

Llanishen Reservoir

Reservoir Act 1975: Measures to be taken in the Interest of Safety under Section 10(6) of the Act

Phase 2 Drawdown

27th May 2010

Document History

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1. Introduction

1.1 Name and Location of Reservoir

The reservoir is known as LLANISHEN RESERVOIR, situated in the City and County of Cardiff about 5km north of the city centre. National Grid Reference ST 186 817 lies within the Site.

1.2 Description of Project

Atkins Limited has been commissioned by Western Power Distribution Investments Ltd (WPD) to action measures to be taken in the Interest of Safety under Section 10(6) of the Reservoir Act 1975, in particular, the main drawdown of the reservoir to allow pipe work to be inspected and surveyed as stipulated in the latest Section 10 report (dated May 2008).

1.3 Scope and Objective of the Report

The purpose of this report is to support the application made under Section 90 of the Water Resources Act 1991 and, in response to a Schedule 5 'Notice of request for more information' (and later requests for clarification), from the Environment Agency, to summarise the measures to be taken, including those undertaken in advance and during the operation to minimise the impact of the drawdown both in terms of flood consequence and environmental matters.

1.4 Application and Notices

The original application was made under Section 90 of the Water Resources Act 1991 (EA Reference: NPSWQD010933). A copy of the application letter, dated 17th March 2010, is provided in Appendix A.

It is understood that the application is now being considered under the Environmental Permitting (England and Wales) Regulations 2010 (EA reference: EPR/AP3228GT). The notice given under paragraph 4 of Part 1 of Schedule 5 of the above Regulations is provided in Appendix B.

2. Existing Information

The following relevant reservoir statistics have been taken from the latest Section 10 report:

2.1 Description

Llanishen Reservoir is a fully bunded reservoir built between 1884 and 1886 for Cardiff Corporation Waterworks Company. The reservoir is retained by 1966 metres of earthfill embankment up to 11.07 metres high with clay cores.

Drawings show that the top water level is stated as being 151.50 feet OD (46.18m) whilst the top of bank level was originally 155.50 feet OD (47.40m). When full to its top water level, the reservoir has a capacity of 1,440,909 cubic metres and a surface area of 238,000 square metres.

The reservoir is almost entirely surrounded by houses albeit at some distance. Discharges from the reservoir pass to a stream channel (the Nant Fawr) which eventually enters 'The Lake' within Roath Park before passing on through the city of Cardiff and entering the Bristol Channel.

2.2 Access

Access to the site can be made via a minor road and track situated at the south-eastern corner of Llanishen Reservoir (off Rhyd-y-Penau Road), and thence either along the crest or via a track down the main embankment to the toe. See Figure 1 attached.

2.3 Catchment

The reservoir has no direct catchment (all banks being higher than the surrounding ground). The reservoir was formerly supplied with treated water from Taf Fawr and Llandegfedd Water Treatment works. It is currently supplied solely by rainfall within the reservoir basin.

2.4 Dam Details

The reservoir is retained, on each side, by earthen embankments which are of zoned construction.

The embankments have a central puddle clay core 5 feet (1.5m) wide at the top with sides battering at 8V:1H. The cut-off trench is also filled with puddle clay. Zones of 'fine material', battered at 2V:1H, are used to protect the core on each side within the embankment section. Finally, the drawings show 'embankment filling' in both of the outer shoulders with the upstream slope being 1V:3H whilst the downstream slope is 1V:2½H.

Where the southern embankment of the earlier Lisvane Reservoir is incorporated into the northern embankment of Llanishen a horizontal layer of puddle clay has been used to join the two cores.

The downstream face is grassed whilst the upstream face is protected by pitching 12 inches (300mm) and 9 inches (225mm) thick above shingling 15 inches (375mm) thick.

2.5 Outlet Pipework and Valve Arrangement

The outlet pipework is housed in a substantial valve tower situated near the south-east corner of the reservoir. Valves control three pipes within the valve tower as shown on a schematic diagram present in Figure 1.

The pipe to be used to effect the drawdown, described in this report, is an 18 inch (450mm) scour pipe controlled by two sluice valves (operating and guard valves) each operated by a capstan (shown as E and G in Figure 1).

2.6 Method of Recording Water Levels

There is a depth board fixed to the side of the valve tower used to record water levels within the normal operating range of the reservoir. There is also a series of stone steps which can be used to record the depth of water in the reservoir to approximately 10ft (3.05m) below top water level. The locations of both are highlighted in Figure 1.

