initiative through an agreement between Hillingdon Borough Council and a consortium led by Jarvis Construction (UK) Ltd. The design concept consisted of five linked faculty buildings forming a series of enclosed private and semi-private courtyard spaces. Important functional relationships between departments were established from the outset and led to the links and interconnections, which are vital to the delivery of the school curriculum. The PFI provider will maintain the school for 25 years.

## THE PROCUREMENT PROCESS

Time was the biggest constraint in the procurement process. A bid was submitted in June 2000, with financial close due in October 2000. The consortium went on site on 21st October. During the procurement process bidders were given a maximum of 12 weeks to respond. The process started with a long-list of 20 bidders reducing to a short-list of 4 in the final stages.

## THE CONSTRUCTION PROCESS

The short timescales of the project caused problems in the construction process due to not being able to get materials on site on time, particularly some specialist materials.

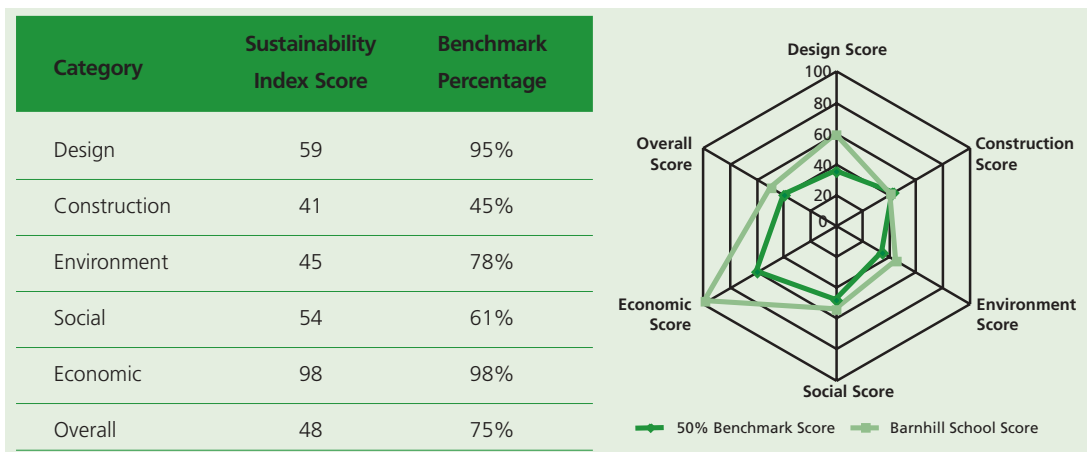
## OPERATIONAL FEEDBACK

Barnhill School has been operational for two years with positive feedback.

## DATA GATHERED

The interview was conducted with Jane Lock-Smith a member of the design team from Terence O'Rourke, Bournemouth.

## BENCHMARK SCORE



# Barnhill School, Hillingdon



## DISCUSSION OF DATA

Data was gathered for the following aspects of sustainability within the broad headings set out below. Associated themes such as daylighting and alternative energy sources were also explored.

## SITE AND LOCATION

The project was built on a previous school site with the old school being knocked down and area landscaped. The new building was built on the former school's playing fields.

## STAGE WHEN SUSTAINABILITY INCORPORATED

The drive for sustainability came primarily from the project team. Terence O'Rourke have much experience in producing Environmental Assessments and have designed 12 PFI schools to date. Buro Happold, the engineers have a good track record in sustainability and services. The project team saw sustainability as a niche in the PFI process and believed that including it in their bid would gain an advantage over the other competitors for winning the scheme.

The client's design team insisted that the school must achieve a 'B' as an absolute minimum under DfEE SEAM criteria. This is a good standard. Barnhill was independently assessed and achieved an 'A' rating and was nominated for the School of the Future title.

## ECOLOGY

Existing habitat was developed and a new ecology area designed. The new school was built on the former school's playing fields and the old school was demolished and landscaped to provide playing fields. Terence O'Rourke had an ecologist on their team to advise on habitats.

## PROJECT STATUS

In operation for two years.

## ENERGY

The School opens at 07:00am and operates evening clubs. The building is zoned such that heating can be provided to areas being used outside core hours whilst the remainder of the building is shut down after hours. Energy consumption is also monitored for each zone. Jarvis Facilities Managers set targets, which were written into the tender document. They also stated who would supply electricity using a green tariff. Energy targets were put in voluntarily by the consortium.

Natural ventilation was used wherever possible and is a key feature in the classrooms. The front and back of classrooms were ventilated naturally and attenuated louvres were used. All zones have automatic temperature controls. Under floor heating was used in 80% of areas which has higher capital cost but lower maintenance. The building is zoned into areas of use to make it easier to manage. The consortium tried to steer away from mechanical ventilation, but air quality was very important. The structure of a thick concrete slab was fast to build but also enabled night-cooling of the structure. Solar stack ventilation was also used at Barnhill.

## WATER

Grey water recycling was included with the double pitch roof which is used to collect rainwater for use in school. Schools generally have large consumptions of water. Porous car parks were built with interceptor connections. Hard play areas drained to water landscape areas.



# Barnhill School, Hillingdon

## WASTE AND MATERIALS

The design team aimed to select materials with a low environmental impact and low emissions. Natural ash timber and solid ash doors and architraves were used. Water based emulsion paint was used. WC cubicles were selected carefully assessing impacts of glues and materials. External walls used local bricks and mineral wool insulation in cavity. Cladding used did not have foam based insulation. The roof has acoustic insulation material and thermal insulation. Calzip was used for the roof, and the supplier was good at giving environmental information. Stainless steel balustrade was selected for durability. The design team looked for British Standards or Agrément Certificates then environmental information in their product selection.

The scheme also had to provide stationery to the school and this introduced an opportunity/strategy for stationery recycling. The consortium tried to shorten cable routes to give short service runs to reduce cable usage. This was considered at planning stage. This may become less important as wireless technologies emerge.

## TRANSPORT

Car parks were limited and lots of cycle racks installed. Well-lit pedestrian routes were built and showers put in for staff.

## HEALTH AND SAFETY

A full risk assessment was carried out and helped to improve the sustainability of the scheme.

## ECONOMIC ISSUES

The school is actually making money out of the building as it now holds evening sports activities. The amount of third party income has doubled since opening. The building also has the capability of holding conferences.

The options for operating costs were modelled in the design phase and demonstrated to the Facilities Managers in the consortium. Whole Life Costing was used to illustrate quickly the replacement costs and refresh programmes. The PFI consortium have their own Facilities Managers working on site and are driven to reduce energy costs over the life of the project to maximise revenue. The consortium aimed to achieve a low life cycle cost over the 25-year time period.

## LESSONS LEARNT, PITFALLS AND OPPORTUNITIES

The project team for Barnhill saw sustainability as a positive attribute to be marketed as an advantage over the schemes proposed by competitors. Their faith in sustainability can be recognised by the DfEE SEAM rating achieved and its nomination for 'School of the Future'.

Clients need to have good independent advice when setting briefs to ensure that their expectations and a sustainable outcome are produced. CABE are now offering this service although this was not available at the time of developing the brief for Barnhill School. The project team drove a sustainable outcome itself.

A SEAM assessment rating of A should be achievable in new build projects if sustainability is included at the inception of the project. The design team voluntarily set energy targets; water use/recycling, waste issues and transport issues were all considered and sustainable solutions sought. Life cycle costing concepts need to be paramount in the PFI pricing process. When setting a brief the client needs to specify criteria for targets so that tender briefs can be compared on a like for like basis. The project was designed with short time scales and this impacted on the construction phase where difficulty in obtaining some specialist materials caused delays.

Where good innovative design incorporating robust sustainability issues is the objective, then time scales for the PFI procurement process need to be set realistically and may need to be longer in the future.

# Croydon Tramlink



## GENERAL DESCRIPTION OF THE PROJECT

This project involved the provision of an integrated light rail system (tram) centred on Croydon and extending mostly eastwards and westwards to serve a total of four London Boroughs. The initial requirements of the project were to:

- Reduce the severe traffic congestion that was being encountered in Croydon town centre and having a detrimental effect on the economy of the area.
- Assist in the regeneration of areas of social housing that were suffering from deprivation – particularly the New Addington area.
- Improve the public transport corridor running east west across Croydon and beyond.

