Annex F: Aquatic Invertebrate Survey

Cambridge Sport Lakes

Environmental Statement

Ecology and Nature Conservation Chapter Annex F: Aquatic Invertebrates Survey

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List of Contents

Summary

An aquatic invertebrate survey was carried out in May 2004 at five selected sampling sites at the proposed location of Cambridge Sport Lakes. The aim of the survey was to establish baseline data and assess any potential impacts and effects prior to the start of construction of the lake. Three minute kick samples were taken at each site and animals were identified to species level, where possible. Biological water quality was assessed at each site using standard scoring systems for aquatic invertebrates (BMWP scores and ASPT values) and species lists were examined to identify whether any rare or notable species were present.

The ditches sampled all had moderate to good biological water quality, but are probably influenced by organic pollution, such as agricultural run-off, to a certain extent. The assemblages of taxa found at all sites were fairly typical for small, slow-flowing, lowland ditches and no rare or notable taxa were found.

All of the sites sampled may be affected to varying degrees by construction, in particular Site 2 and Site 3. Site 3 had the highest BMWP and ASPT of all the sites sampled. It may be possible to translocate material from these sites into the new Perimeter Drain prior to construction, depending on phasing of the work. In addition, some shallow margins at the Storage Lake would increase suitable habitat for invertebrates.

A detailed management plan should be in place to ensure that construction-related materials and silt are not discharged into any watercourse and should include measures to deal with accidental pollution incidents. A monitoring programme is also recommended following construction, to establish whether there has been any change from the baseline.

1 Introduction

The proposed site for Cambridge Sport Lakes is located approximately 3 miles north of Cambridge, between Milton Country Park and Waterbeach. The study area is close to the A14 and A10 and runs parallel and adjacent to the main Cambridge / Ely railway line. The project consists of two connected lakes for rowing and associated sports, a storage lake for angling, BMX and triathlon tracks, a sports centre and a country park. Currently, the study area consists mainly of farmland with a number of interconnecting ditches. Some ditches, particularly in the northern part of the study area, were dry at the time of survey.

As part of the Environmental Statement, ecological baseline studies, including aquatic invertebrates, were undertaken to establish existing ecological conditions along the route and identify any potential ecological impacts.

Throughout this report, the term ‘invertebrates’ refers to benthic (sediment-dwelling) macro-invertebrates larger than 1 mm. Aquatic invertebrates are good indicators of water quality as they can show long-term changes in quality, which may be missed by spot surface water quality sampling. They also form a vital part of the food chain in aquatic environments. It is essential that the baseline is established prior to any construction work, which can form the basis for any future monitoring during construction and can inform the mitigation process. Baseline information for aquatic invertebrates includes not only an indication of water quality using standard scoring systems, but also an assessment of whether any rare or notable species are present.

2 Methods

2.1 Description of sampling sites

Five sites were selected within the proposed development area, as shown in Figures F1 - F3. These sites were selected to provide overall information on the ditch systems present at the study area, but were limited slightly as many of the other ditches present were dry at the time of survey (particularly in the northern part of the study area). Photographs of the five sampling sites are shown in Appendix A, along with habitat descriptions.

2.2 Sampling methods

A visit to the study area was undertaken on 17th May 2004, with a total of five sites sampled. A three minute kick sample was taken at each sampling location using a net of 1 mm mesh, ensuring that all habitats present were sampled representatively, in accordance with the standard Environment Agency methodology for sampling aquatic invertebrates. This was followed by a one minute hand search of any stones present. Each sample was sieved through a 1 mm mesh sieve, sorted and invertebrates preserved in 70% ethanol. Identification was carried out to species level, where possible, to allow detailed species lists to be produced for each location. For some taxa, identification was not taken to species level due to time constraints of the study or missing features which are essential for species identification, for example oligochaetes, chironomids, early caddisfly instars (family level) and some damaged or immature damselfly and dragonfly specimens (family level). Identification was therefore carried out to the appropriate level of confidence and the term ‘taxa’ is used as an overall term rather than ‘species’ or ‘family’.