There are currently no means of measuring the water level below the base of the steps.

3. Preparation Works

3.1 Siphoning Phase

Phase 1 of the drawdown of the reservoir involved reducing water levels using four pipe siphons installed across the crest and down the slope to the existing masonry scour channel. A summary of this phase is provided below:

- Siphoning period extended from 25th February to 29th April 2010
- Start water level: approx. 45.20mAOD
- Finish water level: approx. 41.80mAOD
- Typical drop rate: 60mm/day
- Estimated maximum flow rate: 220l/sec
- Estimated total volume discharged: 500,000m³

With the water level already below the top water level when the siphoning commenced, the estimated volume remaining in the reservoir is 790,000m³.

3.2 Water Sampling and Testing

APEM Limited (Aquatic Ecology Laboratories based in Wareham, Dorset) conducted a comprehensive survey of the water quality of Llanishen Reservoir and the Nant Fawr during February 2010.

The results from both waterbodies were found to be of high quality with all key determinants meeting the requirements of the Freshwater Fish Directive and in some cases within the limits of the Water Supply Regulations.

3.3 Silt Sampling

In conjunction with their water quality survey, APEM Ltd attempted obtain samples of sediment from the bed of the reservoir for chemical analysis. However, due to the minimal depths of sediment, it was not possible to take samples of adequate volume for testing.

3.4 Fish Survey

APEM Ltd conducted a survey of fish populations within the reservoir in February 2010.

Netting operations were successful in catching small species such as bullhead, minnow and three-spined stickleback. Horizontal and vertical hydroacoustic surveys were also undertaken which allowed the total population of these fish species to be estimated at around 12,000 to 15,000.

The hydroacoustic surveys also identified fish in the 25 cm+ size range with an estimated maximum of 4.9 fish per hectare (this is equivalent to approximately 113 individual fish). Llanishen Reservoir has a legacy of trout angling, going back to beginning of the 20th century and has received annual stockings of rainbow trout until 1998. It is highly probable that these sonar targets were represented by rainbow trout (*Onchorhynchus mykiss*), which is a non-native species and thus would be considered a threat to the ecological integrity of the Nant Fawr.

4. Drawdown

The following sets out proposals for actuating the main drawdown of the reservoir, that is, to reduce water levels to allow the existing pipework to be inspected and surveyed. This should be read in conjunction with Figure 1 (showing the site, relevant site features and access arrangements).

4.1 Controlling the Discharge Rate

4.1.1 Rate of Drawdown

Advice on restricting the rate of drawdown has been provided by the Inspecting Engineer to protect against the potential for the internal slope to become distressed, that is, to protect against rapid drawdown effects. The rate of drawdown is to be restricted to 300mm per day.

It is recognised that previous estimates of the average rate of discharge (based on achieving but not exceeding a drawdown rate of 300mm per day) are likely to be greater than the base flows within the Nant Fawr. As a result, in order to avoid any appreciable adverse affects on the Nant Fawr, it has been decided that the flow rate from the reservoir be capped at the estimated maximum rate achieved during the siphoning phase of the drawdown, that is, 220l/sec.

It is understood that some members of the public have commented that the phase 1 drawdown scoured away at the banks of the Nant Fawr. WPD were contacted by a member of the public, with such a claim, during Phase 1. Atkins contacted the relevant authority who then conducted an inspection – their conclusion was that they “did not see any problems”. We consider, by adopting the same maximum flow rate, that the potential for damage to the banks is equally small (if not less so considering the lower base flow in the Nant Fawr during the summer period). However, we will continue to liaise with the relevant authority during this phase (see also Section 4.1.3 below).

4.1.2 Control of Discharge Rate – Normal Operations

The 18” scour pipe is controlled by a sluice valve operated by a capstan – one turn of the capstan being equivalent to approximately ½” rise in the valve.

The initial valve height, at the beginning of the operation, will be estimated based on basic orifice equations – estimating the area of opening required to achieve the agreed maximum rate. No allowance will be made for inefficiencies associated with the orifice shape and headlosses in the system (giving a conservative rate).

The discharge rate will be gradually increased to the agreed maximum rate (see Section 4.2) – the flow rate being measured across a rectangular weir to be installed within the scour channel.

The water levels across the weir will be recorded twice every day – readings are likely to be made by a suitably briefed security guard. The water levels are to be phoned in to the Atkins Limited project manager for the record.