The system has its hub in the centre of Croydon and from here three routes radiate – two broadly eastwards towards New Addington and Beckenham Junction / Elmers End with the third route extending westwards towards Wimbledon.

The Tram route runs for 17 miles of which 105 miles utilises existing abandoned Railtrack track bed. The remaining route consists of 5 miles of new rights of way with the remaining 2 miles utilising existing rights of way.

Along the route are 38 tram-stops including seven main interchanges with railway services.

The client for the project was Transport for London (TfL), the construction was undertaken by Amey-McAlpine with CentreWest Buses – a division of First Group being the operators. Croydon Council was involved with the project to ensure that during the construction and design stage of the project the minimum amount of disruption was caused to the businesses and population of Croydon and the adjoining Boroughs.

The capital expenditure for the project was £200 million with Central Government providing £125 million of this total.

## THE DESIGN AND BRIEFING PROCESS

The design and briefing process considered the following factors:

The need to reduce traffic congestion in Croydon town centre by reducing the amount of car journeys undertaken, to replace some bus routes and provide improved access and journey times to social housing areas that were suffering from deprivation.

To provide a truly integrated transport system incorporating mainline rail, underground, bus, taxi and interchange facilities.

A full study of travel patterns were modelled against the planned network together with 'before and after' surveys to confirm previous and new travel arrangements and their impact – a linking of functionality and sustainability to be analysed. The route/alignment of 'Tramlink' was subject to a full environmental impact assessment study with both local and national agencies being involved.



# Croydon Tramlink

## FUNCTIONALITY ISSUES

### Background

Croydon is the largest commercial centre in the South East of England, outside Central London. It has a population of nearly a third of a million, and more commercial office space than Sheffield, Newcastle, or Nottingham. By 1988, traffic congestion on Croydon's roads was perceived to be the most significant disincentive to companies retaining their businesses there.

### The Client Need

Retaining existing businesses and jobs and attracting new ones is now a principal aim of Croydon Council's economic programme. Surveys of the local business community's perceptions of transport issues showed that companies attach great importance to ease of movement and accessibility. They also have increasing choice in deciding where to locate. When businesses leave Croydon for other locations, it damages the local economy.

### The Functionality Drivers

The main Functionality Driver for Croydon Council was to reduce congestion in the town. The Council consulted widely among the local population who largely opposed proposals for road widening, but were 80% in favour of a light railway that would improve access to Croydon from the east and west and lead to:

- an increased number of visitors to the town
- businesses and retailers being encouraged to invest in the town's economy
- guaranteed reliable and short journey times resulting from
- a roadway not shared with other forms of transport
- right of way, where the roadway had to be shared with cars and buses
- relocation of all statutory and local utilities to avoid disruption to travel during maintenance
- interchange links with other public transport at railway and bus stations.

A Public Private Partnership for funding was established because Government required that private sector commitment to the scheme be achieved in line with its policy to achieve better whole life value for public money. Government policy also requires that all public procurement should be environmentally, economically and socially sustainable, as far as possible.

## THE CONSTRUCTION SOLUTION

A light railway system was developed under Private Public Partnership between London Transport and Tramtrack Croydon Ltd (appointed as concessionaire in November 1996 for a period of 99 years). It serves a population of around 600,000 people who will be able to save journeying time as a result of improved frequency, speed and reliability of the service, compared to other private and public transport alternatives.

## THE PROCUREMENT PROCESS

The Tramlink Project Development Group was established in 1992 with the brief to carry out a design for the scheme. This group consisted of Croydon Council, London Transport, Tarmac (construction), AEG (tram manufacturer) and Transdev (operating company). The group produced a performance specification for putting out to tender. Tramtrack Croydon Limited (TCL) was successful and was awarded a 99-year concession.

## OPERATIONAL FEEDBACK

Croydon Council has published their own figures for 'operational year 2000', which states that Croydon, was the only London Borough to report zero traffic growth. Additionally the Whitgift Centre – Croydon's largest shopping mall – reports car park usage down by 6% but footfall in the mall up by 11%. This they attribute to 'Tramlink'.

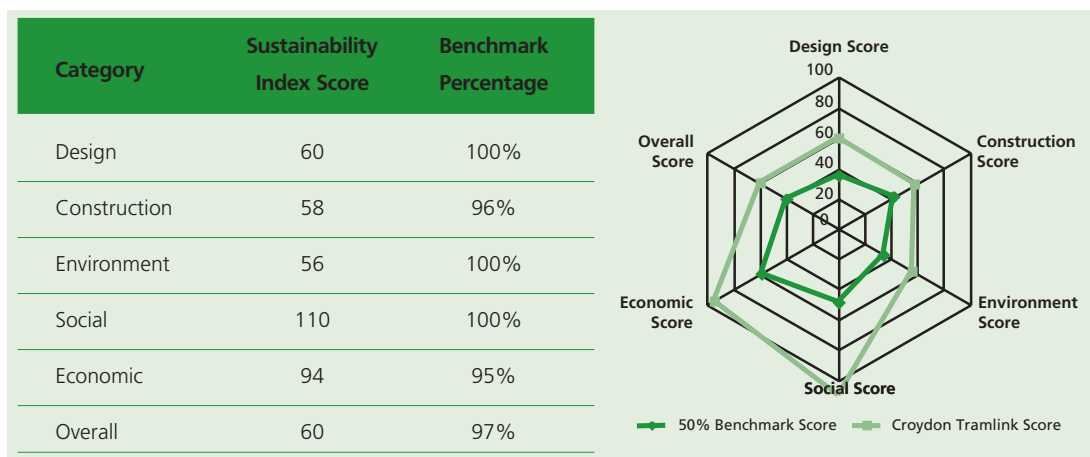


## DATA GATHERED

### Questionnaire

The interviews were conducted with Croydon Council, Amey-McAlpine and CentreWest Buses using a questionnaire developed by BRE. The broad headings covered and the findings in each are set out below.

## BENCHMARK SCORE



## SITE AND LOCATION

The project is a light rail system of 17 route-miles with associated infrastructure (tram-stops, depot, administration offices, electricity substations) and it has utilised both brown and green field sites.

## STAGE WHERE SUSTAINABILITY INCORPORATED

By its nature a light rail system embodies many sustainability issues and thus Croydon Council and Transport for London, in opting for this approach, incorporated sustainability at the outset. Possible alternative options to overcome the negative aspects of city centre pollution and congestion could have been new road-schemes, designated bus lanes, fast 'bus ways', reopening and remodelling of existing Railtrack routes or a combination of the above.

By building Tramlink many sustainable issues have been incorporated, for example 'green transport system', reuse of existing materials and infrastructure, revitalisation and inclusion of disadvantaged areas and population groups.

## IMPACT ASSESSMENTS

The route/alignment of the tram route was subject to a full environmental impact assessment study. There was a detailed study of the route through Addington Woods to minimise the amount of trees that needed to be removed. Within these woods the opportunity was taken to remove some of the non-indigenous tree stock (self-seeding had increased the tree density) and replace and reinstate with heathers. Replacement soil had to be of the same pH value as that existing.

Transport for London is carrying out a full Impact Study. Croydon Council has undertaken their own survey and the results are stated under 'Operational Feedback'.

## ECOLOGY

Ecology was an important consideration throughout the project (eg the reinstatement of indigenous heathers to Addington Woods as stated previously).



## Croydon Tramlink

Considering the whole system, 900 trees were removed but were replaced with 1200.

At Addington Hills some of the soil that was removed for the construction works was acidic, the construction company imported soil of a similar quality so that the ecology of the area was retained.

Other ecological issues that were undertaken included the following:

- Nesting boxes were provided for bats.
- Badger runs were provided along the track alignment to allow badgers to cross the track-bed safely and construction was stopped during their mating season.

### PROJECT STATUS

Tramlink is now fully operational. Passenger numbers are:

Year 1 – 16 million, this was below target but the full service/system was not fully operational at this stage.

Year 2 – 19 million, the operator could not confirm whether this was on target but stated that continuation of some parallel bus services that were to be replaced by Tramlink would have an impact on any projected figures.

The service frequencies are every ten minutes – 7 days a week except for the highly populated New Addington service where the frequency is every eight minutes.

### ENERGY

The operator set no obvious energy targets, however the tram motors are AC motors supplied, via inverters, from a 750V DC overhead supply which is supplied from the National Grid (AC). This is stated by the operators to be more efficient than using DC motors. The same operator also operates the Sheffield Tram System where the trams use DC motors and this was cited for comparison purposes.

