Appendix E: Design and Engineering Method Statements

CAMBRIDGE SPORT LAKES

REPORT AND METHOD STATEMENT ON DESIGN AND ENGINEERING

INDEX

1 DESIGN CRITERIA

The main element of the Sport Park, the Rowing Lake, has been designed to the following fundamental criteria:

1.1 The international rowing body, FISA, stipulate that for international competition the Lake must be 2150m long, accommodate 8 lanes each 12.5m wide, with a minimum water depth of 3.5m on the middle 6 lanes.

1.2 The Lake must be protected as far as practicable from wind from all directions.

1.3 The water quality must be able to be maintained at an acceptable level for wildlife and water sports.

1.4 The effect of the completed course on the hydrology of the Cam valley must be at least neutral, and preferably positive.

1.5 The Lake must be connected to the Upper Cam by a waterway navigable by rowing eights.

1.6. The completed Park must be landscaped in a manner to reduce wind across the Rowing Lake, to cater for the proposed land sports and recreation, and to present a pleasing overall effect while enhancing the environment.

2 CANAL DESIGN AND CONSTRUCTION

2.1 Navigation:

2.1.1 Height and water depth restrictions at both ends prevent anything other than rowing craft and canoes from using the Canal. The entrance from the Cam is designed to preserve existing Bump Stations and to easy and safe entry and exit to and from the Cam.

2.1.3 The entrance is angled and curved to provide optimum manoeuvring space and maximum sight lines into the Cam for eights. The Canal is wide enough for eights to pass each other without easying.

2.1.4 For safety, crews have to easy approaching the Railway Underpass from both sides, and drift through under momentum. In high water conditions headroom under the Towpath Bridge and Railway Underpass will be reduced to the point where crews will be unable to pass through, thus closing the Canal automatically. In addition, a flow and height sensor will automatically signal 'canal closed' during high water conditions.

2.2. Hydrology:

2.2.1 A typical cross-section of the Canal is shown on Annex G drg. 22941/ES/003A To minimise weed growth water depth would normally be 1.8m except at the Towpath Bridge, Award Drain Aqueduct, and Railway Culvert, where a minimum of 300mm is required.

2.2.2 In times of normal rainfall, surface run-off will exceed evaporation losses, resulting in a flow from Lake to river of between zero and approximately 2m/hr. In cloudburst conditions, flow in the Canal may reach approximately 6m per minute. In conditions which cause evaporation losses in the Lake to cause abstractions of water from the Cam through the Canal, water from the Storage Lake will be introduced automatically to balance or exceed losses.

2.3 Earthworks:

Canal construction is detailed on Annex G drg. 22941/ES/011A and is built on the same principle as the Lake, with a clay bottom and clay seal on the sides. Spoil from the excavation will be placed alongside the Canal and landscaped.

3 MAIN EXCAVATION

3.1 Design: borehole results (Randall Survey 2001) show a consistent picture over the whole site: about 1m of topsoil/loam overlays a seam of gravel about 1m thick. Below the gravel is a deep consistent stratum of gault clay extending at least 10m below ground. It is intended to exploit the impervious clay by excavating an average 3.5m below ground, penetrating about 1.5m into it, forming the Lake bottom from in-situ clay and using the surplus to form a seal along the Lake sides in porous areas. Any faults in the in-situ clay will be excavated and plugged with surplus clay. Thus a complete basin will be formed, and sealed over its entire perimeter with impervious material. Water at Upper Cam level will be retained in the Lake where the surrounding water table outside the site perimeter will be about 1m lower. Precautions such as cutoff drains around the Lake perimeter will be taken to prevent any seepage through the seal raising the surrounding water table.

3.2 No material will be removed off site without prior permission.

3.3 Construction Sequence:

3.3.1 Topsoil will be removed in areas of engineering necessity and in other areas to provide enough material for landscaping. It will be stockpiled as necessary.

3.3.2 Gravel will be excavated from the stratum uncontaminated by clay and (a) laid immediately when possible for coaching way, roads, paths, etc. (b) processed and stockpiled for later use (c) disposed with surplus clay in spoil heaps.

3.3.3 Material will generally be excavated by machines standing on the well-drained gravel bench and dumped to spoil.

3.3.4 The clay seal will be formed by excavating down to sound clay at the Lake perimeter to present a clean joint. Clay will be placed immediately in the prepared trench and the seal puddled and compacted by bulldozer and sheepsfoot roller.

3.3.5 Clay from the general Lake bottom will be excavated and dumped to spoil with the gravel. Care will be taken to mix dumped clay and gravel in the spoil heaps to provide drainage and water-retention properties for landscaping.

3.3.6 The excavation will be pumped dry from sumps formed in the Lake bottom. If water from the surrounding water-table forces its way through defects in the clay bottom and newly-formed lining, it will be apparent soon after exposure. The defective areas will be excavated immediately, and puddled. Sensors will be placed behind the seal to detect areas of raised water pressure. On filling the Lake and the seal becoming fully hydrated, the pressure profile will be monitored to detect areas of raised water pressure outside the seal. Any areas for excessive seepage will be identified, the Lake lowered 1.2m, and the seal reinstated.

