Learning legacy

Lessons learned from the London 2012 Games construction project

Achieving CEEQUAL Excellent on the Olympic Park

Abstract

London's bid for the 2012 Olympic Games set out to create the most sustainable Olympic Park ever and deliver a lasting legacy of regeneration for east London. The principles of sustainable development were embedded in the planning, design and construction of the Olympic Park.

To deliver sustainability in design and construction the Olympic Delivery Authority (ODA) sought to use existing and recognised tools. One of the existing tools the ODA used to assess and rate the sustainability performance of 18 permanent infrastructure projects on the Olympic Park, plus the Olympic and Paralympic Village car park, was the Civil Engineering Environmental Quality Assessment and Award Scheme (CEEQUAL).

CEEQUAL offered the ODA a reputable tool that was independent and externally audited. A CEEQUAL Whole Project rating of Very Good was sought for each project being assessed, with an amalgamated rating for the entire Olympic Park being awarded upon completion of all of the assessments.

Through two case studies, Primary Foul Water Pumping Station and Wetland Bridges, this paper sets out how CEEQUAL was implemented on the Olympic Park, the lessons that can be applied to CEEQUAL assessments of other large infrastructure projects and offers suggestions on how CEEQUAL could evolve into a more robust sustainability assessment tool.

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CEEQUAL was applied to the permanent infrastructure and public realm

A CEEQUAL Whole Project rating of very good was sought for 18 projects on the Olympic Park, with an amalgamated rating for the entre Park being awarded upon completion of all of the assessments.

Introduction

London's bid for the 2012 Olympic and Paralympic Games set out to create the most sustainable Olympic Park ever and deliver a lasting legacy of regeneration for East London.

The principles of sustainable development were embedded in the planning, design and construction of the Park. Establishing effective management tools and processes for embedding sustainability into all phases of the programme and across all construction projects was essential on this complex, very large and high profile regeneration project.

To deliver sustainability in design and construction the Olympic Delivery Authority (ODA) sought to use existing and recognised tools. One of the existing tools the ODA used was the Civil Engineering Environmental Quality Assessment and Award Scheme (CEEQUAL).

CEEQUAL offered the ODA a reputable tool that was independent and externally audited. Eighteen projects on the Park, plus the Olympic and Paralympic Village multi-storey car park, were assessed for a CEEQUAL Whole Project Award. A CEEQUAL rating of 'Very Good' was sought for each of the projects being assessed, with an amalgamated rating for the entire Park being awarded upon completion of all of the assessments.

Implementing CEEQUAL on the Park involved the use of multiple assessors. Each project had two or three assessors, each assessor being responsible for assessing either the client, design or construction questions. The ODA's Delivery Partner (DP) – CLM – was responsible for assessing the client questions and for coordinating the assessments and ensuring standardisation of the assessments across the Park.

The assessors spent time establishing a robust approach to using CEEQUAL. This resulted in greater efficiencies in evidence gathering and sharing of best practice; leaving more time to improve the sustainability performance of the project and achieve high CEEQUAL performance.

This paper sets out how CEEQUAL was implemented on the Park, the lessons that can be applied to CEEQUAL assessments of other large infrastructure projects and offers suggestions on how CEEQUAL could evolve into a more robust sustainability assessment tool.

What is CEEQUAL?

CEEQUAL is an assessment and awards scheme for improving sustainability in civil engineering and public realm projects.

CEEQUAL can be applied to the entire project life cycle, and it aims to demonstrate the industry's commitment and performance to delivering exemplary environmental and social performance.

A CEEQUAL assessment is split into 12 sections, measuring the actions that the client, designer and contractor have taken to deliver exemplary environmental performance. The areas[a] assessed are:

- project management
- land use
- landscape issues
- ecology and biodiversity
- the historic environment
- water resources and the water environment
- energy and carbon
- material use
- waste management
- transport
- effects on neighbours
- relations with the local community and other stakeholders.

A CEEQUAL assessment is typically carried out over the entire project life cycle, but it is possible to assess performance partway through the project under an Interim Award. The Interim Award is particularly useful for projects that last for many years, enabling knowledge to be captured and assessed before key personnel leave the project. A further assessment can be undertaken to convert the Interim Award to a Whole Project Award at the end of construction. However, on the Park it was felt that an Interim Award would not offer any additional benefits, but would incur additional costs, and therefore was not undertaken.

a The Olympic Park was assessed under CEEQUAL Version 4.

CEEQUAL on the Park

The Park is a 500 acre or 2.4 square kilometre site and consists of many discrete projects, each working to different programmes and being delivered by a variety of design and construction teams.