### WASTE AND MATERIALS

There was a policy to reuse/recycle existing materials from the sites used for the construction of the system. Other suitable materials were imported from other construction sites. A local company crushed hard materials and prepared them for use on Tramlink.

Norwood Country Park was used as a temporary work site and some waste was used for landscaping this site. It allowed the ground to be levelled to accommodate a new football pitch. Although the construction of an additional pitch had not been in the original project plan, the opportunity arose, due to a need to dispose of spoil and a holistic solution was offered which benefited all parties. This waste was not dangerous waste but included some large items.

Part of the old abandoned Railtrack track bed between Woodside and Selsden was used for Tramlink; this included the section between Sandilands and Lloyd Park where a tunnel was refurbished.

On the Wimbledon route the track bed ballast was used as base layer for the new track bed. Approximately one third of the wooden sleepers from this section were reused. The remaining sleepers were sorted and sound ones were used for the track layout at the depot. Approximately one third of the steel rail was reused on the new alignment. Wimbledon station platform was refurbished to facilitate the interchange between Tramlink, Underground and mainline rail services.

The tram-stops are of a uniform design and pre-fabricated which will minimise construction defects and influence Whole Life Costs.



## TRANSPORT

The project itself serves a transport and community need.

Other issues within the project are:

Cycle ways have been included where possible and some tram stops cater for cycle parking.

## POLLUTION

Air pollution is measured by Croydon Council on a regular basis but there is limited data on 'Before Trams' to compare with the new data.

During the construction process dust levels were measured with absorbent discs and sent to Environmental Health Officers for analysis.

The glazing for the windows in the trams incorporates a removable film so that unwanted etching can be limited and graffiti can be removed at regular intervals.

The depot at Ampere Way is located on contaminated land. The level of contamination was, however, low which required a limited amount of remediation treatment.

The trams are quiet but there is some track noise (squeal) on tight curves and there is some wheel flange noise because of the need to compromise between fast running and slower street running speeds.

The tram wheels are designed to minimise noise and vibration and the track within the street is embedded in polymer that also assists in reducing noise and vibration.

The policy agreed by the operators and Croydon Council is that if a person can prove that they are affected by noise then some compensation will be considered. Tramlink and TfL share these costs up to £1 million (capped).

Although the claims to date total £20 million. Tramlink believe that authentic claims will total less than £1 million.

## HEALTH AND SAFETY

The operation and design phase takes account of the following issues:

- At all tram stops CCTV and 'Help points' are incorporated.
- The design of the system required that there should be no ground level interface with main line track and this requirement necessitated the building of two flyovers.
- During the construction phase Croydon Council staff visited every school to promote the safety aspects; this campaign was modified and repeated prior to the system being operational to promote awareness of potential dangers of interfering with the system and loitering on the tracks.
- Leaflets and Newspaper campaigns reinforced the messages.

## SOCIAL ISSUES

One very positive outcome of the project has been the revitalisation of New Addington. This is a large social housing area built between 1930s and 1950s with a population of approximately 25,000.

To access this area from Croydon town centre required travelling on one main arterial road. The distance being 5 miles with typical car and bus journey times of 55 –75 minutes. This journey time has now been reduced to 17 minutes and with the frequency of the service the maximum time required to access the Town Centre and vice-versa is 25 minutes.



## Croydon Tramlink

The Tramlink has also facilitated easier access to job opportunities at the Purley Way where there are Industrial/Retail Warehouses.

Additionally with the ease of access for mobility impaired users and the installed security at tram stops, journey, leisure, shopping and social options for this particular area have been significantly enhanced by Tramlink.

The original remit for the project acknowledged that the workforce for the construction phase would use where possible local labour and some 200 were employed. During the operational phase some 80 local jobs have been created – drivers, maintenance crews and revenue inspectors.

Croydon Council appointed a person with the task of integrating the project into the school curriculum.

### ECONOMIC ISSUES

Without the input of the private capital funding a project of this magnitude would have been difficult to finance from other sources.

Fare structures and fare limits are set by TfL that may impact on the target passenger numbers set, level of sustainability achieved and the ultimate success of the project.

### LESSONS LEARNT, PITFALLS AND OPPORTUNITIES

For this project to succeed it required Central Government to prime the project with the private capital funding. It would have been unlikely that such a scheme would have progressed had such capital funding not been made available. The vision of Croydon Council to ensure that a 'green transport scheme' was the project outcome and that a full environmental impact assessment was carried out in advance added to the sustainability aspect of the project.

Clearly the benefits of the scheme to the residents of New Addington should be seen as an excellent example of how project success and sustainability can be referenced. Particular attributes are the positive inclusion of mobility impaired and socially disadvantaged groups in the project specification.

One aspect that could be seen as a potential pitfall to project success is the lack of economic flexibility on the operator's part in fixing fare structures. This aspect together with the competing bus routes (which were to be curtailed once Tramlink was fully operational) could impact on the passenger number targets.

However the operators have identified other opportunities to increase passenger numbers, possibly taking passengers away from the competing bus routes, by offering different London commuting options with train operating companies using the interchanges that Tramlink serves. By commuters using Tramlink and other interchange stations instead of the busy East Croydon interchange substantial fare savings can be realised.

# Pullar House, 35 Kinnoull Street, Perth



## GENERAL DESCRIPTION OF THE PROJECT

Pullar House is an office building located in the centre of Perth that provides accommodation for the Planning and Development Services department of Perth and Kinross Council. The Council procured the building through a PFI scheme from Kinnoull House Ltd; a consortium set up to deliver this project consisting of Morrison plc and the Royal Bank of Scotland. The building was completed and first occupied in September 2000. 720 staff are employed at the site. The office draws together into a single location the full range of the Council's frontline services and incorporates a one-stop shop.

## BUILDING DESCRIPTION

The offices are of three-storey construction, built on the site of an old fabric-dyeing factory.

The offices have a gross floor area of 9895 square metres with a net area of approximately 8380 square metres. The building is rectangular in shape and has a relatively deep plan reaching a maximum of 40m along its spine. Much of the building's central core is, however, taken up by two atria that form part of a natural ventilation system.

The construction reused the factory's original stone street façades to form the south and west elevations (accounting for 55% of the external wall area). The original timber windows of these façades were also refurbished and reused.

## SERVICES

The design philosophy for the building is based on natural ventilation. Openable windows, incorporating trickle ventilators on outer façades and automatically controlled high level ventilators in the atria facilitate a stack effect to draw air through the building. The natural ventilation system is designed to maintain comfort conditions under all normal conditions but mechanical ventilation is provided for use during periods of excessive heat gain. The mechanical ventilation system supplies air to the floor voids and extracts through the atria. A facility to recover heat from the exhaust air is provided.

The building is provided with conventional LTHW heating and gas fired boiler plant that services individually controlled radiator and under floor circuits.

Cooling for the ventilation system, to all general areas, is provided via coils supplied with water from a stream flowing beneath the building. IT facilities have dedicated split chillers.

## FUNCTIONALITY ISSUES

### The Client Need

Perth and Kinross Council needed a new building to accommodate the 720 staff employed in the Planning and Development Services Department. The site of the old fabric-dyeing factory was selected after extensive consultation with the local community.



## Pullar House, 35 Kinnoull Street, Perth

### The Functionality Drivers:

- Office accommodation was required for 720 council staff.
- A central Perth location was required within easy reach (100 m) of the main bus routes.
- A Private Finance Initiative procurement route was used in line with Government policy for public procurement to achieve better whole life value.
- A BREEAM (BRE environmental assessment method) assessment was required to demonstrate sustainability.
- Government policy requires that all public procurement be environmentally, economically and socially sustainable, as far as possible.
- The Council performance specification had to be met.
- The building was to be maintained by the PFI provider, Kinnoull House Ltd. on behalf of the Council.

### THE CONSTRUCTION SOLUTION

A three-storey office building, with a gross floor area of 9,900 square metres, has been constructed in the centre of Perth, on the site of an old fabric-dyeing factory. The construction re-used the original stone street facades to form the south and west elevations. The ground, which was contaminated with diesel oil and other contaminants, was treated by bio-remediation during the site regeneration. The council procured the building through a PFI scheme from Kinnoull House Ltd, a consortium set up to deliver the project and consisting of Morrison plc and the Royal Bank of Scotland.