As the levels in the reservoir fall, there will be a need to raise the sluice valve as compensation in order to maintain the agreed maximum flow rate. Therefore, a representative from Atkins Limited will periodically attend the site, confirm levels across the weir and make adjustments to the sluice gate level as instructed by the Atkins Limited project manager.

4.1.3 Control of Discharge Rate – Adverse Weather

It is of utmost importance that the operations do not cause or contribute, or be perceived to cause or contribute, to flooding in the Nant Fawr and other water bodies downstream of the point of discharge.

The Nant Fawr is an ordinary water course – the Environment Agency having no monitoring or early warning mechanisms in place. It is therefore proposed that named persons be signed up to receive flood warnings for the wider River Rhymney catchment with the following measures being in place to deal with various levels of warning as set out below:

EA Designation	EA Description	Action
No Warnings in Force	-	Dewatering to be maintained at desired rate.
Flood Watch	Flooding of low lying land and roads is expected. Be aware, be prepared, watch out.	Site to be attended, water levels recorded and adjustments made to the sluice gate to reduce the rate of discharge by approx. 50%.
Flood Warning	Flooding of homes and businesses is expected. Act now!	Site to be attended, water levels recorded and the valve closed.
Severe Flood Warning	Severe flooding expected. There is extreme danger to life and property. Act now!	The valve will remain closed or, if open, the site will be attended, water levels recorded and the valve closed.
All Clear	Previous flood watches or warnings are no longer in force for this area.	Site to be attended, water levels recorded and adjustments made to the sluice gate to the level set prior to the flood watches or warnings being in force.

In order for the above to be achieved, 24hr security is being provided for the full duration of the operation. All access keys and sluice gate keys will be kept in the security cabin which is situated at the entrance to the reservoir.

Sluice valve reference G (see Figure 1) will be used for all normal operations however, a second valve (Ref: E) can be used should G seize and is unable to closed for any reason.

4.2 Water Quality

It was stated within the application that the potential for significant or harmful levels of silt entering the Nant Fawr is considered to be low and that the primary measures (straw bales) are likely to be adequate. Notwithstanding this, it was explained that further mitigation measures involving moderating flows and adding Floc Blocks would be introduced as set out in a flow chart.

In response to the Schedule 5 Notice (and later requests for clarification), further details regarding control and monitoring of water quality, including dissolved oxygen, are set out below – to be read in conjunction with updated flow charts, covering “Start Up” and Normal Operations”, provided within Appendix D.

4.2.1 Poor Water Quality

Available test information shows that the water quality within the reservoir (chemically and in terms of dissolved oxygen) is high. Notwithstanding this, we understand measures need to be taken to confirm that the water quality is acceptable immediately prior to commencing the discharge. This will be done by:

- a) Inspecting the reservoir surface for signs of an algal bloom occurring;
- b) Employing APEM Ltd to measure, from a boat located at the entrance to the scour tunnel, dissolved oxygen at various depths in the reservoir.

The discharge will only commence once there is confirmation that no algal bloom is occurring and that the level of dissolved oxygen is greater than 50%.

4.2.2 Control of Suspended Solids

The series of straw bales installed in the masonry lined channel will be used for controlling suspended solids by encouraging settlement during normal operations.

Flows will be moderated or stopped if the direct readings show levels are becoming elevated or exceed threshold levels.

The decision may be taken, in the event of a sudden increase in suspended solids, to insert Floc Blocks into the channel to maximise the removal of silt whilst action is being taken to stop the flow.

Floc Blocks

Floc Blocks are solid blocks of slow release flocculant which work by releasing into the water stream trace amounts of anionic polymer chain molecules which act to bind together fine solids to promote settlement. A Material Safety Data Sheet for the proposed product is provided in Appendix C. The Floc Blocks will be used according to manufacturer's instructions.

4.2.3 Method of Monitoring

Regular monitoring will be needed in order to ensure that acceptable threshold values are not exceeded. Monitoring will need to be conducted in the outflow channel – the settlement sump located within the masonry lined channel (see Figure 1) provides an ideal site in which to deploy any measurement tools.

Dissolved Oxygen

An optical dissolved oxygen sensor is to be employed with a local display for direct reading.