The requirement to use CEEQUAL to drive sustainability performance was set out in London's bid for the 2012 Olympic and Paralympic Games when the ODA published its Sustainable Development Strategy (SDS)[b].

The SDS set out 12 sustainability objectives that the ODA was committed to achieving. Some of these targets were embedded into the Park

	Client	Designer	Contractor	Final score (where confirmed)
Enabling Works				
Enabling Works South Park	ODA	Atkins	BAM Nuttall	94.1% (Excellent)
Enabling Works North Park	ODA	Atkins	Morrison Construction Ltd	94.2% (Excellent)
Structures, Bridges and Highways (SBH)				
North park civils and loop road	ODA	Atkins	Skanska	Undergoing assessment
South park civils and loop road	ODA	Arup	BAM Nuttall	Undergoing assessment
Rail over bridges	ODA	Arup	Balfour Beatty Civil Engineering	94.5% (Excellent)
Olympic Stadium Bridges	ODA	Arup	Balfour Beatty Civil Engineering	94.6% (Excellent)
Wetland Bridges	ODA	Atkins	BAM Nuttall	98.3% (Excellent)
F06 Competition bridge	ODA	Arup/Hparc	Lagan	88.8% (Excellent)
Lea Navigation Bridges	ODA	Atkins	SISK	Undergoing assessment
Utilities				
Networks	ODA	Atkins	McNicholas	87.7% (Excellent)
Telecom Duct Network	ODA	Arup	McNicholas	87.7% (Excellent)
District heating and cooling network	ODA	Parsons Brinckerhoff and Cofely East London Energy Limited	Cofely East London Energy Limited	82% (Excellent)
Foul Sewer and Pumping Station	ODA	Arup	Barhale	93.8% (Excellent)
Landscape and Public Realm				
North park	ODA	Atkins	BAM Nuttall	Undergoing assessment
South park	ODA	Arup	Skanska	Undergoing assessment
Greenway	ODA	Arup	VolkerFitzpatrick	97% (Excellent)
Aquatics Centre				
F10 bridge	ODA	Arup	Balfour Beatty	94.54% (Excellent)
Media Hub				
Multi-storey carpark	ODA	Carillion Construction/ Byrne Brothers	Carillion Construction/ Byrne Brothers	93.3% (Excellent)
Off park venue – Athletes Village				
Car park	ODA	Lend Lease	Bourne Construction Ltd	82.3% (Excellent)

Table 1: Olympic Park projects assessed for a CEEQUAL Whole Project Award including organisations involved and scores where known at the time of writing. Note: further details on the completed projects can be found on the CEEQUAL website. Available from: www.ceequal.com/awards.html (accessed 27 June 2012).

b The ODA Sustainable Development Strategy is a sustainability champion product which can be downloaded from the London 2012 Learning Legacy website. Available from: www.learninglegacy.london2012.com/publications/sustainable-development-strategy.php (accessed 5 April 2012).

CEEQUAL was a requirement of the Sustainable Development Strategy and was a contract requirement.

A bespoke web-based assessment tool was developed to collect the evidence and record the answers for all the CEEQUAL assessments.

Planning Permission as conditions or within the Section 106 Agreement. One of these targets included a commitment to use CEEQUAL on all permanent infrastructure on the Park and to achieve a minimum CEEQUAL Whole Project rating of 'Very Good'. CEEQUAL was also a contractual requirement for design and construction teams.

Table 1 illustrates the projects that have been assessed for a CEEQUAL Whole Project Award; organisations involved in delivering the project and the scores where these have been confirmed at the time of writing.

CEEQUAL management process on the Park

The Delivery Partners (DP) managed all CEEQUAL assessments across the Park, which included registering the projects for CEEQUAL Whole Project Awards and assessing the client elements for each project. The DP produced a document called 'Implementation Guidance for Project Teams (IGPT) Environmental Impacts' which set out how CEEQUAL would be managed during design and construction[c].

Atkins were appointed CEEQUAL design assessors for the north Park infrastructure projects, Arup were appointed CEEQUAL design assessors for the south Park infrastructure projects. On contract award, the construction contractor was required to appoint a qualified CEEQUAL assessor to assess the construction elements in collaboration with the client and design assessors, and maintain a CEEQUAL Very Good rating. The construction contractor was contractually required to pay the CEEQUAL verification fee.