3.3.7 The earthmoving will be carried out by groups of hydraulic excavators working with six-wheeled dumptrucks, with bulldozers and rollers grading and compacting.

4 SURFACE WATER DRAINAGE - **See Section 1 – Stage 1 Flood Risk Assessment Fig 8 – Proposed Drainage System**

4.1 Award Drain no 288:

4.1.1 The project requires this Drain to be diverted into the Lake by pumping through a permanent pumping station. A detailed design will be produced for approval by the relevant Statutory bodies. **See Section 1 – Stage 1 Flood Risk Assessment Fig 8 – Proposed Drainage System.**

4.1.2 Before major excavations start, the Drain diversion will be built and in operation.

4.2 Award Drain no 291: no diversion of this Drain is required apart from carrying it under the Canal at the Award Drain Aqueduct. See Section 6.3 and **See Section 1 – Stage 1 Flood Risk Assessment Fig 8 – Proposed Drainage System.**

4.3 Award Drain no 393: this Drain will be diverted Southwest alongside the Cut to connect with Award Drain 291 west of the railway.

4.4 Perimeter Drain will be built on the site boundary where there is not already an existing drain or the diverted Award Drain. The existing network of field drains outside the site boundary will all drain into this new drain, thus preserving the drainage and groundwater regime of the ground outside the perimeter. See Section 5.

4.5. The Perimeter Drain will act as a cut-off drain, collecting any water which may have penetrated through the Lake's clay seal and surrounding ground. The water table outside the Perimeter Drain will therefore be unaffected by water from ground inside the perimeter. Piezometers have already been installed at points outside the site perimeter to monitor future groundwater levels after the Lake has been filled.

4.6 Water Table after completion: as mentioned in para 4 the water table outside the Perimeter Drain will remain at existing levels after the projects is completed. Inside the perimeter, any small amount of water penetrating the clay seal will drain freely through the gravel into underlying strata, any excess being picked up by the Perimeter Drain. The water table in this area would thus remain at existing levels or be very slightly raised in localized areas. In the long term the water table will not fall as a result of the Lake.

4.7 Water Table during construction: as described in 3.2.6, the basic concept behind the construction method is to test continuously the Lake seal against the surrounding water pressure during excavation. Any significant ingress of water will halt the diggers and will have to be dealt with promptly. Any water finding its way into the basin will be re-circulated by being pumped back into the surrounding drains, thus replenishing the water table.

4.8 Chemical composition: data obtained from NRA indicates that there is no significant variation between the chemical composition of the Upper Cam and local groundwater. Therefore any long term seepage of water from the Lake will not have a significant effect on the chemical composition of the groundwater.

5 ARCHAEOLOGY

5.1 A Research Design has been prepared by Oxford Archaeology which sets out the archaeological background, potential and priorities for the site, and establishes the principles upon which the mitigation of the impacts of the scheme on the archaeological resource will be based. While the specific mitigation measures set out are aimed primarily at the impact of the main rowing lake, it has been accepted by the Cambridgeshire County Council Archaeology Office that the principles of that mitigation are applicable to other impacts of the scheme not specifically covered by the Research Design.

5.2 The scope of any such mitigation measures will be determined in consultation with Cambridgeshire County Council Archaeology Office and will be carried out in accordance with a Written Scheme of Investigation

which has been approved by the Local Planning Authority. **See Section 4 : Updated Research Design for Archaeological Mitigation**

6 STRUCTURES

6.1 TOWPATH BRIDGE

The appearance of the bridge is designed to enhance the towpath scene. The structure will be designed for long life and minimum maintenance. The design load for the bridge will be determined by the requirements of NRA and Cam Conservators and the parapets designed in accordance with current practice. The bridge supports will be designed to cater for side impacts from river vessels. **See Annex G drg. 22941/ES/002A – Cam Towpath Bridge**

6.2 ANGLIAN WATER OUTFALL PIPES

These twin 600mm dia pipes are situated underneath the towpath. Prior to excavating the Canal entrance, the pipes will be exposed and encased in concrete to the satisfaction of Anglian Water. There will be a minimum water depth of 300mm over the encased pipes, but in the event that the river is abnormally low the 'flow and level' sensor will automatically activate 'canal closed' signals to prevent damage to rowing craft. **See Section 1 – Stage 1 Flood Risk Assessment Fig 8 – Proposed Drainage System**

6.3 AWARD DRAIN AQUEDUCT

The aqueduct carries the Canal over Award Drain no 291. It is designed as multi-barrel, successive barrels being brought into action at higher water levels by an initiation weir. Design water velocities are at a level to optimise self-cleansing, and debris grilles will be fitted to LA requirements to minimise cleaning and maintenance. Precautions will be taken against bank erosion and scour of the floor of the canal by the flume effect of the shallow water above the Aqueduct. **See Section 1 – Stage 1 Flood Risk Assessment Fig 8 – Proposed Drainage System & Annex G drg. 22941/ES/003A**