3 Baseline conditions

Standard scoring systems were used to assess the biological quality of each site. In the Biological Monitoring Working Party (BMWP) scoring system, each invertebrate family is allocated a score between 1 and 10, depending on its sensitivity to organic pollution. A score of 10 indicates high organic pollution sensitivity, whilst a score of 1 indicates pollution tolerance. The total BMWP score for each site is then calculated, with a higher score indicating better water quality. The Average Score Per Taxon (ASPT) index gives an indication of the evenness of community diversity (for example, whether the invertebrate community consists of a few high scoring taxa or many low scoring taxa). ASPT is calculated by dividing the BMWP score for each site by the total number of scoring families found there, so it is independent of sample size. As for BMWP scores, a higher ASPT indicates better water quality. The BMWP scoring system is shown in Appendix B.

Table 1 shows all invertebrate taxa found at each sampling site. BMWP scores and ASPT are also shown, along with the category of biological water quality (for example, moderate, good) implied by these scores. All of the taxa found during this survey appear to be generally widespread and common, from information in the identification keys.

Table F1 Freshwater invertebrate taxa and abundances at each sampling site, with BMWP scores and ASPT

Invertebrate taxa	Site 1	Site 2	Site 3	Site 4	Site 5
Mollusca (snails)					
Sphaeriidae: *Sphaerium* sp.	15	1	89		
Sphaeriidae: *Psidium* sp.	4			3	
Hydrobiidae: *Bithynia tentaculata*	15		6		
Physidae: *Physa fontinalis*	1				
Physidae: *Aplecta hypnorum*				5	
Planorbidae: *Planorbis contortus*	5	4			
Planorbidae: *Planorbis complanatus*		32			
Planorbidae: *Planorbis spirobis*		6			
Planorbidae: *Planorbis planorbis*				8	
Planorbidae: *Planorbis corneus*	2				
Valvatidae: *Valvata piscinalis*	59				
Lymnaeidae *: Lymnaea peregra*	1		2	2	3
Lymnaeidae: *Lymnaea stagnalis*	2		3	4	4
Lymnaeidae: *Lymnaea palustris*	1				
Oligochaeta (worms)					
Oligochaeta	34	15	1		7
Hirudinea (leeches)					
Erpobdellidae: *Erpobdella octoculata*	4				2
Glossiphoniidae: *Glossiphonia complanata*	4				

Invertebrate taxa	Site 1	Site 2	Site 3	Site 4	Site 5
Crustacea					
Gammaridae: *Crangonyx pseudogracilis*	1	12	1	5	2
Asellidae: *Asellus aquaticus*	1	10	4	4	16
Ephemeroptera (mayflies)					
Baetidae*: Cloeon dipterum*		1			
Caenidae: *Caenis luctuosa*			2		
Odonata (damselflies and dragonflies)					
Libellulidae (immature specimens)		1	1	3	
Coenagridae: *Coenagrion* sp. (damaged specimens)	7				
Hemiptera (bugs)					
Gerridae (immature)					18
Nepidae: *Nepa cinerea*					
Megaloptera (alderflies)					
Sialidae: *Sialis lutera*			3		
Coleoptera (beetles)					
Dytiscidae (larvae)		3	6	3	
Dytiscidae: Hydroporinae (larvae)		2			1
Dytiscidae: *Hydroporus palustris* (adults)		1		1	
Dytiscidae: *Ilybius ater* (adults)		1		1	1
Haliplidae (larvae)			1		
Helodidae (larvae)				56	17
Hydrophilidae (larvae)				3	
Hydrophilidae: *Helophorus* sp. (adults)				2	1
Invertebrate taxa	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**