Adapting CEEQUAL for use on the Park

CEEQUAL has one set of assessment criteria that can be applied to a range of civil engineering projects and it is through the 'scoping out' process that the standard CEEQUAL criteria is adapted to suit the project that is being assessed. This is different to the Building Research Establishment Environmental Assessment Method (BREEAM) where the Building Research Establishment (BRE) developed a bespoke BREEAM methodology for London 2012 permanent venues[d].

When developing the management framework for applying CEEQUAL to the Park, it became apparent that the 'standard' CEEQUAL approach could not be readily applied and a 'bespoke' approach was required.

The Park was split into 18 Whole Project assessments (plus the Athletes' Village car park) based on how the construction contracts were awarded. The projects varied in scale, scope and programme delivery. To arrive at the CEEQUAL score for the entire Park, CEEQUAL agreed that individual project scores would be weighted based upon their capital value and the scores amalgamated to produce the Park-wide score.

The DP held a number of workshops with CEEQUAL, and the design assessors to develop the CEEQUAL bespoke assessment process.

The outcome from these workshops was the development of an agreed methodology. The methodology and process adopted included the following:

Development of a web-based assessment tool

At the time of commencing the Park CEEQUAL assessments (approximately February 2008), CEEQUAL were requesting that assessors used an Excel spreadsheet when undertaking assessments. Due to the number of assessors from different organisations that were involved in assessing each project (see Table 1) it was evident that a more sophisticated tool was needed on the Park.

c The Implementation Guidance for Project Teams – Environmental Impacts is a Sustainability champion product which can be downloaded from the London 2012 Learning Legacy website. Available from: www.learninglegacy.london2012.com/publications/environmental-impacts-implementation-guidance-for-projec.php (accessed 5 April 2012).

d Refer to BREEAM paper – Development and use of BREEAM for Olympic Park venues – on London 2012 Learning Legacy website. Available from: www.learninglegacy.london2012.com/publications/development-and-use-of-breeam-for-olympic-park-venues.php (accessed 5 April 2012).

The development and use of the bespoke web-based tool has subsequently helped CEEQUAL to develop their own web-based assessment tool that is now being used to assess all new CEEQUAL assessments.

The CEEQUAL assessment criteria was adapted for use on the Olympic Park.

The decision was taken to use software that was already part of the ODA procurement process, to collect the evidence and record the answers for all the CEEQUAL assessments. A software engineer was appointed to adapt the tool to ensure it had the required functionality.

The following measures were incorporated into the software to maximise efficiency:

- Assessors could view the evidence and rationale that had been written by the other assessors who were assessing the project. This was vital to ensure collaborative working among the assessors.
- Documents could be made available to more than one question, removing the need to upload it more than once.
- A consistent file naming structure was created so that all files could be easily recognised and assigned to a question.
- A progress indicator was created for each question so the assessor and the client could monitor progress in real-time.
- The tool could produce reports instantaneously to demonstrate progress made on the assessment, areas of high performance and areas where the project was not performing well.

The bespoke, web-based assessment tool was developed in collaboration with CEEQUAL to ensure it met their standards. The development and use of the ODA tool has subsequently helped CEEQUAL to develop their own web-based assessment tool that is now being used to assess all new CEEQUAL assessments.

Adapting the CEEQUAL assessment criteria

- The CEEQUAL assessment assigns responsibility for answering questions to different parties (client, designer or contractor). On the Park these standard assignations needed to be flexible so the most appropriate party could answer each question. See example below.
- As client, the ODA was responsible for answering some questions which in a 'normal' assessment would be answered by either the designer or contractor. For example, within the Waste section, the ODA answered questions relating to Duty of Care (9.2.2 – 9.2.5), which would normally be answered by the contractor. This was because the ODA provided a common waste provider that contractors on the Park had to use. The client was responsible for providing Duty of Care evidence across all packages.
- In several instances, and where the construction contract was not yet awarded, it was agreed that where the design assessors had undertaken the design of a number of projects and the design had followed the same principles and guidelines, the same design evidence could be applied to a number of packages. For example, using the same principles and approach for designing the rail over bridges and Olympic Stadium bridges were fundamentally the same, so it was agreed that one set of design evidence could be submitted for both projects. Likewise, it was agreed that, across the Park, the client evidence would be fundamentally the same with some relatively minor alterations to project specific questions.

Assigning questions example

Section 5 of the CEEQUAL manual deals with the historic environment. On the Park the Enabling Works project had sole responsibility for undertaking the heritage assessment of the Park. It was therefore deemed appropriate that questions relating to this topic would only be answered by the Enabling Works contractors and scoped out of all subsequent assessments, even if they were classified as No Scope Out (NSO). It was agreed with CEEQUAL that the follow-on contractors had no further input to these questions and they were removed from subsequent assessments to avoid double counting.