Total Suspended Solids

It is expected that suspended solids will be measured against a particular threshold value to be set by the Environment Agency under this consenting process. It was therefore decided that a system employing a datastick to directly monitor total suspended solids will be needed (again linked to a local display). This will give the most reliable and safest method for measurement over a 24hour period.

4.2.4 Setting Up Details

To ensure a representative through flow of water is measured, the data stick and sensor will be securely installed within the sump by the supplier. The results will be directly reported to a reading unit set up in a security shed sited immediately adjacent to the sump – a 240volt mains electricity supply will be run to the shed. A data logger will also be sited in the shed to provide a continuous record of the results.

4.2.5 Frequency of Readings

The local display will be manually read every hour – readings are likely to be made by a suitably briefed security guard. A series of trigger levels will be assigned, based on the threshold values set by the Environment Agency, and the Atkins Limited project manager will be informed and decisions made as set out in the updated flow charts provided in Appendix B (*given for an example control level of 50mg/l*).

The use of a data logger has the advantage of providing continuous surveillance, the software interface can be programmed to record at any given time interval (likely to be one reading every 15 minutes).

4.3 Control of Fish

4.3.1 Restrictions

The Environment Agency has specified that best efforts should be made to prohibit fish from the reservoir entering the Nant Fawr. This is to protect the resident stocks of brown trout and the general ecological integrity of the Nant Fawr.

4.3.2 Mechanical Screening

It is inevitable that fish of all sizes will be washed from the reservoir. Accordingly, it will be essential, as a minimum precaution, to install a mechanical screen within the masonry lined channel to exclude fish from being dispersed beyond this point.

In terms of siting the screen, the downstream end of the settlement sump provides an ideal position which will allow screens to be lowered into vertical runners and trapped fish to reside in the deep settlement sump until their capture and removal.

Due to the potential for very large numbers of small fishes to be washed from the reservoir, mesh size is an important consideration. A 3.3mm stainless steel mesh is to be provided – sized to prevent many of the 2010 recruits from entering the stream.

It is recognised that such a fine mesh would be prone to fouling and would be likely to require regular cleaning or changing (a second “spare” screen is to be provided to minimise the disruption to the drawdown process).

4.3.3 Exposure to Floc Blocks

The combination of actions to control suspended solids ensures that:

- i. Floc Blocks are only used as a last resort.
- ii. The period in which fish come in contact with the polymer is kept to an absolute minimum.

The likelihood of such an emergency occurring just as a protected fish species, such as eels (*not yet identified as being present in the reservoir*), are released into the channel is very low.

5. Risk Assessment

5.1 Operation Risks

Some of the operational issues, for instance, managing rate of discharge, have already been discussed in Section 4 above. The table below considers these and other determined hazards or risks which may have an impact on the proposed operations. The table should, where appropriate, be read in conjunction with the flow chart provided with the application.

Risk/Hazard	Cause	Risk/Hazard Control Measure (if any)
<i>Flooding downstream</i>	Discharge into the Nant Fawr during adverse flood conditions	See Section 4.2
	Blockage in Nant Fawr	Following initial consultation with the EA, approach Cardiff Council to check condition of the stream and identify obstructions which may affect its ability to deal with flows
	Unprepared control in Roath Lake	Approach Cardiff Council to check their ability and readiness to deal with flows
<i>Silt transport into the Nant Fawr</i>	-	See Section 4.3
	System Failure	Hourly readings will identify problems. If failure occurs, the flow must be stopped and the system repaired. Consider providing a Sechi disc to allow discharge to commence and be monitored during daylight hours.
	Vandalism of straw bales	24hour security provided – regular checks must include condition of straw bales. If damaged, the flow must be stopped and the affected bales replaced (a number of spares will be available).
	Vandalism of monitoring system	System installation to be suitably robust. 24hour security provided – hourly readings will identify problems. If damaged, the flow must be stopped and the system replaced. Consider providing a Sechi disc to allow discharge to commence and be monitored during daylight hours.
<i>Fish loss to Nant Fawr</i>	-	See Section 4.4
	Vandalism of screen	24hour security provided – regular checks must include condition of mechanical screen. If damaged, the flow must be stopped and the screen replaced (a spare will be available).

