If groundwater levels are shallow then seasonal monitoring should be undertaken as groundwater levels will be critical in the assessment of potential floatation of the below ground pool tanks. The Geotechnical Investigation must also provide a detailed assessment of the likely differential settlement in the pool tank areas given the loading from the pool tanks (see below).

Differential settlements and movement

Different parts of the structure will be more or less tolerant to settlement and movement of the structure. This should be assessed by traditional design methods taking in to account the finishes to the building. The swimming pool tanks will need to be considered separately. With 'level deck' construction the effects of any differential settlement around the pool tank are very visible. This is particularly true of a 50 m long pool tank. The design should allow for the effects of settlement when the pool tanks are emptied and filled, e.g. taking into account the typically brittle nature of the finishes to the pool tank and the surrounds.

If there is a requirement to cast the base of the pool tank on insulation, the structural designer must assure himself that the long term compressibility of the insulation, possibly in wet chlorine contaminated environment, would not result in differential settlement that could alter the flow paths into a level deck channel.

Tolerances in construction

Normal building tolerances will apply to the building generally (except where special finishes might be required), but special tolerances will apply to the main pool tank. If a 50 m pool tank is to be constructed as a competition pool rather than as a community pool, more stringent tolerances would apply to the length of the tank and the flatness and verticality of the end walls. The level of competition should therefore be agreed with the client.

If movable floors and booms are to be included in the design of the pool, the tolerances of the whole tank should be discussed with the floor and boom supplier to confirm that the required accuracy can be achieved both in terms of the fit of the components within the tank and in relation to any competition requirements.

Once the level of tolerance is determined, it is important for the design team to determine how this tolerance will be achieved. The final accuracy can be obtained using rendered finishes and the tiling but, to determine the size of the pool tank structure, it is necessary to establish whether all the pool tank walls will be rendered.

Structural Engineering considerations

Foundations

The construction of foundations should allow for routing of underground services especially filtration and drainage pipework.

The foundation solution needs to take into account the settlement requirements for the building frame and the additional more onerous requirements for a level deck channel around the 50 m pool. The foundation solutions for the two parts of the building may well be different based on the settlement characteristics of the substrate at formation level. For example, the frame of the building might be built on pad foundations but the pool tank may be piled to counter differing local ground bearing pressures over the area and depth of a 50 m pool.

If the pool tank is piled then the structural solution must take into account the differing loads on the piles by adjusting the pile centres to ensure that the loads on all piles are similar. Alternatively, the pile designer should ensure that the settlement of piles with different loads is similar. Safety factors on pile loads should be agreed with the specialist subcontractor.

Consideration will also need to be given to the depth of excavation required for the pool tanks and the construction of the adjacent foundations. Deep tanks with diving facilities or retractable deep boom slots can be difficult to construct, especially on confined sites. To avoid large battered excavations, consideration should be given to sheet piling or contiguous piles to secure the excavation.

Deep swimming pool tanks should also be reviewed for floatation against groundwater level information provided by the Geotechnical specialist.

Filtration plant room

For the affordable model, a basement filtration plant room is assumed designed to allow filter and other plant replacement. Structurally, the basement would be built in in-situ concrete with pumped drainage. Externally, basement tanking details need to be carefully considered to ensure long term serviceability of the plant room space.

If the available site layout allows, locating the filtration plant room at ground floor level may, in certain circumstances, prove more economic and allow easier maintenance and replacement of the large and heavy filters. In this case, a recessed pump pit is normally provided in the floor, typically 1.2 m deep (therefore below pool water level), to ensure flooded suction is achieved in the filtration pumps. In either case, lifting beams would be provided for easy access.

A separate chemical store should be provided with a sealed floor and bund to prevent spillage and a sump so that any spillage can be removed.

Traditional plant rooms

Mechanical plant rooms should be located to suit the air distribution in the building. Ideally, the Building Services Engineer should consider locating smaller plant rooms around the building so that the size of air distribution ductwork does not become overly large, with long runs from the plant room to the point of delivery. If this were the case, then air handling ductwork can dictate the depth of ceiling voids and therefore floor to floor heights. Large ducts can also be very disruptive to the structural zones in floors and at roof level.

Electrical plant rooms

It is important to understand at the very early stages where the electrical switch rooms are likely to be and especially whether a substation will be incorporated into the building envelope.

Design of swimming pool, pool surrounds and balance tanks

General arrangement of swimming pool tanks

The design of commercial tanks both 25 m and 50 m is usually undertaken in shuttered water retaining reinforced concrete. This is done for both robustness of construction and durability. Sprayed concrete can be used successfully to create tanks that comply with crack width requirements and is very useful if there are any ‘free form’ walls in the development. However, for a rectangular 50 m tank, very careful planning and the early engagement of specialists is essential if this type of construction is to be successful.

A well designed and detailed tank of this nature would be expected to give a minimum life of 60 years.

Other options are available, in particular the use of stainless steel tanks designed by a specialist to similar criteria as the concrete option, although life spans may be significantly shorter.

The general arrangement drawings need to take into consideration the main elements that will be incorporated into the design. For example:-

- Filtration associated works: early liaison with a pool filtration specialist is essential to determine the location and size of balance tanks, the rate of backwash discharge, the set out of the flow return sumps in the base of the tank, the size and shape of the level deck channel for the return water to the filters and the route of the delivery pipework from the filtration plant room to the pool tank.
- The arrangements for access to the pool so that the location of steps, platform lifts, etc. can be incorporated into the pool tank design.
- The location and detail of the proposed access ladders into the tank. In addition whether the tank will have a ‘rest ledge’, this is usually 1200 mm below water level.
- Details of any movable floor and boom need to be understood at the very early stages of design development as the depth of movable floor will dictate the overall depth of the pool tank (or part thereof) and the type of boom (often installed in a 50 m pool to increase the use and flexibility of the water space). The booms can be a floating boom ‘docked’ at the end of the tank in which case the length of the pool will need to be 50 m, plus the boom width.

  Alternatively, the boom could sit in a trench below the floor of the main pool tank. The type of movable floor construction is also important in order to establish the location of any cables or rams through pool tank walls or otherwise.
- The use of the pool and level of any competition requirement will need to be established at the early stages of design to enable the plan tolerances of the construction to be confirmed. This might also dictate whether a permanent upstand for starting blocks is required for each racing lane. If so, this is usually constructed from reinforced concrete.
- The location and installation requirements for lane ropes (and their storage) and timing pads is required.

- The falls to the pool surround slabs needs to be carefully considered as it is good practice to provide a separate 'foul' drainage channel in the pool surround slab to cater for wash down water (BS EN 15288: Part 1:2008). It is not normally accepted that 'dirty' wash down water can be returned to the level deck channel and through the filtration system. The drainage pipework required to take the flow from this drainage channel would normally be suspended from the underside of the pool surround slab as, due to its length, falls are likely to be very shallow. Manholes in pool surround slabs should be avoided wherever possible as they look unsightly, create maintenance issues and interfere with the pool surround falls and tiling layouts.
- Other requirements that could affect the concrete structure of the tank include temporary starting blocks, underwater speakers, underwater lighting, underwater cameras, pool covers, etc.

The design of swimming pool tanks

The design of the water retaining elements should include the pool tanks, the balance tank(s), the pool surround slab and a 150 mm (min) upstand that encloses all the wet areas to provide full containment. Other areas such as wet changing areas, showers, etc. should be similarly bunded and tanked to the Architects details.

The design of the water retaining elements must take into account conventional loadings applied to the structural elements and construction loads. For a swimming pool tank it is normally considered that the worst load case would be when the tank is empty, the area below the pool surround (outside the tank) is backfilled and a construction surcharge load is applied. In addition to the conventional loadings, these elements must also to be designed as water retaining to BS EN 1992-3, using a maximum crack width of 0.2 mm[3].

Pool surround slabs should be designed as water retaining suspended slabs, as it is considered that backfill below the slab would not provide a settlement free support.

In recent times it has become more prevalent to use the services of a specialist to design concrete mixes with additives that assist the water retaining properties of the concrete. Whilst this is not strictly necessary, and well-designed traditional concrete will suffice, it can give comfort to main contractors who consider that the pool tank and testing of the tank is critical to the construction programme. In this circumstance, they may be prepared to pay the premium that such a service attracts.

Detailing of the reinforcement in concrete tanks must also be given careful consideration particularly at corners where larger moments can be generated in deep tanks. In general, a well detailed tank with appropriate cover to the reinforcement would require no additional protection such as using galvanised reinforcement.