Approximately 8000 individual documents were uploaded into the web-based assessment tool.

– Where responsibility for an answer is split between parties, for example, client and design, one party will be assigned as the primary party and will be responsible for collecting evidence from all responsible parties, and entering it in the correct format on the web-based assessment tool.

The scoping out process

In a standard CEEQUAL assessment, scoping out is carried out in a single session between the single appointed assessor and verifier. Because the assessment for the Park packages involved client, design and construction assessors, any scoping out needed to be agreed between all parties.

A pre-scoping meeting was held with the three assessors, which had the benefits of ensuring an efficient scoping out process and identified questions which would only be answered by a single assessor rather than all three, adding to the efficiency of the evidence-gathering process. Following this, a formal scoping out meeting was arranged with the verifier.

The evidence gathering process

With such a large project and so many work packages there was a huge volume of information to collect (approximately 8,000 individual documents were uploaded into the web-based assessment tool).

CEEQUAL is designed to encourage early engagement with the project teams, partly to simplify the evidence-gathering process.

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An integrated Environment and Sustainability Management System (ESMS), which has been externally audited and certified to ISO 14001: 2004, was developed for the Park.

This was the first time a joint Environment and Sustainability certification process had been developed and certified on a major construction project. The ESMS delivered both environment and sustainability assurance through design, procurement and construction for all the projects on the Park. The ESMS ensured that robust systems, tools and processes were in place to assure the environmental and sustainability targets on the Park, manage legal compliance, and ensure best practice through continual improvement. The implementation of an integrated ESMS led to efficient collection of evidence.

Assessment and contractor handover

The CEEQUAL assessment process commenced in February 2008 and, at the time of writing, some projects are still being assessed. Because the design and construction assessments were carried out by different organisations, it was very important that there was an efficient handover of the assessment from the designer to the contractor. The DP facilitated this handover through a review and sign-off process. Once the client and design assessment was completed, as far as practicable, the DP reviewed the evidence before it was handed over to the construction assessor.

With the handover there was a list of outstanding evidence that the design assessor believed was missing, from either the client or the Construction team. This meant that at the end of the construction stage there would be no outstanding evidence from the Design team (since they would probably have moved on from the project by then). The CEEQUAL design assessor was retained to attend coordination meetings with the construction assessor to clarify any issues that arose.

This paper will now introduce two projects that have been assessed under CEEQUAL on the Park, Primary Foul Water Pumping Station and the Wetland Bridges, outlining the achievements and lessons learned from undertaking a CEEQUAL whole project assessment.

Case study – Primary Foul Water Pumping Station (93.8 per cent Excellent)

Project team
Client: Olympic Delivery Authority (ODA)
Architect: John Lyall Architects
Design Team: Arup and Barhale Construction / Hyder Consulting / Donaldson Associates
Main Contractor: Barhale Construction

The Olympic Park Primary Foul Water Pumping Station achieved a CEEQUAL Excellent Whole Project Award (93.8 per cent). The project forms part of the Park strategy to keep foul and surface water drainage components separate, reducing discharges of sewage to the River Lea, improving river water quality and reducing the load on Abbey Mills Pumping station and Beckton wastewater treatment works downstream.

The core design principles for the project were as follows:

1 The building should reflect its function and represent the engineering it supports.
2 The building should make a positive contribution to the character of the urban realm within which it is placed.
3 The design should address the particular physical constraints applied by the location and the different contexts of the Games and legacy uses.

Application of CEEQUAL on the project

Sustainability requirements for the pumping station were driven by the client and designers. Monthly meetings were held between the design and sustainability teams to establish how the project could implement the requirements of the SDS. This made it significantly easier for the design assessor to collate CEEQUAL evidence.

The Project Management systems that were developed by the ODA and the DP resulted in exemplary environmental performance being delivered throughout the project life cycle. The benefits of the systems and processes that have been developed have allowed the project to score highly in a number of CEEQUAL sections, including Project Management, Use of Materials, Waste, Transport, Nuisance to Neighbours and Community Relations.

The ODA embedded sustainability into the procurement of design and contractor services by requesting tenderers to demonstrate how they would deliver sustainability requirements. A balanced scorecard was used to evaluate how designers and contractors would perform against the ODA's suite of objectives. The evaluation criteria were set typically at 70:30 (Technical: Price) and sustainability formed part of the technical questions.