Risk/Hazard	Cause	Risk/Hazard Control Measure (if any)
<i>Damage to SSSI</i>	-	Only occasional pedestrian access to the gate entrance to the reservoir for the operation of the sluice valve. Access will be significantly reduced once the required flow rate is achieved.
<i>Staff Changes (Atkins)</i>	Key staff members are unavailable due to sickness or leave.	A back up member of staff to be involved to provide cover as necessary.
<i>Unable to access site</i>	Access blocked or hindered by measures taken by local campaign group	24hour security provided – regular checks must include review of all access points to ensure that they are safe and clear at all times

5.2 Other Risks

The Section 5 Notice states:

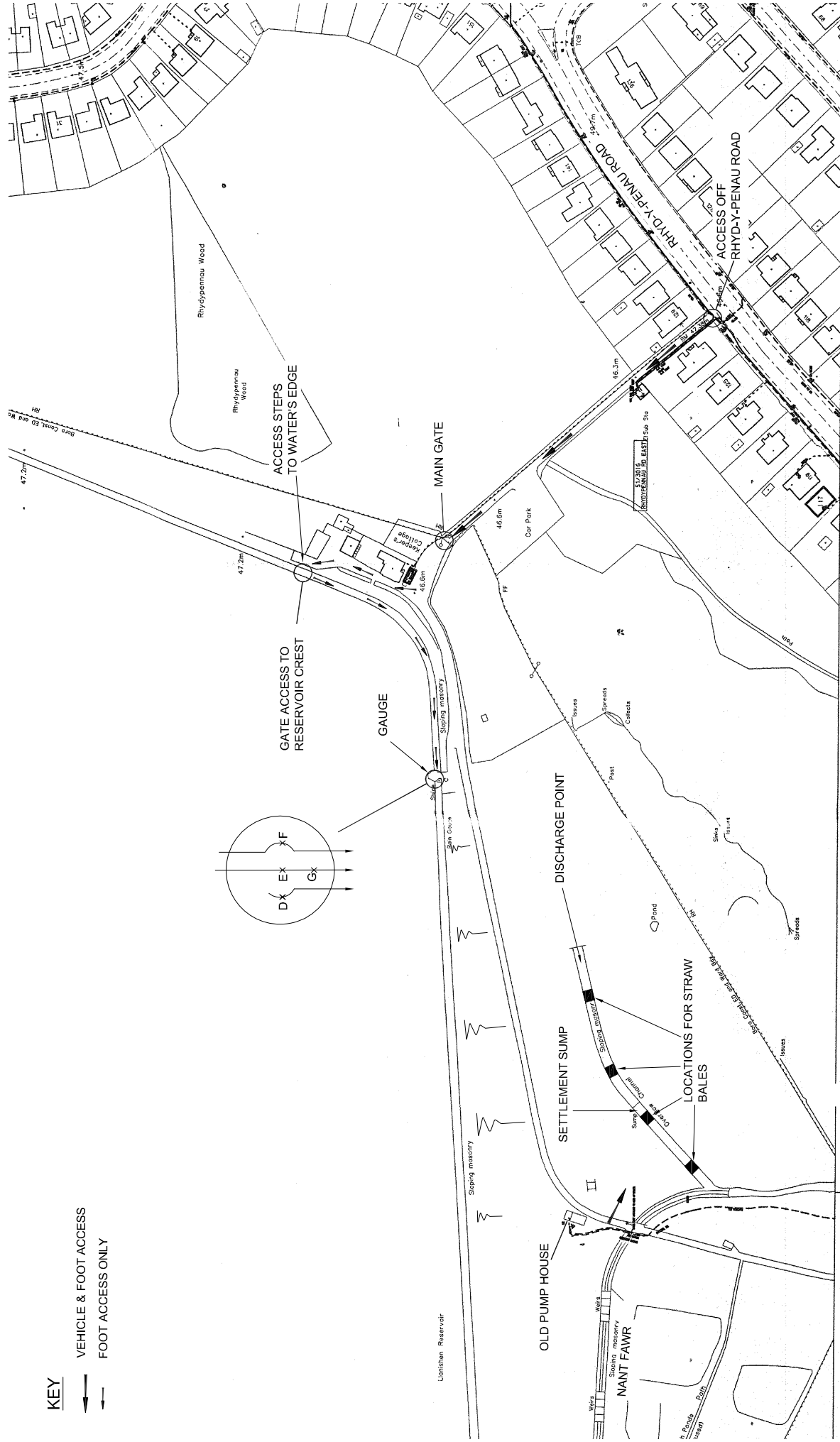
“Given the concerns expressed by the Countryside Council for Wales regarding the possible effect of the drawdown of the reservoir on the clay banks surrounding it, the Agency also recommends that the risk assessment should include details of how the integrity of these clay banks will be ensured.”

