MONK LAKES, MARDEN, KENT

Water Resource Management Strategy

1. Introduction

1.1 This document sets out the proposed water resource management strategy for the proposed three new lakes at Monk Lakes, Staplehurst Road, Marden. It closely follows the existing water management measures undertaken at the wider existing site. The issues covered include the construction period and the prevention of pollution, the initial filling of the three lakes, the maintenance of water levels, discharge of excess flow after completion and the general management of the lakes.

1.2 Detailed steps will taken during construction and maintenance to ensure that the Monk Lakes proposals and the management of the existing recreational fishing lakes is undertaken so that additional pollution does not occur from this site.

1.3 The general strategy to avoid pollution or silt entering the River Beult will be the use of Puma and Bridges Lakes as 'reed beds' and settling ponds for the construction and operation periods of the new lakes. Puma and Bridges Lakes are stocked at a lesser density than the others and, with Mallard, also operate as reservoirs as well as settling lagoons for any sediments and surface water run-off arising from the construction. Most run-off from the site, whether from the construction period or during day to day operation, will be directed via Puma, and to a lesser extent, Bridges lake and a temporary settling pond. This ensures there is no water travelling directly from any of the new lakes into the River Beult, again either from day to day management or during construction. All run off will therefore be subject to a period of settling before entering the river. Any topping up of the new lakes will be taken from these existing lakes. This has been practised occasionally in the past for the Match Lakes.

2 Construction Period

2.1 The bulk landform and earth moving will be undertaken in the first instance and subsequently each lake will be landscaped and filled in a phased manner.

2.1 During the period of the earthmoving works, surface run-off from the site will be routed as far as possible into Puma Lake. For areas to the west of the site it may not be feasible to direct run-off to Puma Lake and a temporary settling pond will be located in the area between Lake 3

and the river. This will be located in the north west corner of the site where it will receive and settle water from the western perimeter ditch before allowing it to discharge into the river.

3 Initial Filling of Lakes

3.1 The total volume required to fill all three new lakes is 168,000 m^3. This quantity of water is unlikely to be available in one season but nor will it be necessary.

3.2 The applicant has a full licence for abstractions from the River Beult (licence nr 06.094 dated 16 September 2008, expiring 31 March 2018). This has never been used. The existing seven lakes, including the four elevated Match Lakes, have been operated for a number of years without making use of abstractions. The licence permits the abstraction of 113,750 m^3 per year, 2,275 m^3 per day or 113.5 m^3 per hour, whichever is the most restrictive. There is a proviso that the flow in the river at Teston gauging station must exceed 10 m^3/s for abstraction to be permitted. The Beult is known to suffer from low flows and, although flow data is not available to the applicant, it is considered preferable not to rely on river abstractions to fill the lakes. The water balances presented below therefore do not rely on abstractions although, if and when river flows permit, it would be helpful to make use of abstraction.

3.3 Once the earthmoving is complete, it will take two or three seasons to prepare all three lakes with reeds, platforms etc. A possible scenario is as follows. By pumping 0.2 m from each of Puma, Bridges and Mallard lakes and 0.1 m from each of the four Match lakes some 25,000 m^3 of water is obtained, made up as shown in table 1 on the following page.

Table 1: Water balance for initial filling

Lake	**Surface area (m^2)**	**Volume (m^3)**
Puma	38,000	
Bridges	49,000	
Mallard	16,800	
Total area & volume for 0.2 m depth abstracted for the new lakes.	103,800	20,800
Match lakes		
Total area & volume for 0.1 m depth abstracted for the new lakes.	42,200	4,200
Total volume available for new lakes per abstraction episode		25,000
Lake 1	28,000	
Lake 2	36,000	
Lake 3	20,000	
Total area & volume for 2 m depth in three new lakes.	84,000	168,000
Volume for 0.3 m depth on new lakes		25,200

3.4 Bridges and Puma Lakes are naturally topped up from normal run-off from much of the site area as they lie at lower ground level. Mallard and the specimen Match lakes also receive run-off particularly in the winter seasons when the new lakes would be filled. Recently there has been a run of dry winters and yet there has been no difficulty in maintaining the levels within these existing lakes without recourse to abstractions.

3.5 As can be seen from the table there is enough water available on site to fill lakes 1, 2 and 3 to 0.3 m depth and this covers the base clay layer sufficiently to prevent desiccation and cracking. Assuming the existing lakes recover over the winter period there would be another 25,000 m^3 available to fill lake 1 by a further 0.9 m, making a depth of 1.2 m, enough to proceed with planting etc. Lakes 2 and 3 would follow in similar fashion. If there are periods when the River Beult flow exceeds 10 m^3/s, then this process could be speeded up. For example 10 days of flow above the threshold would allow 23,000 m^3 to be abstracted.

3.6 The total area of the site is some 470,000 m^2 of which about 70,000 m^2 on the western side will drain directly to the river via the perimeter drain. So approximately 400,000 m^2 forms the catchment to Puma, Bridges and Mallard lakes. This excludes any contribution from higher ground to the south of Staplehurst Road. The total surface area of these three lakes (table 1) is 103,800 m^2 so it is not unreasonable to assume that in the region of 400 to 800 mm depth could be abstracted in an average year without adverse effect on the lakes. On this basis, and using the lower figure, it would take four years to fill the new lakes.