### THE DESIGN AND BRIEFING PROCESS

Sustainability issues were addressed from the outset of this project.

The Council's design brief/performance specification required, amongst other things, that:

- There should be no air-conditioning (other than for essential cooling within the two central IT/Communications Rooms). Comfort conditions were to be delivered employing natural ventilation.
- The building was to have a good standard of insulation.
- Control facilities were to be incorporated that allowed for close control of building services, such as lighting, to match occupancy requirements.
- A greater emphasis was placed on whole life-cycle costs than initial capital costs. This feature aligned well with the Service Provider's philosophy for operating a 25-year contract.

Energy consumption targets were not set but it is predicted that the building will generate 50.9kg/m<sup>2</sup>/yr of CO<sub>2</sub>.

### THE PROCUREMENT PROCESS

Morrison plc has an environmental policy that requires the use of the 'environmentally friendly designs' wherever possible in its construction activity. This approach coupled with the fact that the Facilities Management division was keen that their operational liabilities should be minimised through the installation of durable facilities has assisted the sustainability of this building.

### THE CONSTRUCTION PROCESS

Throughout the construction period efforts were made to minimise the amount of waste generated and subcontractors were provided with waste allocation targets.

A significant proportion of the materials from the old building were reused in the new building, including:

- the existing façade

# Pullar House, 35 Kinnoull Street, Perth



- crushed aggregate
- feature cast iron rafters.

Much of the timber was recycled – shredded or chipped.

It was also possible to pre-fabricate a significant proportion of the construction and further minimise waste generation.

## OPERATIONAL FEEDBACK

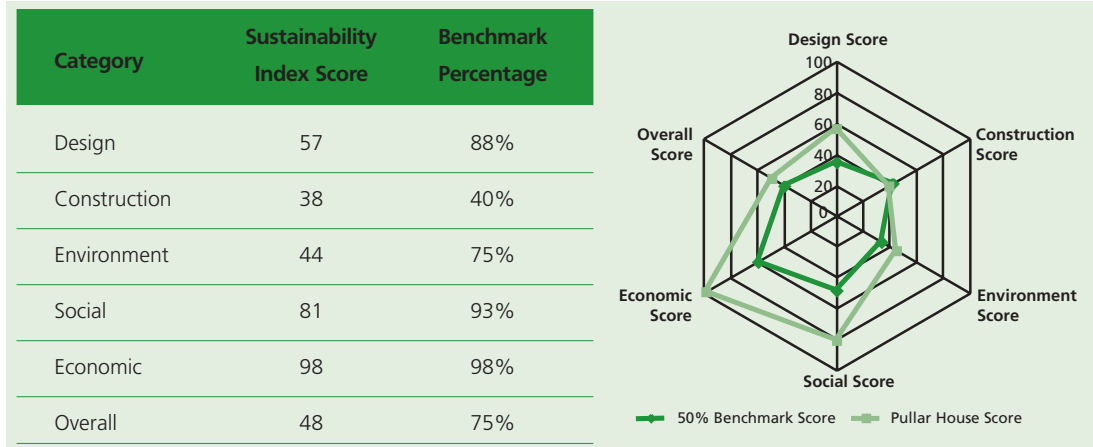
At this early stage in the operation of this contract there are few reported problems and all facilities are generally operating as planned. The only reported problems have been associated with air movement and these have been relieved (not fully overcome) by re-siting some of the grilles of the ventilation system.

Regular monthly meetings are held between the Council and Morrison FM to discuss operational details.

### Questionnaire

The interview was conducted using a questionnaire developed by BRE. The results of the interview form the basis of this case study. The interview was conducted with Andy Gillies, the Council's Head of Architectural Services, Merv Penman, who also contributed to the development of the Council's output specification, and Julian Hunter of Keppie Design who was responsible for the design of the building.

## BENCHMARK SCORE



## DISCUSSION OF DATA

Data was gathered for the following aspects of sustainability. Within these broad headings associated themes such as daylighting and alternative energy sources were also developed. Whilst the information gathered covered every theme, where there were no aspects of sustainability incorporated in the project, the theme is not discussed. The intention has been to highlight the issues of particular interest from which lessons can be learnt and good practice disseminated.

## SITE AND LOCATION

The location is on a significant brownfield site in the centre of Perth. A fabric-dyeing works previously occupied the site and ground contamination issues (principally resulting from diesel oil spillage) had to be addressed in the regeneration of this site.



# Pullar House, 35 Kinnoull Street, Perth

## STAGE WHEN SUSTAINABILITY INCORPORATED

Issues of environmental impact and sustainability were considered from the earliest stages of design on this project. The project benefits from a BREEAM assessment and scored an 'Excellent' rating.

## IMPACT ASSESSMENTS

As mentioned above a BREEAM environmental impact assessment was carried out on this project and an 'Excellent' score was achieved. BREEAM awards an environmental label after assessing buildings against a range of environmental issues covering impacts on the environment at global, regional, local and indoor levels. The issues cover:

- Management – overall policy and procedure.
- Health and comfort – indoor and external.
- Energy – operational energy and CO<sub>2</sub>.
- Water – consumption and leakage.
- Land use – greenfield and brownfield sites.
- Site ecology – ecological value of the site.
- Pollution – air and water pollution (in addition to CO<sub>2</sub> covered above).

For each issue the assessment allocates the number of credits available. Where buildings have attained or exceeded various benchmarks of performance, an appropriate number of credit's is awarded. A total of more than 100 credits are available. The relative importance of the credits awarded under each issue are taken into account through the application of consensus based weightings to produce a final score. This is interpreted in the form of an overall rating of 'Excellent', 'Very Good', 'Good' and 'Pass'. The Pullar House project achieved an excellent rating.

## ECOLOGY

The ecological value of the site was addressed during the development. Reports were compiled of its archaeological value (the site had been in industrial use for over 200 years). Steps were taken to protect the trees present on the site and the stream that runs beneath it. On the latter point advice was sought from the Scottish Environment Protection Agency on the suitable means of protection and enhancement.

## PROJECT STATUS

Complete and occupied.

## ENERGY

Energy targets were not set in the PFI agreement, however, the design of the building, employing natural ventilation, ground water air cooling and high efficiency luminaries means that the building is relatively energy efficient. CO<sub>2</sub> emissions are predicted to be of the order of 50.9 kg/m<sup>2</sup>/yr.

## WASTE AND MATERIALS

55% of the façade of the new building is made up of the refurbished façade from the old dye works and 20% of the aggregate used on site were derived from the demolitions of the old buildings.

Recycling facilities are made available within the new office space and recycling storage facilities are available externally.

# Pullar House, 35 Kinnoull Street, Perth



## TRANSPORT

The building is located in the centre of Perth and within easy reach of the main bus station (approx 100 m). Relatively few car parking spaces (85) are provided for the 720 personnel who work on site.

## POLLUTION

The boiler plant has very low NOX burners installed.

## HEALTH AND SAFETY

The building scores highly on health and comfort by virtue of the natural ventilation system and openable windows. Automated controls are provided for both heating and lighting systems, which provide for an energy efficient and well-controlled environment.

## SOCIAL ISSUES

Extensive consultations were undertaken with the local community both at planning stage and during construction.

The development provided for the reinstatement of an ancient pedestrian route.

## LESSONS LEARNT, PITFALLS AND OPPORTUNITIES

This project has benefited from the incorporation of sustainability targets from the earliest stages of the design process. A comfortable working environment has been achieved without the need for air-conditioning and as a result the building has a low environmental impact (50.9 kg CO<sub>2</sub>/m<sup>2</sup>/yr).

The long-term nature of the contract with Kinnoull House and the contractor's interests in life cycle costs further assists in reducing the environmental impact of this building.

# The Cumberland Infirmary, Carlisle



## GENERAL DESCRIPTION OF THE PROJECT

This project, located in Carlisle, involved the provision of a new district general hospital on an existing site. The project was part of the first wave of PFI schemes and was the second major NHS scheme signed. It has been operational since 2000.

The newly constructed facilities have a floor area of 33,000 square metres and the development retained 10,000 square metres of existing buildings. The buildings occupy approximately 50% brownfield and 50% greenfield land. The project has also resulted in the amalgamation of services, previously split across three sites.