Hydrophilidae: *Anacaena* sp. (adults)					2
Hydrophilidae: *Hydrobius fuscipes* (adults)				3	1
Chrysomelidae: Galerucinae (adults)			6		
Chrysomelidae: Halticinae (adults)					3
Trichoptera (caddisflies)					
Limnephilidae (early instars)		1	3		
Diptera (true flies)					
Chironomidae	1	16	13	5	3
Ceratopogonidae			2		
Culicidae				10	
Stratiomyidae				3	
Ptychopteridae					1

Total no. of taxa	**18**	**15**	**16**	**18**	**16**
BMWP score	**47 ***	**42 ***	**62 ****	**46 ***	**43 ***
No. of scoring families	**14**	**10**	**14**	**11**	**11**
ASPT	**3.35 ***	**4.20 ****	**4.43 *****	**4.18 ****	**3.91 ****

BMWP scores and implied water quality:

Poor *

Moderate **

Good ***

Very Good ****

ASPT and implied water quality:

Poor *

Moderate **

Good ***

Very Good ****

Exceptional *****

BMWP and ASPT can be combined to give an overall description of the biological water quality of a watercourse using the Lincoln Quality Index (LQI), which is shown in Appendix B. Using this index, the ditches had the following biological water quality:

Site 1 : Moderate Quality (E)

Site 2 : Good Quality (C)

Site 3 : Good Quality (B)

Site 4 : Moderate Quality (D)

Site 5 : Moderate Quality (D)

Previous surveys by the Environment Agency at the Public Drain upstream of the lock at Milton from 1990 to 2003 found slightly higher BMWP scores than in this study, although still implying moderate biological water quality.

Site 1

This site was located at the southern end of the study area, on a well-vegetated ditch running parallel to the River Cam. Both BMWP score and ASPT were very low, indicating poor water quality. The invertebrate community composition reflected the slow-flowing nature of the site and was dominated by snail species. Certain species (for example the snail *Valvata piscinalis* and the damselfly *Coenagrion* sp.) were found at this site but not at any of the other sites sampled, possibly reflecting a closer link with the River Cam.

Site 2

This site was located on a meandering ditch in the southern half of the study area. The ditch was well-vegetated with emergent vegetation and steep banks. As for Site 1, the BMWP score was low indicating poor water quality, however the ASPT was slightly higher (although only indicating moderate water quality). As for Site 1, the community composition was fairly typical of a slow-flowing habitat although this site contained a lower diversity of snails and a higher diversity of beetles taxa.

Site 3

Site 3 was located on a ditch at approximately the mid point of the study area. The ditch crosses the study area in an east-west direction. Both BMWP score (moderate water quality) and ASPT (good water quality) were the highest of all the sites sampled. As for the other sites, the community composition was fairly representative of a slow-flowing lowland system, with most taxa found having a preference for slower flows.

Site 4

This site was located on a ditch which runs parallel to the Cambridge / Ely railway line, at the foot of the embankment. This was the longest ditch, running almost the entire length of the study area and was also sampled at another location (see Site 5 below). Site 4 was located at the northern end of the study area, close to Carr Dyke. The BMWP score was low (indicating poor water quality), while the ASPT was slightly higher (indicating moderate water quality). This site had the highest diversity of beetles of all the sites and particularly noticeable was the large number of beetle larvae of the family Helodidae, which were also found further along the same ditch at Site 5, but at no other sampling location.

Site 5

Site 5 was located further south on the same ditch as Site 4. Both BMWP score (poor water quality) and ASPT (moderate water quality) were similar to Site 4, as was community composition.

4 Assessment of impacts and effects of the scheme

Site 1 may be directly affected by the Canal link from the Alan Burrough Training Lake to the River Cam, which could have an impact on the input of water into this ditch. The ditch at Site 2 will be completely lost under the Competition Lake, as will the western section of the ditch at Site 3. These two sites both had good biological water quality, compared to moderate at the other sites. Site 3 in particular had the highest BMWP and ASPT of all five sites. The existing railway ditch (Site 4 and Site 5) will be retained.