The ODA and its DP had a dedicated Environment and Sustainability team to monitor, manage and assure environment and sustainability requirements throughout the project life cycle. While this is recognised as a positive influence on the sustainability of the project, it was apparent that many of the CEEQUAL requirements within Section 1 (Project Management) occurred on the programme as a matter of course. This is reflected in the 100 per cent score that the Pumping Station scored for Section 1 (Project Management), and which smaller projects may find challenging to obtain.

Early in the design process, the sustainability team met with their design team to explain and seek buy-in to the CEEQUAL process. This was undertaken through a series of meetings, where the CEEQUAL process and evidence required was explained.

The emphasis was on establishing the right mindset within the team, so that they would be looking at their work and thinking 'How can I adapt or change the sustainability of this design to maximise CEEQUAL credits?'; 'What kind of evidence can I collect to demonstrate this?' The importance of documenting design decisions and the type of evidence that can be used was an important factor to ensure robust evidence was available.

Sustainability requirements for the pumping station were driven by the client and designed from Concept Design.

The Pumping Station achieved exemplary performance in Landscape Issues, receiving a CEEQUAL Outstanding Achievement Award.

The Design team provided evidence throughout the design process, which was good CEEQUAL practice, but also benefitted the Design team as they felt that they were learning about CEEQUAL requirements and how the requirements could be integrated into the design.

Achievements

The Pumping Station achieved exemplary performance in a number of CEEQUAL sections, including Section 3 Landscape Issues where it achieved a CEEQUAL Outstanding Achievement Award[e] in recognition of the visual and architectural components of the scheme, which are considered to be over and above that usually expected for a Pumping Station and set a benchmark for an often bland branch of utilities buildings.

The majority of the scheme is underground, with the Pumping Station being the only visual element. Utilities buildings typically serve their primary function rather than provide architectural innovation. The design development for the building was set in the context of the ODA utilities vision for the Park and the townscape and visual assessment. The vision encouraged the team to investigate the architectural potential of the building and the final design incorporates both functional elements and artistic elements on the public faces of the building, such as the Victorian sewer designs cast into the external concrete panels.

The circular form of the building was selected to reflect the civil engineering beneath. The inner workings of the pumping station have been left exposed as a key feature rather than hiding them away. The use of transparent fencing further increased visibility and enhanced the feeling of personal security around the site[f].

As well as the impressive structure, the project incorporated a lighting scheme which combined task lighting for operation and maintenance, as well as various feature lighting initiatives to improve personal safety, enhance the architectural features and assist with wayfinding. A brown roof and bird and bat boxes were also incorporated into the scheme, providing biodiversity enhancements. CEEQUAL adequately rewards these design features through achieving credits within the sections on historic environment, ecology and landscape.

Victorian sewer design

e Further details on the Outstanding Achievement Award can be found on the CEEQUAL website. Available from: www.ceequal.com/awards_079.htm (accessed 5 April 2012).

f Further details can be found in the complementary engineering and architecture of the Primary Foul Water Pumping Station micro report on the London2012 Learning Legacy website. Available from: www.learninglegacy.london2012.com/publications/complementary-engineering-and-architecture-of-the-primar.php (accessed 5 April 2012).

The number of access shafts along the 1.9km sewer was reduced from 28 in the concept design to 13 during detailed design.

There were several other design decisions which resulted in the project scoring highly under CEEQUAL. Often it is noted by design teams that efficient engineering also results in sustainability benefits, particularly when considering resource use.

As many of the design decisions were taken prior to CEEQUAL being officially initiated on the project, the excellent CEEQUAL score has been achieved because of client requirements, as opposed to being driven by CEEQUAL.

The sustainability team successfully reduced the number of access shafts along the 1.9km sewer from 28 in the initial concept design to 14 at tender stage and the design and build contractor, further reduced this to 13 during detailed design. This option had a much lower carbon footprint, reducing construction excavations and minimising the volume of waste arising, which resulted in significant cost savings for the client and reduced planning complications[g].

Again, it should be noted that this significant improvement in the design has been recognised by CEEQUAL in the award achieved, however, it was not the CEEQUAL requirements that drove this decision in the first place.

Operational flexibility was maximised, with the Pumping Station able to cope with high flows during the London 2012 Olympic and Paralympic Games, but reduced loads during the transformation period before legacy developments are fully occupied. The design achieved stringent noise and odour control standards at the boundary of the Pumping Station, which exceeded limits agreed through the planning process.