The response from Chris Owens (Qualified Civil Engineer under the Reservoir Act 1975) is provided below:

“The embankments are of typical construction for their age, with puddle clay cores supported by compacted earthfill shoulders. Reservoirs are normally constructed to balance demands against seasonal inflows, and are often designed to provide adequate storage for a period of several years with below average rainfall, so may not necessarily be completely full every year, and can be expected to be substantially drawn — even to the extent of being virtually empty — during the course of the year without detriment to the integrity of the embankments. We have no concern about this reservoir standing empty for two or three years, particularly since any refilling would be under controlled conditions and the embankments would be monitored regularly during the operation. In the unlikely event that signs of leakage were noted, refilling would be slowed down or stopped, and appropriate remedial measures implemented if this proved necessary.”

Figures

DO NOT SCALE



A3

LLANISHEN RESERVOIR
 EXTRACT FROM WESTERN POWER DISTRIBUTION UTILITY PLAN
 SHOWING ACCESS TO WORK AREAS (NTS)

FIGURE 1



Appendix A

Copy of Application

Your Ref:

Our Ref: 5042262/MH/CO/031

Telephone +44 (0)1792 641172
Fax +44 (0)1792 472019

info@atkinsglobal.com
www.atkinsglobal.com

NPSC
Quadrant 2
99 Parkway Avenue
Parkway Business Park
Sheffield
S9 4WF

Ext No:

17 March 2010

Dear Sir

EI 15572 - LLANISHEN RESERVOIR

Please find below information relating to Phase 2 of the main drawdown of Llanishen Reservoir which we understand is required for consent to be applied under Section 90 of the Water Resources Act 1991. The application is being made on the behalf of Western Power Distribution Property Investments Limited (WPD).

Location:	Llanishen Reservoir.
Grid reference:	ST 187 814.
Type of consent required:	Single event (Phase 1 of the main drawdown did not require Section 90 consent).
Type of Discharge:	Raw surface water.
Outlet Diameter:	18" with the flow rate being controlled by a sluice valve operated by a capstan.
For single event give approximate date of discharge:	1 st April 2010.
Duration of discharge:	6 to 10 weeks (the duration will depend on the agreed maximum rate of discharge and occurrence of periods of heavy rainfall which will cause the flow rate to be significantly reduced or temporarily stopped).
Estimated total volume per event and daily volume of discharge:	Approx. 1,000,000m ³ , Max 38,880m ³ d ⁻¹ .
Max rate of discharge:	Actual value to be agreed with Cardiff City but is likely to be no greater than 450ls ⁻¹ .

Reason for discharge:	Works in the interest of safety under the Reservoir Act 1975.
Name of receiving watercourse:	Nant Fawr.
Proposed treatment of discharge water prior to release:	The primary treatment involves the construction of four straw bale "dams" in the overflow channel to allow any suspended solids to settle prior to discharge into the Nant Fawr. This method has been tried and proven as part of the Phase 1 operation. Additional measures are discussed in the risk section below.
Contact name, email address and telephone numbers for water company staff dealing with discharge:	n/a please see Atkins contact details at the foot of this letter.
Have you notified any registered interested persons:	We have not notified persons registered under S166 (2)(b) WIA as the reservoir is not owned by a water undertaker. No other formal consent is required for the discharge of water – the receiving body being an ordinary watercourse which is not a designated SSSI. We have discussed the operation and agreed measures with Cardiff City and we have also discussed the operation with the Countryside Council for Wales.
The application should also include a risk assessment and a proposed mitigation measures plan:	Please find attached a report on the water quality in the reservoir written by APEM Ltd. Table 3.1 of the report shows that suspended solids in samples taken at various depths in the reservoir were below detectable limits whilst the conclusion in the report suggests that the water in the reservoir is of a high quality. Most importantly, in relation to this application, it was established during the survey that sediment depths were minimal and it was not possible to obtain sufficient sample for testing.

Based on the above, we would consider the potential for significant or harmful levels of silt entering the Nant Fawr to be low and that the primary measures (straw bales) are likely to be adequate. Notwithstanding this, in consideration of the high level of external interest in this operation, we proposed to be extra cautious in our approach by introducing further mitigation measures involving moderating flows and adding floc blocs as set out in the attached flow chart.