Joints in the pool tank and pool surrounds and casting the pool tank

The pool tanks and surrounds should be cast in reinforced in-situ concrete without joints other than construction joints.

The proposed areas of floor and wall to be poured should be discussed with the main contractor, his subcontractor and the designer to ensure that the size of pour is feasible and that the size and aspect ratios of the pours would inhibit shrinkage cracking. The sequence of pour should be agreed. All construction joints must include a water bar (hydrophilic is preferred) placed strictly in accordance with the manufacturer's instructions.

Mix designs for water retaining concrete should be a designed C32/40, with w/c ratio and cement content generally in accordance with the requirements of grade C35A specified in BS8007:1987.

Pool tank testing

Testing the pool tank is critically important and an approved method of testing is set out in BS8007:1987. This method of testing should be followed precisely and the consequences of the failure of this test on the construction programme must be discussed with the main contractor. This may influence decisions made about the choice of subcontractor and the proposed method of working.

[3] Although lower limits are considered more appropriate for brittle finishes in swimming pools.

Structural framing of the pool building and associated facilities

The most common form of construction for this type of building is a braced steel frame using composite construction where appropriate (see below). The steel frame should be traditionally designed to carry the dead and imposed loads. The frame should also be designed to suit any deflection requirements that might be given by special finishes, e.g. glazing.

In pool halls and wet areas the steelwork should be detailed to ensure that there are no hidden crevices or dead areas where a build-up of chlorine rich residue can accelerate the onset of corrosion.

Anti-corrosive protection

All columns in wet areas (including changing rooms / villages) and filtration (wet) plant rooms must have concrete encasement to a minimum height of 150 mm above the finished floor level. The paint build up that provides the protection of the steelwork (not the decorative finish) must extend a minimum 300 mm below finished floor level. Concrete encasement must have a sloping surface away from the steelwork and the joint between the concrete and steelwork formed by shrinkage must be sealed with a suitable chlorine tolerant flexible sealant.

Paint protection to give life to first maintenance of 25 years should be in line with the recommendations of the Corus paint protection guide system number C4/S2 or S3.

Galvanised issues: galvanising can readily be used in a pool atmosphere but similar to stainless steel it is prone to staining if not cleaned. Detailing of the galvanised steel is important in wet areas as loss of galvanising can occur where metals with different electro-potentials touch.

Stainless steel in swimming pools

In general stainless steel should not be used for any structural application in swimming pools and associated wet areas without very careful consideration of the grade used and the detailing of the proposed sections. Stainless Steel is susceptible to stress corrosion cracking in warm chlorine laden atmospheres. This can cause rapid strength loss and sudden failure in members. In this respect the user is recommended to consult 'Stainless Steel in Swimming Pools' issued by the Nickel Development Institute and other associated bodies (NiDI publication no. 12 010). It should also be noted that stainless steel exposed to a chlorine environment will stain with rust quickly if not cleaned on a daily basis. (Note that stainless steel is often used in structural situations where the Structural Engineer would not normally be consulted, e.g. suspension rods for mechanical services, ceiling suspension systems, glazing brackets, wall ties / restraints, etc. and similar considerations will apply.)

Suspended floor construction

With steel framed buildings it is now common to use composite decking to form suspended concrete floors. The decking should be designed to meet the loading requirements specified but where the suspended slab spans over wet areas or filtration plant rooms the composite deck must be used as a sacrificial shutter and the concrete slab designed to act as a stand-alone slab in the event that the composite decking suffers corrosion in the longer term. In all cases the top flange of the steelwork must be painted.

Where composite decking is used as a sacrificial shutter, the designer may wish to take advantage of composite action for the design main floor steelwork support beams. In this case, studs should be pre-welded to the top flange of the floor beam and paint protected prior to the placement of the metal deck.

Roof construction

In non-wet areas the choice of roof construction and build up is traditional. In the pool hall and other wet areas the choice of roof build up will be by the Architect, but perforated aluminium is often chosen as the inner sheet to meet the requirements of durability and sound. For durability, the roof sheet is supported by hot rolled purlins that are painted with the same specification as the rest of the pool hall environment hot rolled steelwork (toes pointing down the roof slope if PFC's are used). The arrangement of the main roof beams and the grid arrangement will need to be considered to accommodate air handling distribution ductwork and the pool hall lighting.

Galvanised steel structural deck is not recommended for a pool hall environment unless additional paint protection is provided to both sides of the sheet.

Below ground drainage

Detailed discussions will be required with the local Water Authority, the Environment Agency (or SEPA), local drainage boards and Building Control to establish the constraints for the drainage design.

Surface water drainage

The main issues with the surface water drainage design will be common with those for any large building, that is, the volume of flow associated with:

- Car park drainage with interceptors
- Implementing SUDs
- Roof drainage.

Some of this can be offset by using rainwater harvesting to service non-critical elements such as toilets and urinals, although this can sometimes be of insufficient reliability and expensive to incorporate.

If soakaways are used to dissipate surface water flows consideration must be given to future groundwater levels and how this might affect the potential for floatation of the underground tanks.

Foul drainage

With regard to the foul drainage, the most common problem to be overcome is the rate of discharge from the filtration backwash. This needs to be established at an early stage in the design.

The rate of backwash is such that it is common to provide on-site storage with a holding tank. The back wash flows are then discharged back into the foul drainage network at an agreed flow rate.

Backwash discharge usually requires a Trade Effluent Discharge license. This would normally be discussed with the drainage Water Authority at design stage but the license would be applied for by the main contractor just prior to completion of the development.

Design standards and design loads

As with any other building, the designer should consider all relevant Eurocodes, National Annexes, British Standards and good practice guides in the design of swimming pool buildings.

Of particular importance are the following Euro Codes that are intended to replace BS8007:1987.

BS EN 1992-3:2006 Eurocode 2. Design of concrete structures. Liquid retaining and containing structures.

NA to BS EN 1992-3:2006 (National Annex).

Appendix 7: Building Services

This summary contains information on the building services systems that have been selected for the indicative affordable design. The Appendix provides further details on these systems and alternatives. Please refer to Appendix 8 and associated summary for information on energy efficiency measures and renewable technologies incorporated as part of compliance with Part L2A of the Building Regulations.

Key affordable assumptions
(within the indicative design and costings)

Pool halls (main and secondary)

HVAC

- Heating via a dedicated ventilation system
- Mixing air circulation for pool (ductwork at high level designed for modulation)
- Dehumidification via fresh air
- Plate heat exchanger.

Lighting

- Corrosion resistant IP65+
- Metal Halide floodlights
- Up and down lighting.

Changing rooms

HVAC

- Heating via a dedicated ventilation system
- Plate heat exchanger
- Openable high level windows for natural ventilation in summer where possible.

Lighting

- Corrosion resistant IP65+
- LED * bulkhead fittings or high efficiency fluorescent fittings.

Fitness suite and studios

HVAC

- Heating and cooling provided via dedicated ventilation system
- Comfort cooling provided by chilled waer or VRF system.

Lighting

- Recessed modular LED or high efficiency fluorescent fittings.

Sports hall

HVAC

- Gas fired radiant heating (LTHW radiant panels should be considered if a suitable low / zero carbon heat source is incorporated)
- Natural ventilation via louvred vents at low level and exhaust stacks in roof (with insulated modulation dampers).

Lighting

- High efficiency fluorescent impact resistant fittings.

Café, offices, staff room and circulation

HVAC

- LTHW radiators
- Natural ventilation via manual openable windows where possible, mechanical ventilation for internal spaces.

Lighting

- LED recessed downlighters or high efficiency fluorescent fittings.

General

This section builds on previous Sport England guidance and highlights the most crucial aspects of building services for sports centre with a 50 m pool. The assumptions set out in Sport England's *Affordable Community Swimming Pools (ACSP), Affordable Sports Centres (ASC)*, and Swimming Pools guidance documents will generally apply.

As with the Energy and Sustainability section of this review, the Building Services section also has a strong emphasis on energy saving options. Where requirements differ across the three design options, respective indicative values have been provided, For main plant area locations, see the indicative layouts in Appendix 3.