6.4 RAILWAY UNDERPASS

The height between the Canal surface and the rail of the Cambridge to Kings Lynn railway is about 1.3m (4ft 3in). The design concept is based on taking into account the short length of the culvert (10m, about half the length of an eight), therefore a clear headroom of about 900mm (3ft) will enable crews to negotiate the obstacle without difficulty. Smaller boats can make use of hand-holds built into the roof of the Culvert to propel themselves through. Study of the behaviour of the Upper Cam during high water- and flow-levels indicates that Canal conditions would be unacceptable only when conditions on the Upper Cam warrant closure with the red flag – see para 2.1.6. The principles of the design and construction method have been formulated in consultation with Network Rail Outside Parties Dept. **See Annex G drg. 22941/ES/004C**

6.5 RAILWAY CYCLE UNDERPASS

The Cam towpath is to be connected to the Coaching Towpath on the Lake by a towpath running alongside the Canal and under the railway. The Underpass will be integral with the Railway Culvert and will be installed as part of the main structure. The invert of the Underpass will be arranged to drain into existing drains at the base of the railway embankment, and would be subject to flooding. However, during flood conditions the Canal would be closed automatically (see section 2.1.4) and the signalling would apply to the Underpass. **See Annex G drg. 22941/ES/004C**

6.6 START BRIDGE

The bridge consists of twin spans, permitting 4 lanes of crews to row through at full speed. It will carry emergency vehicles and foot/cycle traffic only. **See Annex G drg. 22941/ES/006A – Start Bridge**

6.9 FEN ROAD BRIDGE

The bridge will be designed as twin simply supported spans with a central pier. The structure will be designed to cater for full HA loading and 37.5 units of HB. The carriageway will be 4.0m wide with 0.75m verge and 1.25m footpath, guardrails to be designed in accordance with current practice. The structure to be designed and built in accordance with Highway Dept's requirements. **See Annex G drg. 22941/ES/005A – Fen Road Bridge**

7 WATER QUALITY

Current research and practice points to avoiding a flow of water through the Lake, thus avoiding the introduction of nutrients into the Lake with the consequential risk of developing algal blooms and initiating eutrophication.

It is intended to fill the Lake from the Upper Cam above the Anglian Water outfall at a time of maximum water availability and minimum nutrient content.

For a limited time after filling, nutrients from the newly disturbed topsoil on the Lake catchment area will leach into the Lake but the amount will be small in relation to the water volume. In subsequent seasons, successive flushing through by water from the Storage Lake will minimise nutrient levels. A programme of water-plant planting and other measures will be carried out after filling, and water quality will be monitored.

During winter, runoff will exceed evaporation losses resulting in a net outflow from the Lake to the Cam. In summer, evaporating losses will exceed runoff and will be replaced by water from the Storage Lake.

The bottom 1.7m of the Lake will not be flushed as readily as the upper 1.8m since the Cut is only 1.8m deep. The lower layers will be monitored for enrichment and measures such as aeration will be carried out as necessary to ensure mixing and oxygenation.

8. ENVIRONMENTAL IMPACT OF CONSTRUCTION WORKS.

8.1 NOISE

A provisional construction plan has been drawn up in which construction work will normally take place between 7 am and 7 pm Monday to Saturday. The main excavation will be carried out by groups of machines each comprising one hydraulic excavator loading two 6-wheel articulated dumptrucks. One bulldozer will spread and grade the spoil. The excavation of Phase 1 and Phase 2 will each take one season.

One of these machine groups would work for a maximum period of about three months at a distance of at least 300m from the three groups of dwellings closest to the site at Waterbeach, Milton and to the East of the A10 Ely road. At all stages of the excavation topsoil will be stockpiled on the site perimeter in advance of the machines, providing an effective screen between the excavation point and the outside world. For the majority of the construction period, machines will be operating at least 500m from habitation and for the most part will be working below existing ground level. The exception to this will be the bulldozer shaping the mounds and landscaping. Electric and/or diesel pumps will be used to dewater the excavation and will be placed in the excavations behind soil heaps to provide effective noise insulation. There will not be a perceptible increase in

background noise levels during construction (i.e. less than 3 dB[A]) increase in accordance with the Dept. of Transport's Manual of Environmental Appraisal).

8.2 DUST

Excavation will take place in moist conditions and will be dust free. The dumptrucks will run mostly on gravel haul roads in moist conditions close to the water table. In the event of haul roads drying out a water bowser will be on hand to prevent 'dusting up'. Clay dumped to spoil will be mixed with soil/gravel and will stay moist until spread.

8.3 LIGHT

Construction will not normally take place in darkness. During construction of the Railway Underpass night possessions would be required for limited periods of up to 4 days, in which case lights and generators will be in operation. This operation will take place close to the A45 embankment approximately 350m from the nearest dwelling at Bates Bite lock, and the increase in background noise and light will small and short-lived.

8.4 TRAFFIC

Access to the side will only be via the permanent access off Car Dyke road. Site personnel will number an average of 20. No heavy machine or dumptruck will leave the site until its use has ended. There will be intermittent deliveries of building materials, fuel, and spares, and visits by maintenance vehicles, staff cars and buses.

8.5 ACCESS

During construction public access to the site will be prohibited, except to designated platforms. Public and vehicular access along Fen Road will be maintained at all times.