For your information, we will continue to consult directly with Cardiff City and also keep the Countryside Council for Wales fully informed.

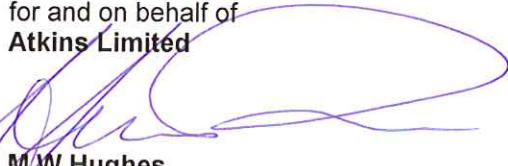
We would be pleased to receive your comments regarding the above and to receive confirmation of consent to discharge.

For the record, the suggested date for commencing this phase of the drawdown has been set to show WPD's continued commitment to meeting their obligations under the Reservoir Act 1975. Could you please keep us fully informed of the progress of the application including details of any departments or external bodies consulted (with details of the purpose of the consultation in relation to this particular application under the Water Resources Act 1991). If there is likely to be

any delay in the issue of consent, resulting in a delay in commencing the discharge, we would ask that we be given adequate notice of the delay with an assurance that the delay is appropriate for this application.

Please do not hesitate to contact me on the number below if you have any questions.

Yours faithfully
for and on behalf of
Atkins Limited



PP

M/W Hughes
Principal Engineer
Water & Environment

Enc.

APEM Llanishen Reservoir water quality final report
Silt monitoring flow chart

Appendix B

Copy of Section 5 Notice

Notice of request for more information
Environmental Permitting (England and Wales)
Regulations 2010

Notice requiring further information

To: M W Hughes
Atkins Limited

Application number: EPR/AP3228GT (Previous Reference: NPSWQD010933)

The Environment Agency, in exercise of its powers under paragraph 4 of Part 1 of Schedule 5 of the above Regulations, requires you to provide the information detailed in the attached schedule. The information is required in order to determine your application for a permit, dated 17th March 2010. The information requested should be sent to the following address by 28th May 2010.

Information should be sent to:

Scott Leighton
National Permitting Service
Water Quality
Ty Cambria
29 Newport Road
Cardiff
CF24 0TP

Or emailed to:
scott.leighton@environment-agency.gov.uk

Name	Date
Scott Leighton	6th May 2010

Authorised on behalf of the Environment Agency

Schedule

In line with 'Regulation and risk assessment of reservoir releases'¹ the Environment Agency require that you submit a risk assessment. This will demonstrate that you have taken into account all of the risks associated with the discharge and detail the operating techniques that you will use to address these risks. Whilst you have provided some information of this nature the Agency require that the risk assessment is submitted as a document that can be made reference to should a permit be issued.

Given the concerns expressed by the Countryside Council for Wales regarding the possible effect of the drawdown of the reservoir on the clay banks surrounding it, the Agency also recommends that the risk assessment should include details of how the integrity of these clay banks will be ensured.

¹ http://www.environment-agency.gov.uk/static/documents/Business/WQ_TGN_Part_06.pdf

Appendix C

Material Safety Data Sheet

FLOC BLOCKS AN1

Material Safety Data Sheet (MSDS)

Revision date Friday, 28 May 2010

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1. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND THE COMPANY/UNDERTAKING

Product name: **FLOC BLOCKS AN1**

Manufacturer: Mudtech Ltd, Wyburn House, 1 Crab Lane, Stafford, ST16 1SB UK
Telephone 44 1929 551245 Fax 44 1929 554361 sales@mudtech.co.uk

2. COMPOSITION/INFORMATION ON INGREDIENTS.

Anionic polyacrylamide blend

3. HAZARDS IDENTIFICATION

Not classified as hazardous.

May cause slight skin irritation, especially with repeated or prolonged exposure. May cause some eye irritation which should cease after removal of the product. Very slippery when wet.

4. FIRST AID MEASURES

General: If you feel unwell, seek medical advice, and show this information if possible
Inhalation: Not likely: Solid product
Skin Contact: Wash affected area with clean water. Seek medical health if irritation persists. Replace contaminated clothing.
Eye contact: Irrigate the eye with water or eye wash solution for 10-15 minutes. If irritation persists seek medical attention.
Ingestion: Seek medical help immediately if swallowed. Do not give anything by mouth to an unconscious person. Do not induce vomiting without medical advice.

5. FIRE FIGHTING MEASURES

Suitable Extinguishing Media: Use water or foam spray, carbon dioxide or dry chemical. If water is used, restrict pedestrian and vehicular traffic in areas where slip hazard may exist.
Protective Equipment: Firefighters, and others exposed, wear self-contained breathing apparatus. Wear full firefighting protective clothing. See MSDS Section 8 (Exposure Controls/Personal Protection).