Access and maintenance

Early consideration should be given to the way the building is maintained and CDM issues specific to each scheme must be recorded on a risk register. Examples of key aspects concerning access for maintenance and replacement within a sports centre development incorporating a 50 m pool include:

- Large items of plant in ground floor or basement plant rooms e.g. filters, pumps, boilers etc
- Roof top plant e.g. fans, motors, filters, chillers and air handling units (AHUs)
- Plant spaces serving movable floors and booms, if required, depending on type proposed
- Light fittings suspended at high level in the pool hall (minimising, or ideally avoiding, location directly over the pool tanks) and sports hall
- Soffit suspended items e.g. water polo curtains.

Generally, servicing routes between plant rooms and serviced spaces need to be sized and designed by specialist consultants to ensure ease of installation and maintenance.

A services undercroft is often incorporated in pool projects to make accessible the servicing routes for pool treatment pipework and drainage, and provide ductwork routes to enable displacement ventilation.

For the affordable 50 m pool options, such undercrofts have not been included in the interests of space efficiency and cost. Safe access requirements are, however, achieved on the following basis:

- Water treatment plant in the basement incorporating a well for plant replacement
- Mechanical and electrical central plant and incoming services easily accessible on the ground floor
- Air handling and heat rejection plant on the roof accessible via the lift or via demountable louvres and a crane for larger items.

Plant location strategy

The affordable schemes are based on a traditional plant room approach with water treatment, boilers and wet services in an internal plant room at ground and basement levels, with only air handling plant located on the roof.

Packaged rooftop plant rooms are an alternative option to an internal boiler room, and could be applicable to a 50 m pool scheme on the basis that there is a large flat roof area available. Benefits would include:

- Reductions in internal area
- Quicker installation
- Sequencing improvements for Contractors.

However, the following issues need to be considered:

- Potential additional capital cost
- Need for earlier procurement of M&E and BMS elements in the programme
- Visual impact
- Associated cranage requirements (heavy items to manoeuvre).

Packaged rooftop plant rooms are not appropriate for water treatment plant as the pumps ideally need to be located below the pool level to operate under flooded suction and the filtration plant is too large and heavy. While construction of basement plant rooms is more costly than ground floor construction, location of filtration plant in the basement, in conjunction with roof top plant, minimises the overall building footprint.

The type of movable floor and boom proposed in Option 1 does not require a separate plant room, but alternative types may need a dedicated plant room.

Statutory supplies and services provision

Statutory authority and existing utility services information needs to be obtained for each site. Any existing services within the building footprint will need to be removed or diverted, and new supplies arranged in liaison with the utilities companies.

Indicative supply requirements to enable preliminary cost estimates are set out below. Note, however, that project specific calculations must be undertaken by an M&E consultant as part of the design process.

Electrical supplies

A suitable incoming three phase electricity supply will be required for the development. Outline estimates of supply size:

Option 1	300 kVA
Option 2	335 kVA
Option 3	350 kVA

Gas supplies

A suitable incoming natural gas service will be required for the development. Outline estimates of supply size:

Option 1	2400 kW
Option 2	2750 kW
Option 3	2750 kW

Water services

A suitable incoming water service will be required for the development. Outline estimates of supply size:

Option 1	10 l/s
Option 2	11 l/s
Option 3	11 l/s

This estimate is on the basis of no cold water storage provision. Requirements for resilience are to be discussed with the commissioning body.

Telecommunications

The design team should ascertain the requirements for telephone lines, internet connection and cable TV requirements with the commissioning body in order to allow suitable duct provision.

Design criteria

Any specific requirements in relation to design criteria should be discussed between the commissioning body and the design team.

External design criteria

CIBSE Guide A should be followed for the following external design criteria (dry bulb and wet bulb temperatures) appropriate to the location of the development:

- Winter:
  - For calculating heating loads
  - For sizing of protective devices (such as trace heating and frost coils)
- Summer:
  - For calculating cooling loads
  - For sizing heat rejection plant

If the development is significantly above sea level then an adjustment needs to be made to winter design criteria.

Internal design criteria

Design criteria specific to the pool hall and wet changing areas are set out below, Also see the CIBSE A guide for guidance on support spaces (offices, café, etc.). For the sports hall, health & fitness and associated support accommodation, refer to Sport England's *Affordable Sports Halls* (ASH) and *Affordable Sports Centres* (ASC) documents.

Pool water

Pool water temperature needs to be set and varied according to the prevalent type of use. Energy consumption increases with pool water temperature, so the temperature should be minimised with a balanced view on user satisfaction and comfort.

Changing the pool temperature takes a significant amount of time and energy. The heat load for the pool is generally sized on the basis of raising the pool water temperature by 0.5°C / hour, although the requirements for different temperatures and the programme for use should be discussed between the commissioning body and design team.

Provision of different temperatures either side of a boom can be deemed to be beneficial to the flexibility of use in a 50 m pool. This is particularly pertinent if the learner provision is within the main pool. However it is not a well established approach, and if under consideration the following issues should be addressed:

- A separate full water treatment systems would be required for each side of the boom
- This technique is not often implemented, so there is limited experience within the industry
- The thermal performance and associated losses across the boom should be considered.

Below is an excerpt from the Pool Water Treatment Advisory Group guidance for recommended maximum pool temperatures for different types of use appropriate to the 'Affordable' scheme:

Competitive swimming and diving, fitness swimming, training	28°C
Recreational, adult teaching, conventional main pools	29°C
Leisure pools	30°C
Children's teaching	31°C
Babies, young children, special needs	32°C

Refer to Sport England's Swimming Pools Design Guidance Note Appendix 2 - Servicing the Building page 6 for further recommendations.

Pool covers

Pool covers are noted as a priced extra as they can provide further operational savings and credits within a BREEAM assessment. A detailed study would need to be made in conjunction with the pool operator to assess their value in relation to the proposed hours of use and associated controls available to set back the environmental conditions within the pool hall. The use of the cover must be embedded into the management regime in order to realise the benefits.

Pool hall

The pool hall temperature should be controlled to be up to 1°C higher than the pool water temperature. This will provide a good balance of evaporation and heat loss from the pool. When the air temperature exceeds the pool temperature, there should be no sensible heat loss from the pool to the hall. However, the higher the air temperature, the more moisture it can hold and therefore the higher the rate of evaporation (latent heat transfer) from the pool.

The relative humidity should be controlled between the range of 50-70%. Above 70% there are higher risks of discomfort and condensation, and below 50% evaporation rates and associated energy consumption will increase.

Changing areas

Changing areas are normally maintained at a temperature roughly half way between that of the pool hall and the entrance area to provide a comfortable transition.

Ventilation

The design of the ventilation system serving the pool hall is required to:

- Control air temperature and relative humidity
- Control air quality; chemicals, contaminants and smells
- Control condensation
- Minimise draughts which could be uncomfortable.

The ventilation system should be sized on the larger of; 10 l/s/m^2 of wetted area (pool and surround) or 15 l/s/m^2 of pool area.

The volume of fresh air is generally varied to control the humidity levels, however in order to maintain suitable air quality it should not be reduced to less than 30%.

System specification

Specification of the ventilation system components must be appropriate for the high humidity, temperature and contaminant levels within the air. This should include as a minimum:

- All elements to be epoxy paint coated internally and externally
- Melinex lined acoustic attenuators
- Fans fitted with drain plugs
- Coils with pre-painted fins
- All fasteners, bolts and nuts are stainless steel or specially protected
- Damper motors IP 66
- Powder coating the above elements is an alternative to epoxy paint.

Air circulation options

There are two main air distribution options, each with their different merits:

Displacement ventilation
Introducing air at low level within the space at low velocity and exhausting air at high level, displacement ventilation works by using the benefit of the natural effect of stratification.

Advantages:

- Facilitates simpler variability of air volume, to match load and save energy
- Provides fresh air direct to occupants
- Encourages vertical air movement, removing pollutants from the occupied zone
- Low velocity system reduces fan power.

Disadvantages:

- Requires ductwork routes at low level beneath pool surround (more expensive)
- More complex details for grilles at low level.

Mixing ventilation

A mixing system is based on supply and exhaust ductwork at high level with air introduced at higher velocities (often via nozzles and mixed within the space). Fabric ductwork can provide a lower cost and lower maintenance solution.

Advantages:

- All ductwork at high level, provides simpler services routes

Disadvantages:

- More complex ductwork configuration to achieve a system that can modulate ventilation rates whilst maintaining required throw from grilles
- Mixing the air reduces the ability to remove pollutants at source

Heat recovery options

A significant portion of the energy load of a swimming pool is used to heat the pool hall air supply. In order to control air quality and humidity large amounts of heated moist air are exhausted and fresh air introduced. Considerable scope therefore exists for the use of heat recovery in the ventilation systems, options are outlined below.