Further achievements about the project can be found on the CEEQUAL website. Available from: www.ceequal.com/awards_079.htm (accessed 5 April 2012).

Exposed inner workings and architectural lighting of the pumping station

g Further details can be found in the Primary Foul Water Value Engineering micro report on the London 2012 Learning Legacy website. Available from: www.learninglegacy.london2012.com/publications/primary-foul-sewer-value-engineering.php (accessed 28 June 2012).

Case Study – Wetland Bridges (98.3 per cent Excellent)

At 98.3 per cent, Wetland Bridges is the highest scoring CEEQUAL project to date.

Project Team
Client: Olympic Delivery Authority (ODA)
Bridge Architect: Allies and Morrison
Design Team: Atkins Ltd
Main Contractor: BAM Nuttall
Specialist lighting engineer: Arup
Artist's impressions: Martin Richman

The Wetland Bridges achieved a CEEQUAL Excellent Whole Project Award (98.3 per cent), which is the highest scoring CEEQUAL project to date. A total of 33 highways, land and footbridges are constructed for the London 2012 Olympic and Paralympic Games, the two Wetland Bridges are situated in the north of the Park.

Within the north parklands are the wetlands, which is a significant habitat surrounded by open space and the Copper Box, Basketball Arena and Velodrome. Straddling the wetlands and linking the east with the west of the Park are the Wetland Bridges.

The bridges provide an essential part of the comprehensive pedestrian walkways and cycle routes during the London 2012 Games and in legacy. There are permanent and temporary sections to the bridges, the temporary sections have been designed to cater for the crowd flows during the Games and will be removed in legacy transformation (refer to the decked area shown in Figure 1).

Application of CEEQUAL on the Project
From concept design and throughout design development, the design team worked with their CEEQUAL assessor and sustainability manager and the DP to embed sustainability into the design and deliver the requirements of the SDS through workshops, design reviews and ongoing sustainability reviews.

The workshops provided guidance on CEEQUAL, the assessment process, evidence required and raised awareness, which meant that there was a significant improvement in the effectiveness of carrying out the assessment as the project developed.

The design team felt that CEEQUAL gave a systematic approach to evaluating the performance of the project; the designers developed a greater appreciation of CEEQUAL and found it a useful educational tool; it provided external endorsement and certification of the sustainability performance of the project. Overall, it gave a sense of a job well done and consequently the project received the profile and recognition it deserved.

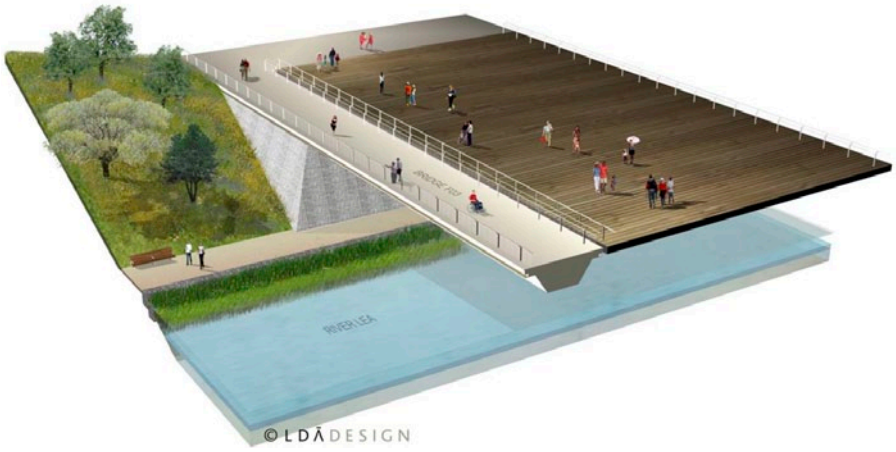


Illustration of one of the Wetland Bridges

The Wetland Bridges achieved exemplary performance in a number of CEEQUAL sections, scoring particularly well in the Energy and Carbon section (96.3 per cent) which is a notoriously hard section to score well in.

Achievements

The Wetland Bridges achieved exemplary performance in a number of CEEQUAL sections, scoring particularly well in the Energy and Carbon section (96.3 per cent) which is a notoriously hard section to score well in. Within this section, CEEQUAL asks for a life cycle energy analysis and life cycle carbon assessment to be undertaken on the key building materials and components used on the project. This level of analysis and assessment had not been undertaken on any of the CEEQUAL assessed projects on the Park.