There are potential risks from increased siltation and pollution loading associated with the construction of the lakes and surrounding area. A section of the open channel at Site 3 and the whole of Site 2 will be lost during construction, therefore it is important that habitat diversity and water quality do not deteriorate in the remaining open channel sections.

5 Conclusions and recommended mitigation measures

An assessment of the invertebrate communities at the five sites sampled indicates that the ditches at the proposed Cambridge Sport Lakes site have moderate to good biological water quality, but are probably influenced by organic pollution, such as agricultural run-off, to a certain extent. The assemblages of taxa found at all sites are fairly typical for small, slow-flowing, lowland ditches. All of the taxa found during this survey appear to be generally widespread and common, from information in the identification keys.

The Storage Lake will have a more natural bank profile than the Competition Lake. This lake will be stocked with fish and used for angling, however it is recommended that this lake has some shallow margins and vegetation, if possible, which would provide suitable habitat for invertebrates. Depending on the phasing of work, it may be possible to translocate some vegetation and sediment from the sections of Site 2 and Site 3 which will be lost, into the new Perimeter Drain which will be constructed along the western side of the study area.

A detailed management plan should be in place to ensure that construction-related materials and silt are not discharged into any watercourse and should include measures to deal with accidental pollution incidents.

It is recommended that a monitoring programme following construction is carried out to establish whether there has been any change from the baseline. This should be carried out at the same time of year as this baseline survey.

Appendix A Photographs of Sampling Locations and Habitat Descriptions

Site 1

This site was located on a ditch running parallel to the River Cam at the southern end of the study area, close to the proposed Canal location. The channel was well-vegetated with both emergent and submerged vegetation and steep banks.

Average width : 1.5 – 2.0 m

Average depth : 0.5 m

Substrate composition : 100% silt

Discharge : Slow

Site 2

This site was located on a meandering ditch in the southern half of the study area. The ditch was well-vegetated with emergent vegetation and steep banks.

Average width : 1.0 m

Average depth : 0.6 m

Substrate composition : 100% silt and decaying vegetation

Site 3

This site was located on a ditch at approximately the mid-point of the study area. The ditch crosses the study area in an east-west direction. The ditch was well-vegetated with emergent vegetation.

Average width : 2.5 m

Average depth : 0.5 m

Substrate composition : 100% silt

Discharge: Slow

Site 4

This site was located on a ditch which runs parallel to the Cambridge / Ely railway line, at the foot of the embankment. This ditch runs almost the entire length of the study area. Site 4 was located at the northern end of the study area, close to Carr Dyke and had steep banks and extensive emergent vegetation.

Average width : 1.0 m

Average depth : 0.8 m

Substrate composition : 100 % and decaying vegetation

Discharge : Very slow

Site 5

This site was located further south on the same ditch as Site 4.

Average width : 1.0 m

Average depth : 0.3 m

Substrate composition : 100% silt and decaying vegetation

Discharge : Very slow

Appendix B Biological Monitoring Working Party Score System for Aquatic Invertebrate Families and Lincoln Quality Index