Plate heat exchanger

A plate heat exchanger utilises a series of parallel plates through which the supply and exhaust air is channelled, providing hygienic separation between the supply and exhaust air paths and achieving efficiencies up to 75%.

Run-around coil heat exchanger

A run-around system consists of heating coils within the supply and exhaust ducts, linked via a pumped heat transfer fluid. They do not require the ductwork to be adjacent which improves flexibility, but have reduced efficiency at 50-60%.

Heat pump heat recovery

Air handling units (AHU) are available with integrated heat pumps, which use electricity to extract more heat from the exhaust air. These systems can also be utilised to replace conventional heat recovery where available space is constrained.

Thermal wheels are not appropriate for a pool hall ventilation system, due to carry-over of moisture, chemicals and contaminants. However, they are appropriate for other mechanically ventilated spaces.

Dehumification options

Fresh air

The volumes of fresh air required in order to manage air quality are often sufficient to manage the control of humidity in the space. This method is preferable. However, the following active dehumification methods are available; they should be implemented in conjunction with 'free dehumification' from the fresh air.

Desiccant dehumification

A desiccant wheel within an AHU provides dehumification of the supply air if required by the high internal and external humidity levels. It incurs comparatively small electrical load in rotating the wheel and utilises heat to recharge the dessicant. This technology can work well in conjunction with a CHP system due to the year-round availability of high-grade heat.

Heat pump dehumification

Dehumification can be achieved by utilising a heat pump to reduce supply air temperature (and remove the moisture) and rejecting this heat into the exhaust. This can utilise the same heat pump arrangement used for heat recovery in winter, operated in reverse.

Natural ventilation

Myth: Natural ventilation is not appropriate for pools.

Fact: The use of natural ventilation to complement a mechanical system should be considered in all pools. Natural ventilation can provide the following benefits at warmer times of year:

- Fresh air can be directly introduced from outside to reduce fan power
- Cooler and dryer external air can provide improve comfort to clothed staff
- Open windows can provide a pleasant environment.

Natural ventilation openings and controls need to be carefully designed in order to minimise the risk of draughts for bathers and to integrate with the mechanical ventilation controls or the centre management regime (if manually openable.)

Natural ventilation is applicable to all other occupied spaces subject to acoustic constraints; sports hall, fitness suite, activity studios, offices and café.

Changing rooms

Changing rooms are often designed to be part of the main pool air volume and therefore conditioned to a similar temperature. This can lead to an uncomfortably hot and humid environment.

The affordable indicative design part separates the pool hall from the changing village from the main pool hall. An additional ventilation system would serve the changing area with a blend of air from the pool hall (to make use of the heat) with fresh air to improve comfort. The two ventilation systems could operate independently if the changing area is screened from the pool hall for security reasons.

Heating

Swimming pool halls and wet-side facilities are unusual in that they require heating year-round.

Heat recovery options

A significant portion of the energy load of a swimming pool is used to heat the pool water. This is to make up for latent heat loss via evaporation and addition of water to make-up for backwashing filters and dilution. Domestic hot water consumption is also high to support both wet and dry side changing facilities. Considerable scope therefore exists for the use of heat recovery in the pool systems.

Heat rejection from chiller

Where a fitness suite is incorporated into the development, comfort cooling will often be required. The heat rejected from this cooling system can be injected into the pool by utilising a water cooled chiller or WRF (water refrigerant flow) system.

Heat rejection from pool water

Guidance denotes that 30 litres of pool water should be replaced per bather to control Total Dissolved Solids (TDS). This water can be passed through a heat exchanger and used to pre-heat the make-up water.

The use of heat recovery from backwash water is not recommended. Backwash water generally contains large quantities of contaminants which can lead to biofilm build up in pipework, and blockages in pumps and heat exchangers.

Heating methods

Warm air heating

Warm air heating is a good method to heat the pool hall and changing rooms, as the ventilation system is already required to control the conditions of the space.

Underfloor heating

Myth: Underfloor heating is always the best solution for a pool surround and changing area.

Fact: Changing rooms in a modern building will have relatively small heat losses with respect to their gains. If they are ventilated as part of the pool hall, air temperatures will be 27-28^{0}C. An underfloor heating system usually operates controlled on air temperature with a maximum floor temperature of ~27^{0}C. So the call for heat, and the ability for the floor to transfer heat into the space is minimal and the system can in reality rarely be used.

If the changing space is separate from the pool hall and lower space temperatures (25^{o}C) are acceptable, then underfloor heating could be used to dry the floor and provide some additional comfort. Although the significant investment needs to be balanced against the level of benefit.

Domestic services

Domestic cold water storage is not included within the affordable scheme plant room space allocation. However the design team should consult with the commissioning body over the level of resilience required in the scheme.

The carbon emissions associated with domestic hot water generation can be reduced by incorporating a solar thermal system (please refer to Appendix 8) or by utilising heat recovery from pool water or cooling to other spaces.

Lighting

Also see CIBSE lighting Guide 4: Sports Lighting (2006) and Sport England's Artificial Sports Lighting Design Guidance Note.

General

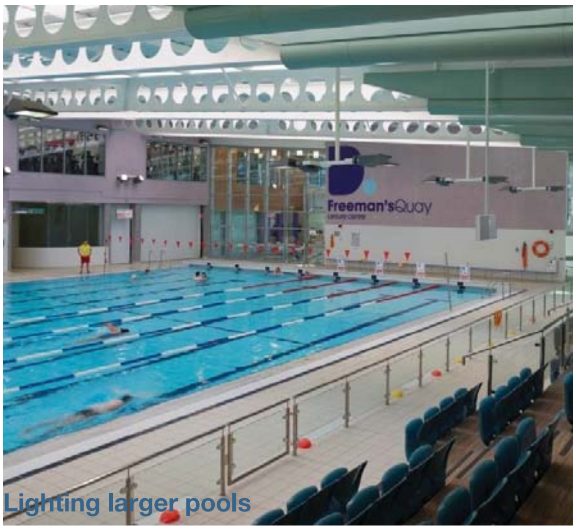
The luminaires to be low wattage high efficient light sources taking into consideration colour rendering, lamp life and energy efficiency. All luminaires to be selected to suitable for aggressive environments as well as IP55 rated as a minimum.

LED fittings can provide benefits in relation to reduced energy consumption and longer lamp life. They will incur a larger capital costs; however, will provide better value over the lifetime of the building and generally pay back in less than 10 years.

Managing reflections and glare

The lighting design of a pool is a complex challenge; it will require a compromise between the follow interconnected considerations:

- The design should aim to direct light into the pool tank in order to provide a clear view of bathers to lifeguarding staff
- Angles of attack of fittings should aim to be >50° from horizontal; this will minimise the direct glare from fittings to bathers and reflections off the water obscuring the view for lifeguards and spectators
- Turbulent water changes the angle of the surface in relation to the fittings and viewer, and therefore in some instances a higher threshold than 50° should be considered
- Light fittings should ideally be located above the pool surrounds and not above the pool tank for ease of maintenance
- Indirect and diffuse light sources can reduce transmission of light into the pool tank and produce reflections
- Underwater lighting can help reduce the risk of reflective glare, the additional cost must be balanced against their benefit (it is not part of the affordable scheme).



Lighting larger pools

In larger swimming pools, achieving the 50° rule without locating fittings over the pool can be a challenge, so the following alternative solutions can be assessed by the team in relation to the specific drivers for the project, the pool uses and the maintenance strategy:

- Movable floor(s) included to provide a solid base for an access platform
- Access to fittings provided by a roof gantry
- Access to fittings provided by a pulley system

Acoustics

Advice should be sought from an acoustic consultant regarding the performance of a pool hall, for the comfort of all swimmers, coaches, lifeguards and spectators, the ability to hear audible fire alarms, public address and evacuation calls, and for speech intelligibility during lessons and coaching. This is particularly important in the larger hall volume associated with the 50 m pool.

Pool and sports halls which are to be used by local schools for teaching, are to comply with the requirements of Building Bulletin 93.

Internal NR ratings

External noise should be assessed via an acoustic survey and appropriate criteria set to control noise from mechanical plant. These should be agreed with the Local Authority.