Total bed numbers were designed to be 474; the Trust is currently operating 444 beds. The hospital offers a full range of inpatient and outpatient services and includes 11 operating theatres. The site incorporates 1200 parking spaces.

The Carlisle NHS Trust has entered into a partnership with Health Management (Carlisle) PLC formed for this PFI project, whose shareholders are AMEC, Building Property Group Ltd and Interserve. Health Management (Carlisle) PLC are financing and building the facilities, and will maintain and manage the services for a 45 year period, with a break at year 30.

The capital cost of the building at financial close was £57M and the annual charges to the Trust are approximately £10.5 million.

## THE DESIGN AND BRIEFING PROCESS

The specification set key performance standards relevant to sustainability including energy targets and offered a small incentive to the PFI partner for bettering the targets. This appears to have significantly influenced the design, which incorporates a number of energy saving features that are discussed in following sections.

In addition, the form of the buildings was chosen to follow the natural slope of the site, reducing the need for excavation and use of aggregates.

## FUNCTIONALITY ISSUES

### Background

Carlisle had three hospitals operating on two sites. By rationalising three hospitals on to the Cumberland Infirmary site, it was possible to gain both clinical and operational improvement to the provision of health care.

### The Client Need

The Carlisle NHS Hospital Trust needed to improve the scope, quality and efficiency of its healthcare provision to people in the Carlisle catchment area.

# The Cumberland Infirmary, Carlisle



## The Functionality Drivers

Rationalisation of secondary health care provision to a single site location, including the following clinical services:

- Day hospital, with integrated rehabilitation unit, occupational therapy, physiotherapy, speech therapy, disablement services, hydrotherapy pool
- Day surgery, ophthalmic surgery, and endoscopy facility
- Unified imaging department with X-ray, CT and MRI scanners
- Accident and emergency
- Audiology
- Breast Screening
- Cardiology
- Coronary care unit
- Dermatology department
- Diabetic clinic
- Dieticians
- Ear, nose and throat department
- Fracture clinic
- Genito Urinary Medicine clinic
- Intensive Therapy Unit
- Maternity, including labour, delivery, recovery, post-partum rooms plus operating theatre
- Mortuary
- Obstetrics and gynaecology clinic
- Ophthalmology
- Oral and Maxillo facial surgery
- Orthodontics
- Outpatients
- Paediatric clinic
- Pharmacy
- Public Health Laboratory
- Renal unit
- Rheumatology
- Special care baby unit
- Operating theatres including for day surgery and maternity.

## Supporting services included:

- Medical records storage and retrieval
- Pathology including biochemistry, haematology and histopathology
- Sterile services
- Stores
- Staff changing areas
- Chapel
- Individual bedside (pay) TV screens and telephones
- Helipad.

The design needed to co-locate departments in a functional way, Accident and Emergency next to the Imaging department and operating theatres near to the Intensive therapy unit. The internal layout was designed for flexibility, so that walls and partitions could be moved speedily and cost effectively in the event of a change in requirements.

A life cycle replacement programme for components and fittings is to be operated by the Management Company in order to maintain the specified level of functional performance throughout the hospital's life. The new facility had to be constructed close to the then existing facility without disrupting it or the patients.

Funding was to be achieved through the Private Finance Initiative, enabling the Carlisle Hospitals NHS Trust to commission the construction of the hospital.

Specific non-clinical service provision must include facilities management, engineering and estate, hotel services, logistics, catering, security, laundry, linen, helpdesk services, non-emergency transport, car park management, reception, telecommunications and accommodation.

Sustainability is a functional requirement in response to Government policy which requires all public procurement to be environmentally, economically and socially sustainable as far as possible.



# The Cumberland Infirmary, Carlisle

## THE CONSTRUCTION SOLUTION

A three-storey, 474-bed hospital has been built on the site of the existing Cumberland Infirmary, including 33,000 square metres of new construction, and 10,000 square metres of retained buildings. Health Management (Carlisle), a consortium of the Building Property Group Ltd., Interserve and AMEC Group, contracted to finance, design and build the hospital buildings at a capital cost of £57 million, and then maintain it and provide all non-clinical services for a period of 45 years.

## THE PROCUREMENT PROCESS

The key drivers for sustainability through the procurement process were as follows:

AMEC's ability to use their negotiation skills and purchasing power to provide a better quality of component, within a set budget. AMEC took a budget driven approach for major elements of the building such that a better quality of component was purchased where possible within a given budget rather than taking advantage of cost reductions. This has had the positive effect of reducing maintenance and, as the life of better quality components is generally longer, reducing the life cycle environmental impact. An example of this was where windows with less associated maintenance costs and with a longer life were purchased instead of the specified windows.

The procurement process placed an emphasis on Life Cycle Costing to optimise the life and maintenance requirements of key building elements. In some cases this produced allied benefits, for example in the case of the windows; the better quality product meant that improved air tightness was obtained. The Trust was able to specify key performance criteria, including energy, which influenced the design.

## THE CONSTRUCTION PROCESS

There was no significant implementation of sustainability during the construction phase, other than positive measures taken to reduce landfill.

## OPERATIONAL FEEDBACK

The site is now approaching its second year in operation. There has been monitoring of client satisfaction, but results were not known at the time of interview.

Energy data had been obtained and was improving from the first year of operation. The PFI partner had proposed a target of 55 GJ/100 m<sup>3</sup> for the new buildings and had, in the second year obtained 58.5 GJ /m<sup>3</sup> for the combination of new and existing. The relative proportions of new to existing buildings suggest that the new buildings alone are achieving 55.65 GJ/100 m<sup>3</sup>. The current mandatory targets for new NHS buildings are 35-55 GJ /100 m<sup>3</sup> and as yet few if any major sites are achieving these figures. It would appear that the Cumberland Infirmary is in line to do so in the near future.

A key element to the success in energy efficiency is the commitment of the FM provider to employ a professional energy manager, transferred from the public sector. This individual has been pivotal in improving and monitoring the energy use, and in training and educating the users. The use of an incentive bonus for bettering the energy targets has undoubtedly proved a motivating factor and is to be favoured over a penalty system.

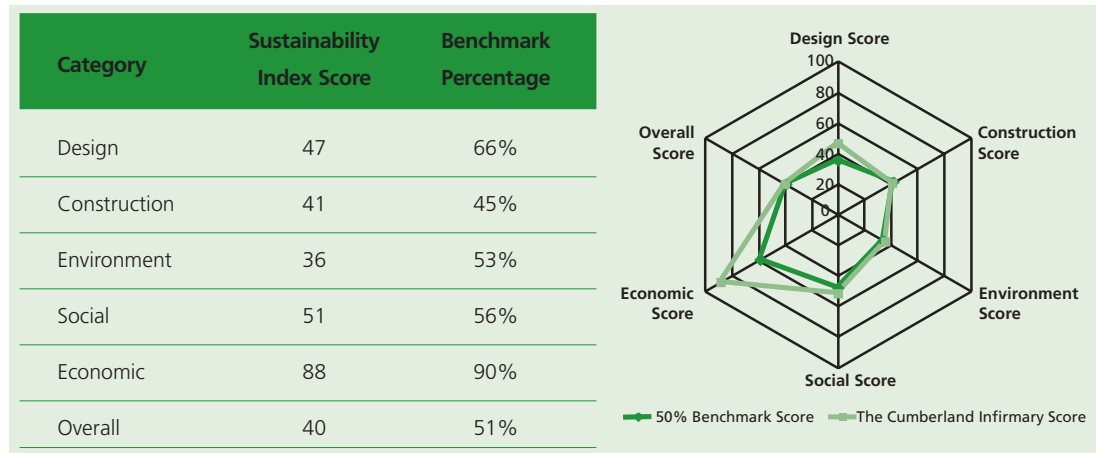
## DATA GATHERED

The interview was conducted with the project manager from Health Management (Carlisle) PLC, representatives from AMEC and Interserve.

# The Cumberland Infirmary, Carlisle



## BENCHMARK SCORE



## DISCUSSION OF DATA

Data was gathered for aspects of sustainability within the broad headings as set out below. The questionnaire also developed associated themes such as daylighting and alternative energy sources.

## SITE AND LOCATION

The project is on a combination of brownfield and adjacent low grade greenfield land. There was some contaminated land, with local 'hot spots' of heavy metals from a previous gas works on the site.