On consultation with CEEQUAL, it was determined that as the project was measuring carbon savings through ODA materials and transportation targets – 20 per cent recycled content (by value); 25 per cent recycled aggregates (by weight) and 50 per cent (by weight) sustainable transportation of materials – this evidence could be used to score credits.

The design team demonstrated achievement of client targets predominately through the Embodied Energy Statement that had been developed. The Embodied Energy Statement for the projects key building materials (concrete, pipes, aggregate and steel) identified embodied impact throughout the materials life cycle, from extraction of the raw materials, through manufacturing, transportation to site, installation, maintenance, disassembly and deconstruction.

The Embodied Energy Statement included consideration of the use of secondary, recycled and reclaimed materials; embedded carbon dioxide (CO_2) of materials and key carbon reductions when comparing different material and/or design options.

Examples of embodied energy reduction measures included cement substitution, use of recycled materials for backfill of pipes, use of site-won materials as fill for retaining walls, specifying high density polyethylene pipes over polyvinyl chloride (PVC) for drainage pipes.

At project close out, the contractor was able to demonstrate that they had achieved the targets:

- 66 per cent sustainable transport (by weight) of key building materials (against the 50 per cent target);
- 86 per cent recycled aggregates (by weight) against a 25 per cent target;
- 45 per cent recycled content (by value) against a 20 per cent target.

Further points under the Energy and Carbon section were achieved because the lighting design for Wetland Bridges specified the use of light emitting diode (LED) luminaries on the bespoke parapet, with fluorescent lights adapted for artistic feature lights in the gabion walls. Both lighting designs are operated under efficient lighting controls, while lighting has been designed out of the tow path.

Utility pipe off cuts have been used as a bird boxes

Wetland Bridges scored well under the Materials section (97.6 per cent) by maximising the use of site-won materials.

Offcuts from utility pipes were used as bird boxes and installed in the gabion baskets

The box girders of the bridges are trapezoidal to optimise the amount of daylight underneath the bridge.

All of these measures contributed to the high score within the Energy and Carbon section.

Wetland Bridges scored well under the Materials section (97.6 per cent) by maximising the use of site-won materials, particularly through the use of secondary aggregates in abutment and wing walls, and the use of offcuts from utility pipes which were used as bird boxes and installed in the gabion baskets.

Concrete that was low in embodied energy was achieved by specifying the use of secondary aggregates, like china clay stent and substituting cement for pulverised fuel ash (PFA). Considerable effort was made to review the use of conventional materials and treatments, and find alternative, more environmentally friendly and healthier replacements that complied with industry standards. For example, the majority of coatings and treatments used were volatile organic compound free (VOC-free).

Wetland Bridges made an artistic statement out of recycled materials. The designs of artist Martin Richman filled gabions with re-used glass which is illuminated in a rich coloured light. Recycled glass beads were used to create a spiralled pattern on the bridge surface. The pattern is evocative of water movement and the dynamic energy of human vitality expressed in athletic ideals.

Further achievements about the project can be found on the CEEQUAL website. Available from: www.ceequal.com/awards_114.html (accessed 5 April 2012).

Gabions have been filled with the re-used glass

Lessons learned and recommendations

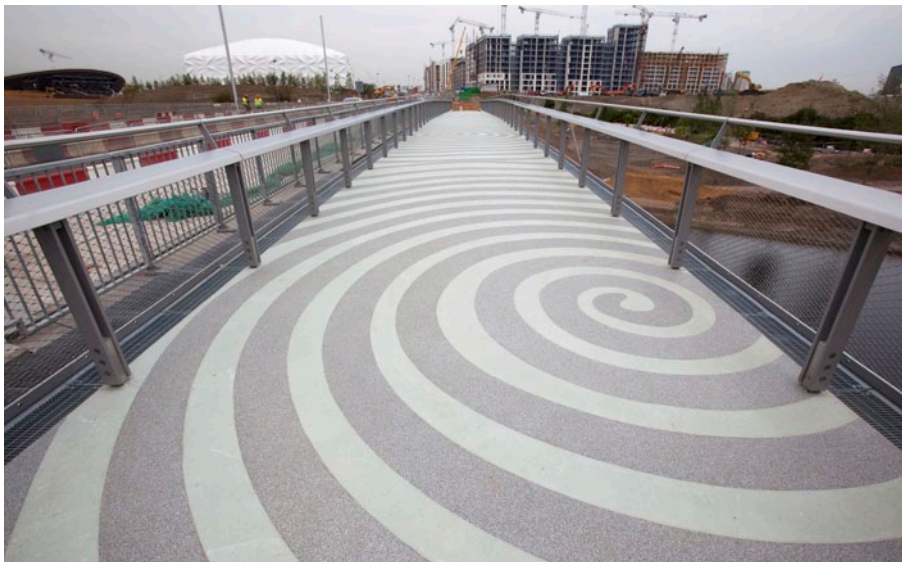
The London 2012 Games has helped to identify recommendations and lessons learned that can help CEEQUAL to adapt and improve as a sustainability assessment tool. Table 2 shows the lessons learned and legacy recommendations for CEEQUAL.