The internal noise criteria and background noise levels generated by building services and external noise ingress for various areas is to be in accordance with the CIBSE recommendations:

- Swimming pool: NR 40-50
- Changing areas: NR 35-45
- Office areas: NR 35
- Health and fitness: NR40.
- Sports hall: NR40

Reverberation times

The pool hall construction and finishes should provide control of the reverberation time (RT) to between 1.5 and 2.0 seconds at 500 Hz. Particular consideration should be given to reverberation times at lower frequencies, if the use of music or PA systems is a key part of the functionality.

Privacy and noise insulation

Consideration should be given to privacy and noise insulation between the following spaces:

- Group changing, for competing teams
- First aid / physiotherapy room
- Male / female WCs
- Offices.

Electrical services

General power

The use of rechargeable equipment to clean poolside and changing areas should be considered to avoid the need for 110 volt distribution and outlets throughout wet areas. Suitable charging points would be required in cleaning and pool stores.

Public address

The public address (PA) system should be audible in all areas of the development. The PA system is required for a number of purposes:

- As an essential part of the emergency procedures
- To communicate with spectators to relay entertainment
- To convey messages from sponsors and advetisrs.

Refer to relevant sections of 'Guide to Safety at Sports Grounds,' Department for Culture, Media and Sport (2008), for further information.

Pool timing equipment

The requirements for pool timing equipment, in relation to any competition use, should be discussed with the commissioning body during the briefing process. Suitable containment routes will be required for pool timing equipment, including touch pads, shot clocks, scoreboard and input from poolside laptops. The scoreboard may be required to integrate with any site-wide digital signage system.

Poolside alarms

Each lifeguard position should be provided with an independent alarm system, remotely monitored at the reception area.

Supplementary bonding

Supplementary equipotential bonding the pool tank and associated wet areas requires careful consideration with specialist input during the design development. Supplementary bonding involves to interconnection of all simultaneous accessible conductive parts to the protective conductor system.

Specialist pool services

For specialist pool services guidance, please refer to Sport England's *Affordable Community Swimming Pools guidance* and Pool Water Treatment Advisory Group (PWTAG) 2009 document Swimming Pool Water Treatment and Quality Standards for Pools and Spas. Both documents give a comprehensive description of water treatment options which are not repeated here.

Below are some comments on newer approaches to water treatment which may help realise improved performance or reduction in energy consumption, are set out below.

Regenerative media filtration

Regenerative media filters remove particles from dirty pool water by forcing the water through a thin layer of powdery filter media that captures the unwanted dirt, oils, and other nasty materials suspended in pool water.

The main two types of media are; diatomaceous earth or perlite. Diatomaceous earth (DE) is a fossilized material that is mined and refined for use as a filter medium, however is very harmful if inhaled and therefore imposes strict maintenance regimes. Perlite is derived from volcanic rock that is superheated to create the powdery substance, and is the latest recommended regenerative media.

Regenerative media filters have a higher capital cost and therefore are not part of the 'Affordable' scheme, although they should be considered on the basis of the following potential benefits:

- Filtration of particles from pool water down to the 1 to 5 micron range (compared to around 20 microns for sand filters)
- Removal of many microorganisms (NB not a replacement for UV treatment)
- Potential for reduced plant footprint
- Potential for reduced backwash volume; however it should be noted that backwash volumes contribute to an overall requirement for pool dilution to control total dissolved solids (TDS) so the water and energy savings are not always able to be realised. [2]

This technology is still reasonably new, but overall can offer good benefits in relation to water quality. However, these benefits need to be balanced against both higher capital costs and higher running costs associated with regular media replacement.

Modulation of water treatment systems

Circulation pumps on all new water treatment systems should be fitted with variable speed drives (VSDs). This, alongside appropriate controls, will enable the system to vary the volume of water circulated through the water treatment system against the bathing load (number of occupants).

This modulation can realise the following benefits;

- Reduced pumping energy
- Reduced heat loss from circulatory system
- Reduced energy associated with UV treatment (where incorporated).

[4] The dilution volumes should be maintained at 30 litres / bather, but can be reduced if a reverse osmosis system is installed, however this will incur higher capital and running costs.

Appendix 8: Energy and Sustainability

This summary contains information on the energy and sustainability aspects of the indicative affordable design, including the requirements associated with compliance with Part L2A 2013 of the Building Regulations. The Appendix provides further details on these systems and alternatives. Please refer to Appendix 7 and associated summary for information on building services engineering.

Please note that Local Authority requirements for energy efficiency and renewable energy generation may exceed those outlined below and a dynamic simulation for each project should be carried out to verify compliance with Part L2A. Technology selections will vary from project to project and should be appraised by the design team in order that they are appropriate to the building form and function and align with the priorities of the commissioning body.

Key affordable assumptions
(within the indicative design and costings)

Energy conservation measures

- Air handling units with heat recovery
- Modulation of the fresh air provided by the ventilation system to meet varying loads in all occupied spaces
- Variable speed drives on all pumps, both for heating, domestic services and water treatment
- Sizing of ductwork to achive low specific fan power
- Daylight linked dimming control on lighting in all well daylit areas
- Lighting control based on presence or absence detection (as apropriate) in all ancillary rooms and stores.

Renewable technologies

- Solar thermal collectors (100m^2 array).

Water conservation: sanitaryware specification to include:

- Sensor or percussion taps and showers
- Dual flush WC's
- Water efficient shower heads
- Flow regulators to taps

Metering and monitoring

- Meter 90% of anual energy consumption by use (Part L2 requirement)
- Output from any renewable energy generation (Part L2 requirement)
- Heat meter on LTHW branch serving pool water heating
- Temperature and RH sensors in the pool hall at pool level and in spectators seating
- Visitors numbers monitored via tills.

General

This section builds on previous Sport England guidance and highlights the most crucial aspects in relation to affordable 50 m pool facilities. The assumptions set out in Sport England's *Affordable Community Swimming Pools (ACSP), Affordable Sports Centres (ASC) and Affordable Swimming Pools* guidance will generally apply.

Under the Climate Change Act 2008, the Government has put in place legally binding carbon reduction targets of 35% by 2020 and 80% by 2050 compared to 1990 levels.

The construction and operation of UK buildings accounts for approximately 60% of national carbon dioxide emissions. Swimming pools are inherently high consumers of energy, with CO_2 emissions circa 4 times that of typical schools and twice that of typical office buildings. There is therefore scope to seek significant benefit from energy efficiency measures and renewable technologies.

Therefore, this review has a strong emphasis on energy saving options which is particularly important for sports centres incorporating a community 50 m swimming pool.

Local planning guidance

The relevant Local Authority Core Strategy or equivalent document will differ from one authority to another and should be referred to as part of the overall energy assessment for the site. The Core Strategy document will outline requirements for energy efficiency, renewable energy generation and sustainable urban drainage solutions.

Building Regulations: Part L2A

The building should be designed in compliance with the Building Regulations Approved Document L2A: Conservation of fuel and power (New buildings other than dwellings - 2013 edition). This came into force for all buildings that did not have a Building Control application lodged or started on site on 6th April 2014.

The Affordable scheme has been designed to comply with, but not exceed, the requirements of Part L of the Building Regulations. The approach to compliance is fabric first a this provides the best carbon reduction for the investment.

Use of efficient M&E services such as heat recovery and LED lighting has been included as far as is reasonable within the budget. In addition to this, an array of solar thermal panels has been included in order to meet some of the large domestic hot water load. For more information see later section.

A dynamic simulation of Option 3 has been produced in order to verify compliance and the results have informed the fabric performance, selection of energy efficiency measures and renewable technologies.

However, design teams need to carry out their own Part L calculations based on the specific form, fabric and systems used for each individual project.

Design hierarchy

The design approach for swimming pools should be focussed on making energy savings in the most cost effective and efficient manner. In order to achieve this, 'passive' measures such as optimising the building orientation and improvements to the form and fabric, should be applied first before considering 'active' methods, such as renewable technologies.

Fabric performance

Thermal transmittance

Part L of the Building Regulations provides two sets of thermal transmittance (U-value) criteria for building elements.

- 'Limiting' values; minimum allowable performance for any element
- 'Notional building' values; benchmark values better than the 'limiting' values and comparable to a typical regulation compliant building.

In the UK climate, a sports centre's indoor temperature is generally much higher than outdoors. A large proportion of energy consumption in swimming pool buildings relates to heating the water in the pool tanks and the air in the pool hall. Therefore, to an even greater extent than other buildings, an optimised fabric performance must be the first consideration with respect to reducing carbon emissions.