Appendix B: Biological Monitoring Working Party Score System

	Families	Score
Mayflies	Siphlonuridae Heptageniidae Leptophlebiidae Ephemerellidae Potamanthidae Ephemeridae	10
Stoneflies	Taeniopterygidae Leuctridae Capniidae Perlodidae Chloroperlidae	
River bug	Aphelocheiridae	
Caddis	Phryganeidae Molannidae Beraeidae Odontoceridae Leptoceridae Goeridae Lepidostomatidae Brachycentridae Sericostomatidae	
Crayfish	Astacidae	8
Dragonflies	Lestidae Agriidae Gomphidae Cordulegasteridae Aeshnidae Corduliidae Libellulidae	
Caddis	Psychomyidae Philopotamiidae	
Mayflies	Caenidae	7
Stoneflies	Nemouridae	
Caddis	Rhyacophilidae Polycentropidae Limnephilidae	
Snails	Neritdae Viviparidae Ancylidae	6
Caddis	Hydroptilidae	
Mussels	Unionidae	
Shrimps	Corophiidae Gammaridae	
Dragonflies	Platycnemididae Coenagriidae	
Bugs	Mesoveliidae Hydrometridae Gerridae Nepidae Naucoridae Notonectidae Pleidae Corixidae	5
Beetles	Haliplidae Hygrobiidae Dytiscidae Gyrinidae Hydrophilidae Clambidae Helodidae Dryopidae Eliminthidae Chrysomelidae Curculionidae	
Caddis	Hydropsychidae	
Craneflies Blackflies	Tipulidae Simuliidae	
Flatworms	Planariidae Dendrocoelidae	
Mayflies	Baetidae	4
Alderflies	Sialidae	
Leeches	Piscicolidae	
Snails	Valvatidae Hydrobiidae Lymnaeidae Physidae Planorbidae	3
Cockles	Sphaeriidae	
Leeches	Glossiphoniidae Hirudidae Erpobdellidae	
Hog Louse	Asellidae	
Midges	Chironomidae	2
Worms	Oligochaeta (whole class)	1

BMWP and ASPT can be combined to give an overall description of the biological water quality of a watercourse using the Lincoln Quality Index (LQI). An overall quality index is calculated using

(X+Y)/2, where X and Y are taken from one of the following two tables, depending on the habitat sampled.

Standard rating derived from BMWP scores and ASPT: habitat rich riffles

BMWP score	Rating X	ASPT	Rating Y
151+	7	6.0+	7
121-150	6	5.5-5.9	6
91-120	5	5.1-5.4	5
61-90	4	4.6-5.0	4
31-60	3	3.6-4.5	3
15-30	2	2.6-3.5	2
0-14	1	0-2.5	1

Standard rating derived from BMWP scores and ASPT: habitat poor riffles and pools

BMWP score	Rating X	ASPT	Rating Y
121+	7	5.0+	7
101-120	6	4.5-4.9	6
81-100	5	4.1-4.4	5
51-80	4	3.6-4.0	4
25-50	3	3.1-3.5	3
10-24	2	2.1-3.0	2
0-9	1	0-2.0	1

Overall Quality Rating, Lincoln Index Values and interpretation

Overall Quality Rating	Index	Interpretation
6.0+	A++	Excellent Quality
5.5	A+	Excellent Quality
5.0	A	Excellent Quality
4.5	B	Good Quality
4.0	C	Good Quality
3.5	D	Moderate Quality
3.0	E	Moderate Quality
2.5	F	Poor Quality
2.0	G	Poor Quality
1.5	H	Very Poor Quality
1.0	I	Very Poor Quality

Appendix C: Aquatic Invertebrate Sampling Locations

Figures F1 to F3

Annex G: Design and Engineering Method Statement

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 drg no.? 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 drg. No. ? 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 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 drg. no. ?

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.

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 drg no ?.

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.

5 ARCHEOLOGY

5.1 A full evaluation of the archaeology will be carried out. This will have implications for the engineering work:

5.1.1 Rescue archaeology: bulldozers and excavators will be made available by arrangement to strip topsoil and clear overburden to a tolerance of approximately + or – 100 mm, and to excavate pits and trenches.

5.1.2 Mitigation measures: some remains identified during evaluation which will not be destroyed by permanent works may be at risk during construction. These will be protected by marking and/or laying a protective layer of gravel over them.

5.2 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.

5.3 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.

5.4 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.

6 STRUCTURES

6.1 TOWPATH BRIDGE See drg. no. ?

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.

6.2 ANGLIAN WATER OUTFALL PIPES See drg. no. ?

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 AW. 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.

6.3 AWARD DRAIN AQUEDUCT See drg. no. ?

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.

6.4 RAILWAY UNDERPASS See drg. no. ?

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.

6.5 RAILWAY CYCLE UNDERPASS See drg. no. ?

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.

6.6 START BRIDGE See drg. no. ?

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

6.9 FEN ROAD BRIDGE See drg. no. ?

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.

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 AW 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.