## STAGE WHEN SUSTAINABILITY INCORPORATED

Sustainability has been a feature throughout the project, but did not seem to have a major influence on the form and footprint of the building. The key interest in this scheme is the whole life costing approach taken by the contractor and the incorporation of energy saving measures in the design and operation of the building.

## PROJECT STATUS

Operational.

## ENERGY

Ambitious targets, for the NHS buildings at the time, were set in the submission. This impacted on the design in the following ways:

- Building Fabric U-values in excess of building regulation requirements, resulting in a U-value for the combination of all elements of  $0.38W/m^2/degree\ K$ .
- Attention to air tightness.
- Comprehensive control system incorporating a Building Management System.
- A strategy of natural ventilation where possible. Specific systems have not been used, except for trickle ventilation. The design of the building promotes natural ventilation, as the plan depth is quite shallow. There is also an atrium, but this is not used as a natural ventilation path for adjacent areas.



# The Cumberland Infirmary, Carlisle

- The ventilation systems all incorporate plate heat exchangers to facilitate heat recovery from the exhaust air. Ventilation systems for NHS buildings generally have to be full fresh air and the use of the highest efficiency exchangers is important.
- Variable volume pumping has been used for the major systems.
- Some areas have automatic lighting controls, eg the atrium.
- Use has been made of free cooling and night cooling where possible.
- The design of the plant rooms is exemplary, with ease of maintenance obviously a major consideration.
- Use of task lighting.
- Use of efficient luminaires.
- Waste and materials.

Waste avoidance has not been a major feature of this project, but consideration has been given to the whole life costing of materials generally. The motivating factor was to obtain a competitive edge to the PFI tariff by minimising replacement, repair and maintenance for the duration of the concession period.

## TRANSPORT

The site is well served by local bus services connecting to transport hubs in the town centre. The major benefit this project has brought to the area is the reduction of staff journeys between the three sites over which the services were previously split.

## POLLUTION

Certain measures were considered in the design such as:

- Positioning of ventilation inlets and exhausts to prevent re-entry of exhaust air and away from external pollution sources.
- Choice of zero ODP refrigerant.
- Low NOx boilers.

During construction, measures were taken to minimise dust, emissions from transport, noise, and run off to watercourses. Safety measures were taken in the storage and handling of chemicals and energy efficient plant was used. The site was operated under the Considerate Contractor Scheme.

## HEALTH AND SAFETY

Statutory standards are maintained on the scheme.

## SOCIAL ISSUES

There was a provision of some public open space within the development.

## ECONOMIC ISSUES

The scheme meets affordability criteria and, as with all PFI projects, reduces cost risk to the Trust. The client informs us that the quality of the building is significantly better than would have resulted from conventional procurement. In addition the construction time was significantly lower than conventional procurement.

# The Cumberland Infirmary, Carlisle



## LESSONS LEARNT, PITFALLS AND OPPORTUNITIES

The positive benefits from this project were AMEC's budget driven approach. In essence this meant that they used their purchasing and negotiating skills to procure better quality building components – a budget was set – tenders invited – the purchased components were not least cost but the best quality components obtainable for the set budget.

The above had an impact on AMEC's approach to WLC – ie procuring and installing a better quality, longer life component – ensured lower maintenance schedules and has reduced the monthly tariff.

On the operational side the facility benefits from good Facilities Management and Energy Management by virtue of an on-site Energy Manager and contract incentives that financially reward improved performance compared to set targets.

Lessons learnt include that it would have been beneficial to set energy and environmental targets at the design stage. This was an early PFI project (1996) when the needs/benefits of incorporating such sustainability targets in construction were not widely recognised. For the future, the development of recognised indicators (M<sup>4</sup>) would provide valuable reference benchmark data to assist in this respect.



# The Great Western Hospital, Swindon



## GENERAL DESCRIPTION OF THE PROJECT

The project involves the replacement of Swindon's Princess Margaret Hospital by a new hospital to be known as The Great Western Hospital. It will be located at Commonhead on the outskirts of the town close to the M4. The new facility, which is being built on former agricultural land, is a six-storey L-shaped building with 55,000 square metres of floor space. The site will incorporate landscaped grounds and parking for 1100 cars. The existing Princess Margaret Hospital will be sold off for housing development when the new facility is complete.

The new hospital will have a total of 551 beds, made up of 464 inpatient beds and 87 day case beds. The hospital includes most facilities associated with a district general hospital with emphasis on operating facilities. There will be an expansion of the healthcare services provided at the existing Princess Margaret Hospital. Facilities for staff, which will ultimately number 3500, include a crèche and some residential accommodation. New bus services to the hospital will be created and the Swindon and Marlborough NHS Trust will operate a green transport policy.

The project is nearing completion in November 2002 with fitting out almost complete as at mid-summer 2002.

The Swindon and Marlborough NHS Trust has entered into a partnership with The Hospital Company for the hospital development. The Hospital Company is financing the building, and will maintain and manage the services for a 30-year period. The shareholders of the Hospital Company, which was formed specifically for the project, are Carillion, United Medical Enterprises and Barclays Capital.

The capital cost of the building itself is approximately £100 million

## THE DESIGN AND BRIEFING PROCESS

The original intention of the output specification produced by the Trust was to extend and modify the original site. Negotiations were undertaken with several potential bidders on this basis. Variant bids were considered for alternative solutions and one of these was a greenfield site option, which proved favourable. The planning process resulted in a referral to government level, as planning guidance was not in favour of the use of greenfield sites.

The application was ultimately successful on the basis that there was no other appropriate site available in Swindon and that the Trust would make a contribution to enhancing the local transport infrastructure.

The original specification did not address sustainability in the context of a greenfield site, and the implementation of sustainability to this project has been evolutionary through a combination of the planning constraints and the ethos of the PFI partner.

## THE PROCUREMENT PROCESS

The procurement process drove the selection of the greenfield site and the form and design of the building. The original proposals risked failing to meet affordability criteria. This resulted from the inherent complications of working within a congested existing site, which would have to remain functional for the duration of the construction and refurbishment.

# The Great Western Hospital, Swindon



The procurement process also drove the emphasis on construction sustainability in the following respects:

- Sustainability was used as a unique selling point by The Hospital Company when bidding for the work.
- Carillion's experience and expertise in this field meant that aspects of sustainability could be offered without cost penalty.
- An emphasis on Life cycle costing, for optimum life and maintenance of key building elements, was inherent to the process.
- The Trust was able to specify key performance criteria, which influenced the design.
- Value for money in the construction process as discussed below.

## FUNCTIONALITY ISSUES

### Background

Princess Margaret Hospital was originally built at Okus Road in Swindon between 1959 and 1964. At that time, the hospital was on the edge of town, but has since been engulfed as the town has expanded around it. In 1974 the hospital completed the range of care facilities it could offer including an Outpatients department, Main Ward Block and a Casualty and Orthopaedics department.

By 1990, buildings had changed use, their fabric had deteriorated, and the local population had grown. The hospital found itself too small to meet the expanded service need, poorly laid out and very difficult to get to. It was also dogged by maintenance problems estimated at £48 million to resolve.

### The Client Need

Swindon and Marlborough NHS Trust decided that a new hospital was required to enable provision of higher quality health care in surroundings that were accessible, attractive, comfortable and practical. It needed better access for ambulances, patients, staff and visitors. The site also needed to be large enough to accommodate future expansion. Ten different site options were considered before the new site was chosen. 165,000 home occupants were then surveyed in the catchment area. 78% were in favour of the chosen site.

## THE FUNCTIONALITY DRIVERS

The old hospital served a population of 170,000. The new hospital needs to serve a population of 350,000, half of whom live in Swindon, the others being distributed throughout a rural catchment area bounded by Cirencester in the north, Ludgershall to the south, Chippenham to the west and Wantage to the east.

The site needs were identified as follows:

- an outlook to promote well being
- good emergency access
- to be set in a dip or behind trees to reduce visual impact
- affordable land (every pound spent on the site is a pound less available for patient care)
- to be available to purchase within the Government time scale.

The health care functions to be provided had to include:

- Accident and emergency
- Radiology
- Orthopaedics
- Rehabilitation therapy
- Breast Screening
- Pathology
- Ear, nose and throat
- Paediatric inpatients
- Outpatients
- Women's and children's services



# The Great Western Hospital, Swindon

- Cardiology
- Orthodontics
- Renal Unit
- Pharmacy
- Ophthalmology
- Theatre Suites
- Audiology
- Care of the elderly
- Occupational health
- Surgery
- Physiotherapy, occupational therapy
- High dependency unit
- In-patient care
- Dietetics.