The table below indicates the Part L2A 2013 'limiting U-values,' 'notional' building U-values and proposed target U-values for the affordable design. The targets U-values are approximately 20% better than the 'notional' building values, with some variation accounting for the relative costs and feasibility of different elements.

Element	Limiting U-values W/m²K	Notional building U-values W/m²K	Target U-values W/m²K
Roof	0.25	0.18	0.1
Walls	0.35	0.26	0.2
Floor	0.25	0.22	0.18
Windows *	2.2	1.6	1.5
Roof lights	2.2	1.8	1.5
Pool tank	0.25	0.25	0.25
Internal glazing **	--	--	1.5
Internal walls **	--	--	0.2

Building Regulation Part L2A 2013 target U-values

* Curtain wall systems to fulfil the same criteria as windows, utilising warm-edge spacers.

** Between pool hall and adjacent spaces

Recommended performance for internal glazing and walls between the pool hall and adjacent spaces is included in addition to the external envelope. This is because the pool hall is approximately 10-15°C higher than adjacent spaces, which is comparable in temperature difference to an average winter external to internal scenario.

Air tightness

Careful detailing to achieve a high level of air tightness is crucial, both for the external building envelope and between internal spaces with different design criteria. The 'notional' building criteria under Part L2A 2013 achieves 5 $m^3/(h\text{-}m^2)$ at 50Pa. 3 $m^3/(h\text{-}m^2)$ is a resonable target for any new pool development.

Air testing of the external envelope is required for building regulations compliance. In addition to this, and as part of the Contractor's responsibilities, internal partitions between the pool hall and adjacent spaces should be tested under the same criteria, due to the energy consumption associated with air leakage. Also, carry-over of air from the pool hall to adjacent spaces can cause issues with corrosion.

Condensation

The environment in a pool hall is hot and humid the year round, with humidity control most difficult in the summer.

The design team needs to carefully manage the risk of condensation with attention to:

- Construction details including removing cold bridges and sources of air leakage
- External glazing performance and air movement over glass
- Internal glazed partition performance, particularly between the pool hall and fitness suite
- Avoiding internal rainwater pipework
- Cavity wall design and vapour barriers to minimise risk of interstitial condensation.

Design for daylight

Natural light can make an important contribution to sustainability by reducing the electrical energy used for artificial lighting and by providing passive solar heating. It also contributes to the well-being of visitors and staff, as well as the aesthetics and feel of the spaces.

Location of glazing and glare

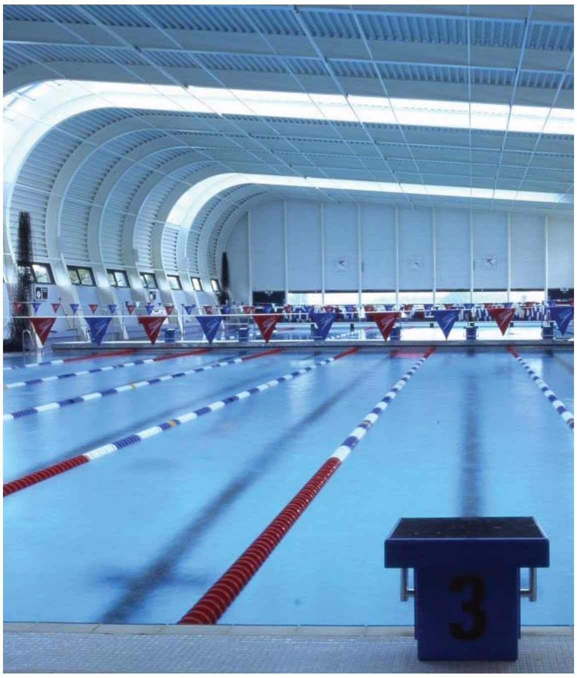
Glazing in the perimeter walls can provide users with pleasant views of outside areas and also help with wayfinding and promoting awareness of the facility from the outside. However, appropriate orientation and placement of glazing is necessary to avoid the risk of glare to lifeguards. Building orientation and adjacencies can result in a compromise and elevations with south and west facing glazing may be unavoidable. In this case, shading devices such as external louvres and overhangs, or internal light shelves or baffles, can be used to manage glare and diffuse direct sunlight. Solar glass may also be required.

The indicative affordable designs are orientated such that the main entrance and the more extensively glazed areas face north. This enables viewing in and out while minimising the potential for glare and unwanted solar gain.

Windows which can be opened behind the poolside seating can provide natural ventilation in summer, making the space more comfortable without requiring additional air handling plant.

Rooflights generally provide a lower risk of glare from the poolside areas due to the angles of reflection. They also provide the additional benefits of passive solar gain to the pool and a potential exhaust air path for natural ventilation in summer. A rooflight area of approximately 20% of the pool hall will generally enable the above benefits to exceed the additional heat loss.

Translucent insulated panel systems can provide natural light with less heat loss than conventional glazing. However, the properties of these panels reduce the light transmission and solar gain which can outweigh the benefit of the improved U-value.



Minimising energy consumption

Larger pools and energy consumption

A 50 m pool will have a larger water volume, larger pool hall and therefore inherently higher energy consumption than smaller pools.

Due to efficiency of support spaces and pool hall volumes, a 50 m pool could achieve lower kWh/m^2 than two separate 25 m facilities. However, energy consumption is strongly dictated by use and a 50 m pool (equipped with booms and movable floors) will aim for intensive use and occupancy, with the following implications:

- The turnover rate, dilution water volume and associated energy consumption could be proportionally higher.

  Note: this would enhance viability for heat recovery

- The pool hall air change rate and associated energy consumption could be higher due to higher evaporation rates

  Note: this would enhance the viability of incorporating options for natural ventilation in summer.

Essential energy saving techniques

A range of essential energy saving techniques for the indicative affordable pool designs have been allowed for within the cost plan. They are included for compliance with Part L of the Building Regulations and current construction and operating practice.

These measures include:

- Air handling units with heat recovery
- Modulation of fresh air provided by the ventilation system
- Variable speed drives on all pumps, both for heating, domestic services and water treatment
- High-efficiency light fittings
- Sizing of ductwork for low specific fan powers
- Daylight linked dimming on lighting in well daylit spaces.

In addition to the above, insulation of pool water treatment pipework can be considered to provide energy savings but is not included in the affordable schemes.

See Appendix 7 Building Services section for further information.

Metering strategy

By providing meters and submeters on energy consuming plant and areas, the building operators are provided with information to enable them to manage the use of the spaces and minimise energy consumption.

The affordable schemes incorporate Building Management System (BMS) linked meters to enable:

- > 90% of the annual energy consumption by use (requirement of Part L)
- Output from any renewable energy generation (requirement of Part L)
- A heat meter on LTHW branch serving pool water heating.

The following sub-meters can also be considered for inclusion:

- Heat meter on LTHW branch serving LTHW coil(s) in main AHU(s) serving the pool hall
- Electricity meter on power supply to water treatment plant
- Electricity meter on power supply to cooling plans
- Water meter on supply for pool top-up.

Metering data should be logged automatically by the BMS, incorporating a simple user interface to allow the building manager to view and export the data.

Renewable energy options

Depending on the overall design and use of the development, some renewable technologies are likely to be required to comply with Part L2A 2013. Although it is only one of a number of possible solutions, an array of solar thermal panels has been proposed as part of the scheme. The array is suitable because:-

- the design has a large accessible area of flat roof
- there is a significant domestic hot water load
- the pool can provide a heat sink in times of lower water use
- the panels are reasonably low maintenance.

Options for a wider selection of renewable technologies which could be used in pool and sports centre developments are outlined below.

Solar thermal collectors

A solar thermal collector is a panel which absorbs the suns radiation and uses it to heat water, which is circulated from the panel into a storage cylinder. There are two main types; flat panel and evacuated tubes, the latter being the more efficient but more expensive option.

Advantages:

- Comparatively low maintenance
- Relatively low visual impact
- Provide a visual amenity which can be used for education in sustainability issues
- More cost effective (£/kg CO_2 saved) than solar PV
- Renewable Heat Incentive (RHI) funding available currently
- Suits pool applications as the pool can be used as a heat sink, which reduces risk of overheating panels
- Low noise.

Disadvantages:

- Requires a large area of accessible flat roof or south facing pitched roof as included in the indicative design options.