4 Maintenance of Water levels during operation

4.1 The lakes will be managed in a manner that reflects natural processes as far as possible. Bridges, Puma and Mallard Lakes will acts as reservoirs for times of drought and can supply other lakes. During the management of the existing facility it has been necessary from time to time to pump water from Bridges or Puma lakes to maintain levels in the Match lakes. This has always worked satisfactorily. The lake water levels throughout the site will be permitted to rise and fall in accordance with the seasons as far as possible. A range of between 1.8m – 2.4m depth is acceptable on the existing match lakes and will be permitted on the proposed lakes 1, 2 and 3, once complete. These ranges will not affect fish stocks and are preferable for natural indigenous flora and aquatic fauna species to adapt to.

4.2 Considering now the post filling period of normal operation, the water balance for the new lakes 1, 2 & 3 must take into account rainfall, evaporation and percolation through the base of the lakes. Basic information used is as follows:

- Average annual rainfall from the Flood Estimation Handbook: 651 mm,
- Average annual evaporation from open water from Meteorological Office map of potential evaporation from UK: 550 mm,
- Run-off factor on land (lake margins): 0.5,
- Run-off factor for lake area: 1.0,
- Permeability of clay lining for lakes 1, 2 & 3: 10^{-9} m/s,
- Hydraulic gradient over the base clay lining equal to 4
- Total catchment of lakes 1, 2, & 3: 135,000 m^2,
- Area of lakes 1, 2, & 3: 84,000 m^2.

4.3 Using the above data the annual water balance for the proposed new lakes is as shown in Table 2.

Table 2: Annual water balance for lakes 1, 2, & 3

Description	Depth of water gain (loss) (mm)
Direct rainfall	651
Indirect rainfall (135,000-84,000)x0.5x651/84,000	198
Evaporation	(550)
Percolation	(126)
Net gain	173

4.4 From Table 1 above it can be seen that in an average year the water levels in the proposed new lakes are self sustaining.

5 Excess Flow after Completion

5.1 Since the initial drafting the flood risk assessment it has been decided to route excess flow from the proposed lakes 1, 2 and 3 into Puma Lake. The quantity of water so discharged will be extremely small and is not likely to contain any pollutants and negligible amounts of suspended matter. Such nutrients or sediments that are present will easily be absorbed or consumed in the reed beds of Puma Lake. In the unlikely event that one of the lakes becomes polluted, it can easily be isolated while measures are taken to remedy the situation. The low level pipework will be arranged so that this can be done.

5.2 Excess flow from Bridges and Puma travels via monks (overflows) into the River Beult. The functions of the monks are to release excess water from the top level of the lakes.

6 Dredging or Draining

6.1 As a consequence of the clean sources of water supplying the lakes (ie rainfall and pumping from other lakes) the rate of sediment accumulation will be extremely slow and removal will be necessary only at 25 year or longer intervals. In addition, other management tools are used to reduce organic matter settlement, for example lime or modern product alternatives.

6.2 The method to be adopted for desilting the lakes will depend on the best technology available at the time but it would be the intention to consult the Environment Agency in planning the operation. The quantities of silt arising will be very small and would be disposed of on the flat outer slopes where it will be beneficial to the growth of ground cover. Great care would be

taken to allow the arisings to drain before placing on the slopes to minimise the risk of material being washed into the surface drainage system.

7 Foul and Surface Water Drainage

7.1 The present water demand from the public supply is about 1000 m^3 per year and virtually all this flow will pass through the Klargester system which discharges into Puma Lake. Puma Lake has extensive reed beds between the fishing pitches and around the islands and this will easily cope with this amount of discharge.

7.2 It is not anticipated that the public supply would greatly exceed that used at present. The proposed Klargester system will be located on land above the floodplain and if necessary foul water will be pumped. Alternatively the proposed Klargester will be submergence proof. Water from the Klargester would discharge into Puma Lake, which will again act as a reed bed.

7.3 Surface water from the site will flow into Bridges and Puma Lakes, some via the lily pond adjoining the car park. The existing car park is surfaced in a permeable material and surface water percolates into Puma Lake. The proposed car park will also be surfaced in permeable material.

8. Other Issues

Fish Stocks

8.1 The fish stocks are standard indigenous course fish species: tench, carp (in various forms excluding grass carp or any exotics), barbel, bream, roach, perch, pike, rudd etc. The site is protected by an approved fish fence to prevent fish from escaping into the river. This lies along the whole length of the Monk Lakes site (including the application site) where it abuts the River Beult.

8.2 The fish fence will be extended around the north west corner of Lake 3 to ground elevation 16.30 mAOD which is the limit of the flood plain as defined by the Environment Agency.

Otters

8.3 At present, otters are not a problem at Monk Lakes. A contingency for the erection of otter fencing is in place, but will not be implemented until there is a demonstrable problem with otters.