Support functions also need to be provided including:

- Main hospital building
- Energy centre
- Main hospital entrance
- Staff accommodation
- Emergency access.
- A principal bus set down and pick up point
- An all-movement junction
- Car parking for staff, patients and visitors
- Peripheral screen planting

Funding was to be achieved through the Private Finance Initiative, enabling the Swindon and Marlborough NHS Trust to commission the construction of the hospital. Sustainability was a functional requirement in response to Government policy which requires that all public procurement should be environmentally, economically and socially sustainable as far as possible.

## THE CONSTRUCTION SOLUTION

The Great Western Hospital at Commonhead, Swindon, near Junction 15 of the M4 is to be a six-storey, L-shaped building with 55,000 square metres of floor space. It will provide 19% more clinical space than the current Princess Margaret Hospital and offer some additional services. It will include environmentally friendly measures such as energy saving and reductions in noise and light pollution. There will also be landscaped grounds and special facilities for staff, such as an Accommodation Building and Crèche. The Hospital Company, a PFI Consortium, contracted to design and build the hospital buildings at a cost of approximately £100 million, and then to provide building maintenance and all non-clinical services for a period of 27 years.

## THE CONSTRUCTION PROCESS

The key features of sustainability have been implemented through the construction process and these features are discussed in more detail later in the case study. A key driver in the construction process was value for money, taken in the overall context of efficiency, ease of construction, avoidance of waste and standardisation of components.

## DATA GATHERED

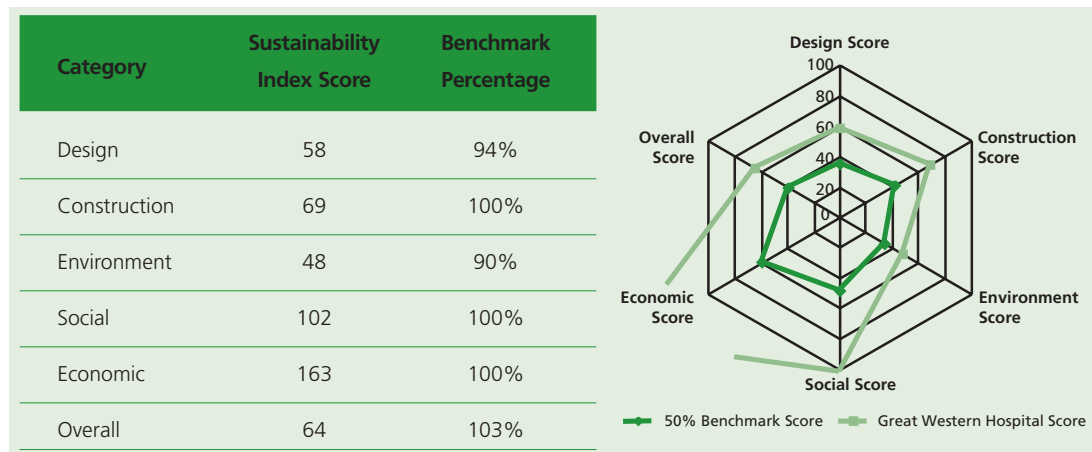
### Questionnaire

The interview was conducted using a questionnaire developed by BRE. The interview was conducted with the Trust's project manager, and representatives from Carillion, who are managing the design and the sustainability aspects of the project.

# The Great Western Hospital, Swindon



## BENCHMARK SCORE



## DISCUSSION OF DATA

Data was gathered for aspects of sustainability within the broad headings as set out below. The questionnaire also developed associated themes such as daylighting and alternative energy sources.

## SITE AND LOCATION

The project is on a greenfield site.

## STAGE WHEN SUSTAINABILITY INCORPORATED

Sustainability has been a feature throughout the project, but did not seem to have a major influence on the form and footprint of the building. The key interest in this scheme is the incorporation of sustainability through the construction process. Sustainability was introduced primarily at the preferred bidder stage of the contract when the orientation and footprint of the building had already been established.

## MANAGEMENT SYSTEMS

It is understood that the project is certified to ISO 14001. The main contractor, Carillion also holds ISO 9000. Suppliers and subcontractors are required to comply with the requirements of these schemes and this is a key feature of Carillion's management of the supply and construction process.

## IMPACT ASSESSMENTS

An Environmental Life Cycle Assessment has been carried out on most construction materials, along with Life Cycle Costing for the duration of the PFI contract. In addition, Transport Impact Assessments have been carried out for all major deliveries, resulting in minimisation of journeys and reduced environmental impact.

## ECOLOGY

Ecology was an important issue as the project is being built on former agricultural land. The site did not however have any sites of special scientific interest. Some trees and habitat were protected and some habitat has been created. There is a plan that is available for public scrutiny for the enhancement of biodiversity. Certain species eg badgers were relocated.



# The Great Western Hospital, Swindon

## PROJECT STATUS

Currently under construction.

## ENERGY

Targets were not set in the specification or in the submission. Targets are currently being reviewed and have not been disclosed at this stage. It is difficult to comment therefore on the likely energy performance of this building.

The initial services design produced was both too costly and unlikely to meet energy targets as it incorporated extensive ventilation and cooling. This was rationalised with the result that the design now incorporates much more natural ventilation. Specific natural ventilation systems such as stacks were not included and windows and trickle ventilators are relied on instead. The success of this strategy is as yet untested, although the designers are confident it will produce the specified internal environment requirements.

## WATER

A balancing pond has been incorporated to lessen the effect of surface water run off to a nearby watercourse. This will also enhance ecological habitat.

## WASTE AND MATERIALS

Minimisation of site waste has been a key feature of this project. The adoption of Sustainability Action Plans (SAP) by Carillion has impacted on the whole supply chain and demonstrates a joined up approach to sustainability rare in construction generally and possibly unique in the construction of NHS buildings.

The approach can be briefly summarised as follows:

- Development of a SAP addressing the issues of transport, health and safety, energy, labour, raw materials and extraction, waste, quality, compliance with legislation, community image and the 'licence to operate' supplier partnerships.
- Working within a framework of sustainable development established with a partner, The Natural Step (TNS).
- A 'Systems Thinking' approach – exchange of individual project information by the many parties involved in construction to optimise overall performance.

The practical outworking of these theories has impacted on the waste management, construction process and materials selection in some of the following ways:

- A target set for 50% reduction of waste from the previous project of the same type and scale.
- Waste management through prevention of unnecessary waste arriving at site and the minimisation of landfill through reuse and recycling. Waste is segregated and where recycling within the site is not possible, local markets are sought.
- Plasterboard recycling. This has represented a large proportion of site waste in the past. It has been reduced by the selection of board sizes to reduce off cuts and the segregation and recycling of the off cuts, returning them to the manufacturer on the lorries delivering fresh boards.
- Reduction in use of VOCs on timber finishes.
- Prefabrication of components where possible to produce improved accuracy, less waste, safer, faster construction and minimisation of delivery journeys. For example, the walling chosen comprised prefabricated concrete panels with the insulation and windows pre-installed. The waste was controlled and monitored at the supplier's factory.

# The Great Western Hospital, Swindon



- Improved roof insulation offset by the reduction in radiator provision to the top floors.
- Avoidance of PVC, for example on certain floor finishes and substitution of natural products such as rubber.

## TRANSPORT

There are two main strands to the discussion here. Firstly, the Trust has been instrumental in discussions with the local bus companies to provide new/improved services. Buses will be able to stop on the site adjacent to entrances. This will ensure the new site does not have to be accessed using private cars, despite being located on the outskirts of Swindon.

The second strand, discussed in part above, is the approach taken by Carillion in the minimisation of transport journeys during the construction process.

## POLLUTION

Pollution has been carefully considered both in the construction process and in the design of the new facility. Light and noise pollution have been considered with a view to minimisation. Construction pollution is monitored and records kept. There have been no reportable pollution incidents to date.

## HEALTH AND SAFETY

Health and safety has been an important consideration both in the construction process and in the design of the new facility. Carillion operates a comprehensive safety policy, with a penalty system for violations. There is an obvious commitment to good housekeeping, tidiness and security, all of which contribute to safety. The accident frequency ratio, for the project as at mid-summer 2002, was 0.3 from project commencement date.