Combined heat and power (CHP)

Combined heat and power is the generation of electricity by either an engine or turbine and the recovery of the by-product, heat. Most often it is based on a natural gas fuel although biofuels can be considered. CHP can provide a low carbon option with respect to grid supplies due to the recovered heat and minimal transmission losses.

Care should be taken not to oversize CHP systems. They should be sized to meet the base (minimum) heat load, which must be carefully considered especially where heat recovery and solar gain design approaches are implemented.

Advantages:

- Suits pool applications as there is an available year-round heat sink which increases run-time and financial benefit
- Low visual impact, as normally housed in plant room
- If correctly sized can provide a cost effective carbon reduction method.

Disadvantages:

- Can encourage operational practice that increases heat consumption
- Can be noisy, although this can normally be managed by locating within a plant room
- Can incur relatively higher maintenance cost, especially if facilities management (FM) staff are not familiar with the technology
- Gas fired CHP does not reduce reliance on fossil fuels as part of improving supply resilience.

Solar photovoltaic (PV)

A solar photovoltaic panel utilises semi-conductors to generate electricity from the suns radiation.

Advantages:

- Comparatively low maintenance
- Relatively low visual impact
- Provide a visual amenity which can be used for education in sustainability issues
- Incentives such as Feed-In-Tariffs (FIT) from the government can improve the financial payback, however please note tariffs are subject to review.

Disadvantages:

- Comparatively expensive, with longer payback times
- Can involve high energy consumption in their manufacture and the use of unsustainable materials.

Wind turbines

Advantages:

- Large scale wind turbines can provide the best carbon offset for the capital invested of all renewable energy technologies
- Provide a visual amenity which can be used for education in sustainability issues
- Incentives such as Feed-In-Tariffs (FIT) from the government can improve the financial payback, however please note tariffs are subject to review.

Disadvantages:

- Within developed areas, noise and daylight flicker from the turbines can cause a disturbance
- Within urban areas turbulent air flow can significantly reduce turbine output
- Within public areas, ice shedding under certain weather conditions must be considered.

Water conservation

The water consumption within leisure centres is significant and is required for showers, WCs, catering and the make-up of the swimming pool water.

The utility costs associated with the water supply are generally more modest than those for gas or electricity, leading to longer payback periods for water saving technologies. However, measures that can be considered are outlined below.

Rainwater recycling

Rainwater can be collected from rainwater pipes and directed into a below ground storage tank. The following methods should be considered to improve the quality of the water:

- Leaf filtration
- Use of the below ground tank to allow sediment to collect (tank to be accessible for cleaning)
- Floating suction filter to collect water from the clean portion of the tank.

With the above filtration, rainwater can be successfully used to backwash the pool filters and for irrigation of any pitches and soft landscaping.

If rainwater is to be used for WC flushing or pool top-up, then further consideration is required into expectations for visual appearance and risks to the public. UV filtration can be used to improve water quality, but the benefits should be weighed against the additional energy consumption and maintenance.

Greywater recycling

For every bather 30 litres of water is recommended to be replaced from the pool, in order to control Total Dissolved Solids (TDS.) This water can be collected and recycled for WC flushing. The recycled pool water should not be stored for long periods of time (due to its elevated temperatures) and therefore break-tank sizes should be minimised.

Myth: Backwash water is useful and should be recycled.

Fact: Backwash water is used to flush through and clean the pool filters, so is generally not sufficiently clean to be re-used (even for WC flushing) without significant levels of water treatment, that would generally outweigh any benefit.

Sanitaryware

The following sanitaryware items are included as part of the affordable scheme to reduce water consumption:

- Sensor or percussion taps, urinals and showers with timed flow
- Dual flush WCs
- Water efficient shower heads
- Flow regulators to taps.

BREEAM

In the event that a BREEAM assessment method is used to raise the sustainability standards, the indicative designs will fall within New Construction Non-Domestic 2014 assessment criteria (from 30th June 2014). See the BRE published manual for full details.

Relevant assessment examples

Examples from the BREEAM assessment criteria relating to leisure centres and pools include:

- **Ene 01 Reduction of emissions**

  Aim: to recognise and encourage buildings designed to minimise operational energy demand, consumption and CO_2 emissions.

  As pools have inherently high energy consumption, methods (as outlined above) to reduce consumption will result in larger potential % offsets achievable in comparison to other building types.

- **Ene 08 Energy efficient equipment**

  Aim: to recognise and encourage procurement of energy-efficient equipment to ensure optimum performance and energy savings in operation.

  Credits are available where automatic or semi-automatic covers are fitted to all pools. The affordable scheme includes pool covers and movable floors which can be utilised as a cover.

- **Wat 02 Water monitoring**

  Aim: to ensure water consumption can be monitored and managed and therefore encourage reductions in water consumption.

  Credits are available for a BMS linked water meter on the mains water supply and sub-meters to areas consuming >10% of the building's total water demand. This would normally apply to both the pool top-up and the showers.

- **Ene 02 Energy monitoring**

  Aim: to recognise and encourage the installation of energy sub-metering that facilitates the monitoring of operational energy consumption.

  Additional credits are available for BMS linked sub-meters for major energy consuming areas serving the pool and change areas.

Soft Landings and monitoring

'Soft Landings' is a collaborative approach to delivering buildings that meet occupants' needs and allow the performance of the building to be optimised.

Commissioning bodies and design teams should collectively review the opportunities for a 'Soft Landings' approach, in order to aim for a smooth handover and to give a building that operates as designed.

To aid the 'Soft Landings' approach; in addition to the metering discussed above the building management system should enable the following monitoring and logging of:

- Temperature and RH in the pool hall at pool level and in spectators seating
- Visitor numbers.

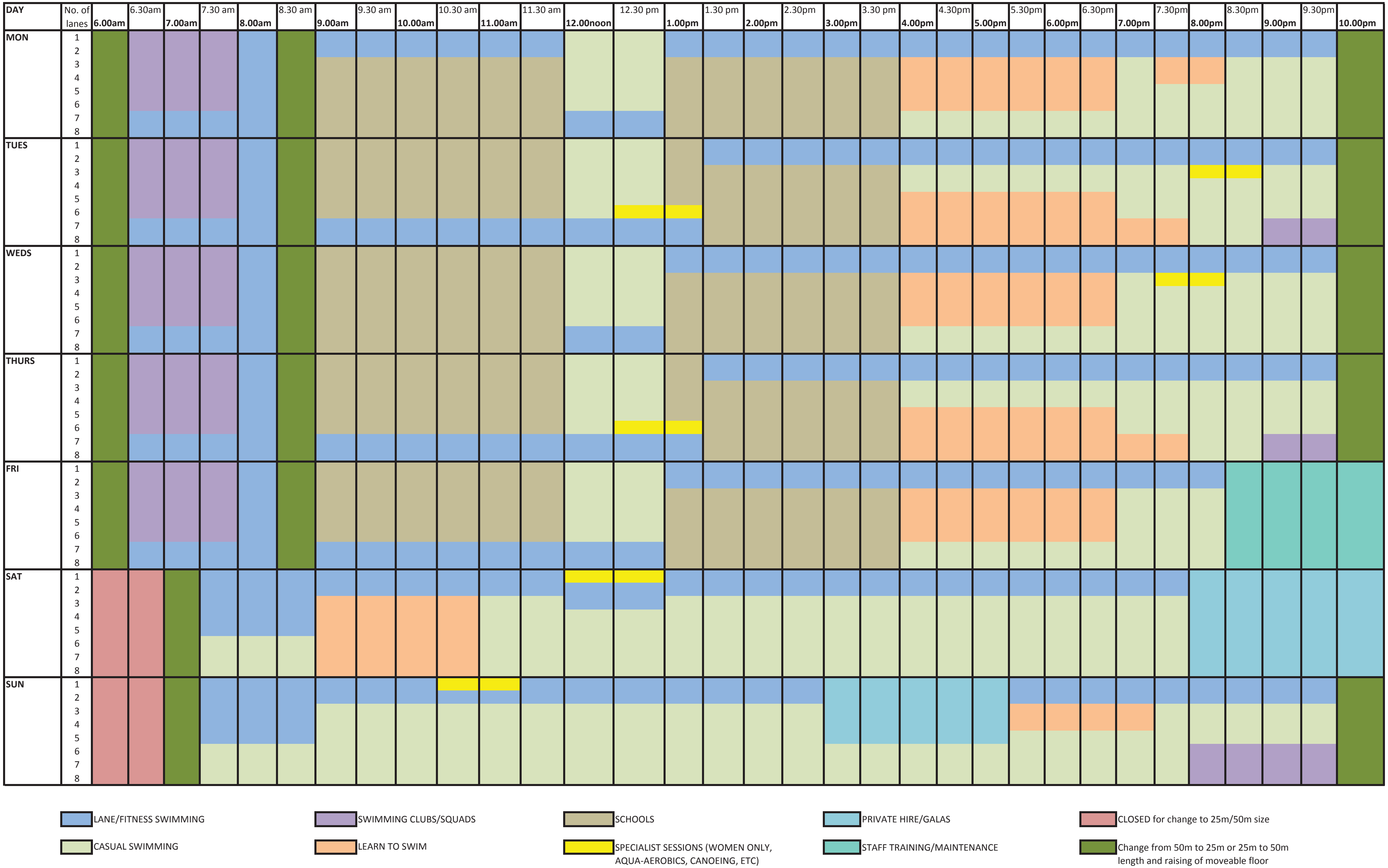
For more information refer to the 'Soft Landings' Framework, BSRIA BG 4/2009 document which outlines how to implement Soft Landings in your scheme.