Lessons learned from applying CEEQUAL to a multifaceted programme	
Developing robust management processes	– Establishing robust process for implementing CEEQUAL allowed the assessors to spend more time working with their client, design and construction teams to improve the environmental and social performance of the project. – This is part of the purpose of CEEQUAL and it is important that project teams are encouraged to think about the CEEQUAL requirements and how they can be delivered. – Educating the teams through briefings and regular meetings with CEEQUAL assessors is a crucial part of this process and will help the project perform to the best of its ability.
Having the right tools to assess multifaceted projects	– Having a web-based assessment tool was vital to carrying out the assessments in a coordinated, collaborative, consistent and efficient manner. With many assessments being carried out consecutively and in parallel within an organisation, the web-based tool allowed efficient management of the assessments and real time monitoring of project performance. Subsequently, CEEQUAL Ltd has launched its own online assessment tool.
Client manager	– Having a client manager responsible for overseeing the CEEQUAL process is essential on large multifaceted projects like London 2012. One person having an overview of all the assessments makes it easier to develop a single coordinated approach and share best practice.
Flexibility	– Rules allowing for efficient identification and collection of evidence are valuable, but the CEEQUAL Assessor should be flexible and not overly prescriptive at the outset. Due to the number of topics and questions covered by CEEQUAL, not every scenario can be predicted. The way in which some questions are answered will only become clear at the time of assessment. Each package of work will operate slightly differently and a continuing dialogue between the CEEQUAL assessor and CEEQUAL Ltd is essential to finding the correct solution (refer to Recommendation 2 below).
Transferring lessons learned	– The value of developing this process has subsequently been realised through applying similar principles to other large scale, complex projects. – The interim CEEQUAL assessment of the Crossrail project was managed by adapting methods successfully established on London 2012.
Recommendations for improving CEEQUAL	
1 CEEQUAL as a driver for sustainability?	**Issue** – The extent to which CEEQUAL influenced the sustainability achievements of the CEEQUAL assessed projects was limited. The ODA had already set challenging sustainability targets which each project had to deliver, and it was client targets rather than CEEQUAL that drove sustainability. **Recommendation for improvement** – Future development of CEEQUAL should seek input from assessors and project teams on the level of achievement CEEQUAL should be aspiring to. It should be noted that CEEQUAL has recently launched Version 5. CEEQUAL engaged with the Olympic Park CEEQUAL Assessors during the development of Version 5 and it is anticipated that Version 5 has taken on board some of the lessons learned from this programme.

Table 2: Lessons learned and legacy recommendations

Recommendations for improving CEEQUAL (continued)	
2 Interpreting the requirements	**Issue** – The majority of the questions in CEEQUAL are not prescriptive and at times there was uncertainty about how to demonstrate compliance with a question. **Recommendation for improvement** – Infrastructure projects differ greatly from project to project and so it would be a challenge to adapt the CEEQUAL questions so that they are more prescriptive, however, CEEQUAL needs to strike a balance between the current generic nature of their questions and becoming too prescriptive and therefore stifling innovation and creativity – Due to the variations between projects it would be challenging to apply more quantitative criteria to a single assessment. Sector specific CEEQUAL assessments, for example, highways, bridges and drainage, could potentially increase the relevance of questions to different types of infrastructure projects, resulting in more direct, quantifiable requirements.
3 Project scale	**Issue** – The scope of any given project will greatly influence the baseline performance against CEEQUAL criteria. Some issues which are managed and improved as a priority on multifaceted projects like the Park, may not be considered on a smaller scale project and will lead to a lower score. **Recommendation for improvement** – Projects could be subjected to questions related to the expected minimum requirements for a scheme of a particular size, rather than applying the same expectations across all scales of projects. This would lessen the ability of large projects to score additional credits without going beyond what is considered good practice. This approach could help CEEQUAL to maintain improvements in the sustainability performance of civil engineering projects, regardless of project scale.

Table 2: Lessons learned and legacy recommendations (continued)



Crushed recycled glass has been used on bridge surfacing

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MAYOR OF LONDON

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