## SOCIAL ISSUES

Carillion has set up a job centre on the site to promote creation of local jobs during construction. The construction project has created more than 150 jobs locally. Work and teacher placements have been offered, and links set up to community representatives such as the police, businesses, residents and schools. The design of the scheme has sought to minimise the noise and light pollution to nearby residents.

The project has been used by both the contractor and the Trust to promote training and education of all those involved and in the wider community.

## ECONOMIC ISSUES

Carillion maintain that their sustainable policy is cost effective and are undertaking research in techniques for cost accounting of sustainable measures. The scheme meets affordability criteria and, as with all PFI projects, reduces cost risk to the Trust. It is believed that the quality of the building is significantly better than would have resulted from conventional procurement.

## LESSONS LEARNT, PITFALLS AND OPPORTUNITIES

Carillion's recognition that sustainability should be an integral part of their bid, and not viewed as an 'additional burden or handicap' to overcome, assured the success of the project from a Construction aspect.

Carillion saw sustainability as an opportunity, and for them it became a unique selling proposition (USP). Within the bid documentation the requirement for the successful bidder to meet sustainability criteria was limited.



## The Great Western Hospital, Swindon

Particular opportunities to note were:

- Procurement and use of materials in a sustainable manner without cost penalty. This included prefabrication, off-cuts of sheet materials returned to supplier on the 'return load' and sustainability action plans that were a requirement of major sub contractors.
- The incorporation of social responsibility by opening a site job centre to ensure that the local population had every opportunity to secure employment on the project.
- This coupled with excellent training opportunities and the provision of teacher and work placements ensured that learning opportunities for schools and colleges were fully addressed and exploited during this phase.
- Possible opportunities lost included the use of renewable energy supplies, absorption chilling and CHP.

Potential pitfalls are:

- There were not enough sustainable targets or indices in the specification. It was, therefore, fortunate that Carillion's submission incorporated the integrated approach to sustainability as stated previously.
- Sustainable cost data is not, to our knowledge, in the public domain and only when it is can it be fully analysed and incorporated into the Public Sector Comparator.
- Inexperienced contractors will build a risk factor into their bid to insure against not meeting sustainability targets or indices in the Output Specification.

The output specification, Invitation to Negotiate documentation needs to be free from conflicts. An example of which would be the setting a low energy target and then specifying strict temperature regimes that could result in mechanical heating/cooling leading to compromise or default on energy targets. For the evaluation process, evaluation of submissions made against conflicting criteria could present difficulties and arbitrary 'scoring' systems measuring compliance only could unfairly prejudice against those contractors proposing extensive natural ventilation. It must be recognised by those setting the output specification and evaluating the bids, that guarantees of temperatures cannot be given to the same extent as for a fully ventilated and air conditioned space.

# Summary Check List



## SUSTAINABILITY OPPORTUNITIES FOR PFI/PPP PROJECTS

The following checklists bring together lessons learnt and general guidelines on incorporating sustainability in PFI/PPP projects. The list highlights specific points raised in the case studies and also draws upon broader discussions on the PFI/PPP process from the case study interviews held with key players.

- Sustainability can be used as a competitive advantage for bidders.
- Sustainable construction can provide savings if principles are incorporated in the initial stages.
- Whole Life Costing principles are key in PFI contracts but need to be incorporated correctly.
- Comparison of tenders needs to be made on a like for like basis.
- Benchmarks and targets should be set to quantify design performance.
- The output document should encourage sustainability in the construction phase and require method statements and policies from the providers.
- In construction and operation phases costs of sending waste to landfill can be minimised by reuse or recycling.
- Innovation can be encouraged by allowing flexibility in the brief to enable Consortia to meet or exceed targets in new and innovative ways.
- Contractor performance can be maximised by offering incentives for good performance. Payment mechanisms for energy efficiency need to acknowledge that providers have limited control over end users, but encourage training, awareness and diligence in monitoring of energy.
- The output specification should include provision for metering, monitoring and reporting structures with positive incentives.
- Reducing energy bills and greenhouse gases can limit liability under Climate Change Levy.
- Performance can be improved simply by good management.
- By incorporating sustainability, risks of failing to meet new environmental legislation/ requirements can be reduced to minimise future financial impact.
- Transport impact can be limited through green transport plans and sourcing local products in construction phase.



# Summary Check List

## POTENTIAL SUSTAINABILITY PITFALLS FOR PFI/PPP PROJECTS

- There needs to be vision and commitment to sustainability from all parties. The whole team from client to contractor must 'buy in'.
- Sustainability needs to be considered from inception and integrated in to the earliest strategic decisions.
- Clients need good independent advice when setting briefs and commissioning to ensure that the brief achieves their expectations and produces a sustainable outcome. CABE (Commission for Architecture and the Built Environment) are now offering some advice on design quality in PFI schemes.
- Monitoring of emerging design should take place to prevent time pressures reducing standards. If problems are not picked up early then there may be no opportunity to resolve the issues without compromising the overall programme. In this situation, compromise of standards is very prevalent.
- Poor communication between the team will make sustainability difficult to achieve, it is important to get all disciplines involved.
- If timescales are too tight there is no room for debate or finding the most sustainable solution. Clients must be firm in refusing to accept tariff reductions in exchange for abandoning environmental and energy targets or sustainability indices.
- Sustainable cost data is not, to our knowledge, in the public domain; only when it is can it be fully analysed and incorporated into the Public Sector Comparator (PSC).
- Contractors with limited sustainability knowledge will tend to build large risk factors into their bid to insure against failing to meet sustainability targets or indices.
- Fear of the unknown and new technologies can lead to innovative approaches not being taken.

# References



## PUBLICATIONS

### Croydon Council

Tramlink – A light rail system for Croydon and beyond, 1996

### Department for Education and Skills

Schools' Environmental Assessment Method (SEAM),  
available from The Stationery Office Publications Centre  
Telephone 020 7873 9090

### NHS Trust Information Booklet

The Great Western Hospital – Healthcare for the New Century, Swindon and Marlborough.  
Available from the Redevelopment Team,  
Princess Margaret Hospital, Okus Road, Swindon, SN1 4JU

### Treasury Guidance Note No. 7

Design Quality in PFI Projects, May 2000.  
Available from OGC, Rosebery Court, St Andrews Business Park, Norwich, NR7 0HS  
Telephone: 0845 0004999

### Welsh Office

A55 Bryngwran to Holyhead Environmental Statement  
– Non Technical Summary. June 1996

### BRE Bookshop

Sustainability lessons from private finance and similar private initiatives, Robert  
Garwood, Susan Logan, Kate Mills and Nigel Willoughby. IP13/02.

Getting it right: a client's guide to achieving functionality in construction. Centre for  
Whole Life Performance.

Publications available from BRE Bookshop. Email: [brebookshop@emap.com](mailto:brebookshop@emap.com)

## WEBSITES

**BRE.** Information on BREEAM at: [www.bre.co.uk/breem](http://www.bre.co.uk/breem)

**BRE.** Information on functionality at:  
[www.bre.co.uk/services/whole\\_life\\_performance.html](http://www.bre.co.uk/services/whole_life_performance.html)

**BRE.** Information on PFI services at: [www.bre.co.uk/pfi](http://www.bre.co.uk/pfi)

**Building and Property Group.** Information on Cumberland Infirmary  
at: [www.b-and-p.com/site.html](http://www.b-and-p.com/site.html)

**Commission for Architecture and the Built Environment.** [www.cabe.org.uk](http://www.cabe.org.uk)

**Carillion.** [www.carillionplc.com/general-hospital/swindon](http://www.carillionplc.com/general-hospital/swindon)

**Movement for Innovation.** M<sup>4</sup>I Sustainability Indicators can be found  
at: [www.m4i.org.uk/toolkits](http://www.m4i.org.uk/toolkits)

**NHS Estates.** Sustainable Development in the NHS:  
[www.nhsestates.gov.uk/sustainable\\_development/index.asp](http://www.nhsestates.gov.uk/sustainable_development/index.asp)

## FURTHER INFORMATION

For further information on these case studies and other initiatives associated  
with PFI/PPP contact: BRE's PFI Unit. Tel 01923 664290. Email [pfi@bre.co.uk](mailto:pfi@bre.co.uk)