Appendix 9: Programmes of Use for 8 Lane 50 m Pool and Secondary Pool

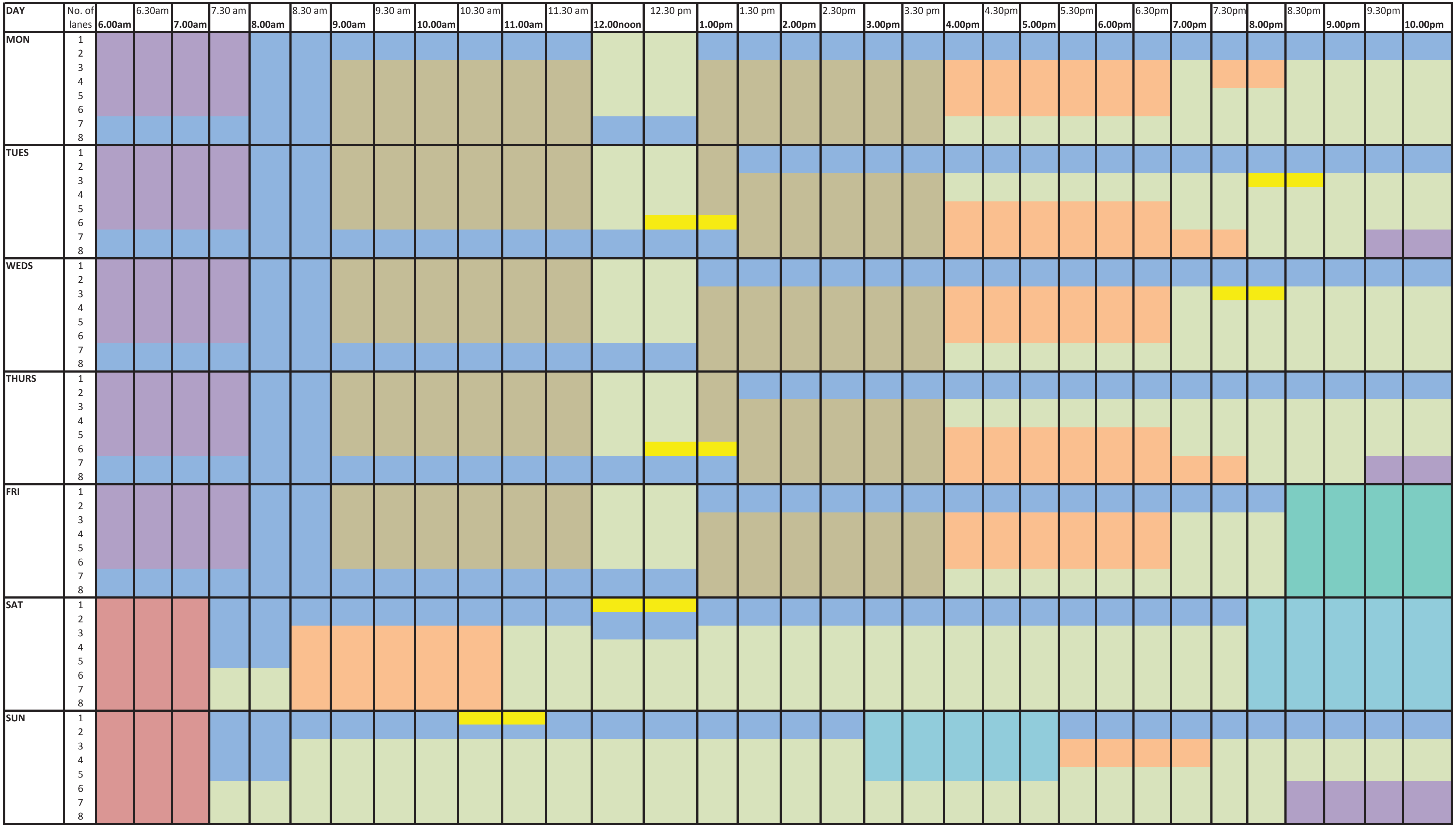
Summary

Appendix 9 shows some indicative pool programming options to illustrate the type of programme which can generate the exemplar revenue estimates discussed in the main document. In particular, the two different programming options show the difference in programmable hours between a 50 m pool and a 50 m pool plus a secondary water space.

Indicative programme of use 50 m x 8 lane pool, with movable floor (Option 1)



Indicative programme of use 50 m x 8 lane pool, plus secondary pool (Options 2 and 3)



- LANE/FITNESS SWIMMING
- SWIMMING CLUBS/SQUADS
- SCHOOLS
- PRIVATE HIRE/GALAS
- CLOSED
- CASUAL SWIMMING
- LEARN TO SWIM
- SPECIALIST SESSIONS (WOMEN ONLY, AQUA AEROBICS, CANOEING, ETC)
- STAFF TRAINING/MAINTENANCE

Indicative programme of use secondary pool

DAY		6.00am	6.30am	7.00am	7.30 am	8.00am	8.30 am	9.00am	9.30 am	10.00am	10.30 am	11.00am	11.30 am	12.00noon	12.30 pm	1.00pm	1.30 pm	2.00pm	2.30pm	3.00pm	3.30 pm	4.00pm	4.30pm	5.00pm	5.30pm	6.00pm	6.30pm	7.00pm	7.30pm	8.00pm	8.30pm	9.00pm	9.30pm	10.00pm
MON		CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	SPECIALIST SESSIONS	SPECIALIST SESSIONS	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING
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WEDS		CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	SPECIALIST SESSIONS	SPECIALIST SESSIONS	SPECIALIST SESSIONS	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING
THURS		CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	SCHOOLS	SCHOOLS	SCHOOLS	SCHOOLS	SCHOOLS	CASUAL SWIMMING	SPECIALIST SESSIONS	SPECIALIST SESSIONS	SPECIALIST SESSIONS	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING
FRI		CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	SPECIALIST SESSIONS	SPECIALIST SESSIONS	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING
SAT		CLOSED	CLOSED	CLOSED	CLOSED	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	PRIVATE HIRE/GALAS	PRIVATE HIRE/GALAS	PRIVATE HIRE/GALAS	PRIVATE HIRE/GALAS	PRIVATE HIRE/GALAS	PRIVATE HIRE/GALAS	PRIVATE HIRE/GALAS	PRIVATE HIRE/GALAS	PRIVATE HIRE/GALAS
SUN		CLOSED	CLOSED	CLOSED	CLOSED	CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	LEARN TO SWIM	CASUAL SWIMMING	CASUAL SWIMMING	LEARN TO SWIM									

CASUAL SWIMMING

LEARN TO SWIM

SPECIALIST SESSIONS eg mums and toddlers,

CLOSED

SWIMMING CLUBS/SQUADS

SCHOOLS

PRIVATE HIRE/GALAS

Creating a sporting habit for life

Alternative languages and formats

This document can be provided in alternative languages or alternative formats such as large print, Braille, tape and on disk, upon request. Call the Sport England switchboard on 08458 508 508 for more details.

User Guide

Before using this guidance for any specific projects all users should refer to the User Guide to understand when and how to use the guidance as well as understanding the limitations of use.

Click here for **'User Guide'**

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Issue tracker

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