6. ACCIDENTAL RELEASE MEASURES

Use personal protective equipment. Product may cause slip hazard. Absorb large spillages with sand or any suitable medium. Dispose of according to local authority guidelines. Small spillages may be flushed away with water. Avoid washings entering water courses.

Methods for cleaning-up or taking-up:

Scoop into marked containers for disposal as chemical waste. Residues or small spillages should be hosed away completely with plenty of water. Contain washwater and dispose of in

FLOC BLOCKS AN1

Material Safety Data Sheet (MSDS)

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accordance with local regulations. Spilled product which becomes wet or spilled aqueous solution create a hazard because of their slippery nature. Pick up with inert absorbent material (e.g. sand, earth etc.).

7. HANDLING AND STORAGE

Handling:

Do not eat, drink or smoke during work. Remove contaminated clothing immediately and launder before re-use. Before breaks and end of work wash hands and/or face.

Storage requirements:

Protect from water and moisture. Keep in a dry, cool place. Avoid extremes of temperature.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Technical measures/precautions:

Ensure adequate ventilation, especially in confined areas.

Respiratory protection:

Respiratory protection not required.

Hand protection:

Rubber or plastic gloves.

Eye protection:

Tightly fitting safety goggles (chemical goggles).

Skin and body protection:

Lightweight protective clothing.

9. PHYSICAL AND CHEMICAL PROPERTIES

Form: solid

Colour: white

Odour: none

pH value: approx. 6.5 (10 g/l)

Melting point: Not tested

Solubility in water: soluble

10. STABILITY AND REACTIVITY.

Conditions to avoid: Extremes of temperature

Materials to avoid: Strong acids

Hazardous decomposition products: No decomposition if stored normally.

11. TOXICOLOGICAL INFORMATION

Skin contact: Not considered toxic by skin contact. Skin irritant.

Eye contact: Risk of persistent effects in the eye.

Acute oral toxicity: rat / LD50: > 2,000 mg/kg

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By analogy with a product of similar composition.

Toxicity to fish:

Oncorhynchus mykiss / 96 h / LC50: = > 3000 ppm (highest tested concentration) Salmo sp. / 7 d / EC50: = > 10000 ppm (Embryo survival test)

Assessment of aquatic toxicity:

Not expected to cause long term adverse effects in the aquatic environment.

When used as directed, the polymer active constituent is retained in on-site waste sludge.

12. ECOLOGICAL INFORMATION

Degradability : Not readily biodegradable

Bioconcentration risk: 0

Water hazard class (as supplied): WGK 2

Water hazard class (as diluted for use): WGK 1

13. DISPOSAL CONSIDERATIONS

Dispose of in accordance with local regulations. In the UK disposal may be made to a licensed treatment/disposal site in accordance with the provisions of "The Environmental Protection Act 1990" as updated.

14. TRANSPORT INFORMATION

UK road/rail Not classified as dangerous in the meaning of transport regulations.

IMDG Not classified as dangerous in the meaning of transport regulations.

ICAO Not classified as dangerous in the meaning of transport regulations.

ADR Not Classified as dangerous in the meaning of transport regulations.

15 REGULATORY INFORMATION

Regulations of the European Union (Labelling) / National legislation/regulations

Classification not required

Inventory status:

European Union (EU):

All components of this product are included on the European Inventory of Existing Chemical Substances (EINECS) or are not required to be listed on EINECS.

United States (USA):

All components of this product are included on the TSCA Chemical Inventory or are not required to be listed on the TSCA Chemical Inventory.

Canada:

All components of this product are included on the Domestic Substances List (DSL) or are not required to be listed on the DSL.

Australia: All components of this product are included in the Australian Inventory of Chemical Substances (AICS) or are not required to be listed on AICS.

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China: All components of this product are included on the Chinese inventory or are not required to be listed on the Chinese inventory.

Japan: All components of this product are included on the Japanese (ENCS) inventory or are not required to be listed on the Japanese inventory.

Korea: All components of this product are included on the Korean (ECL) inventory or are not required to be listed on the Korean inventory.

Philippines: All components of this product are included on the Philippine (PICCS) inventory or are not required to be listed on the Philippine inventory.

16. OTHER INFORMATION

Recommended use Wastewater rclarification aid

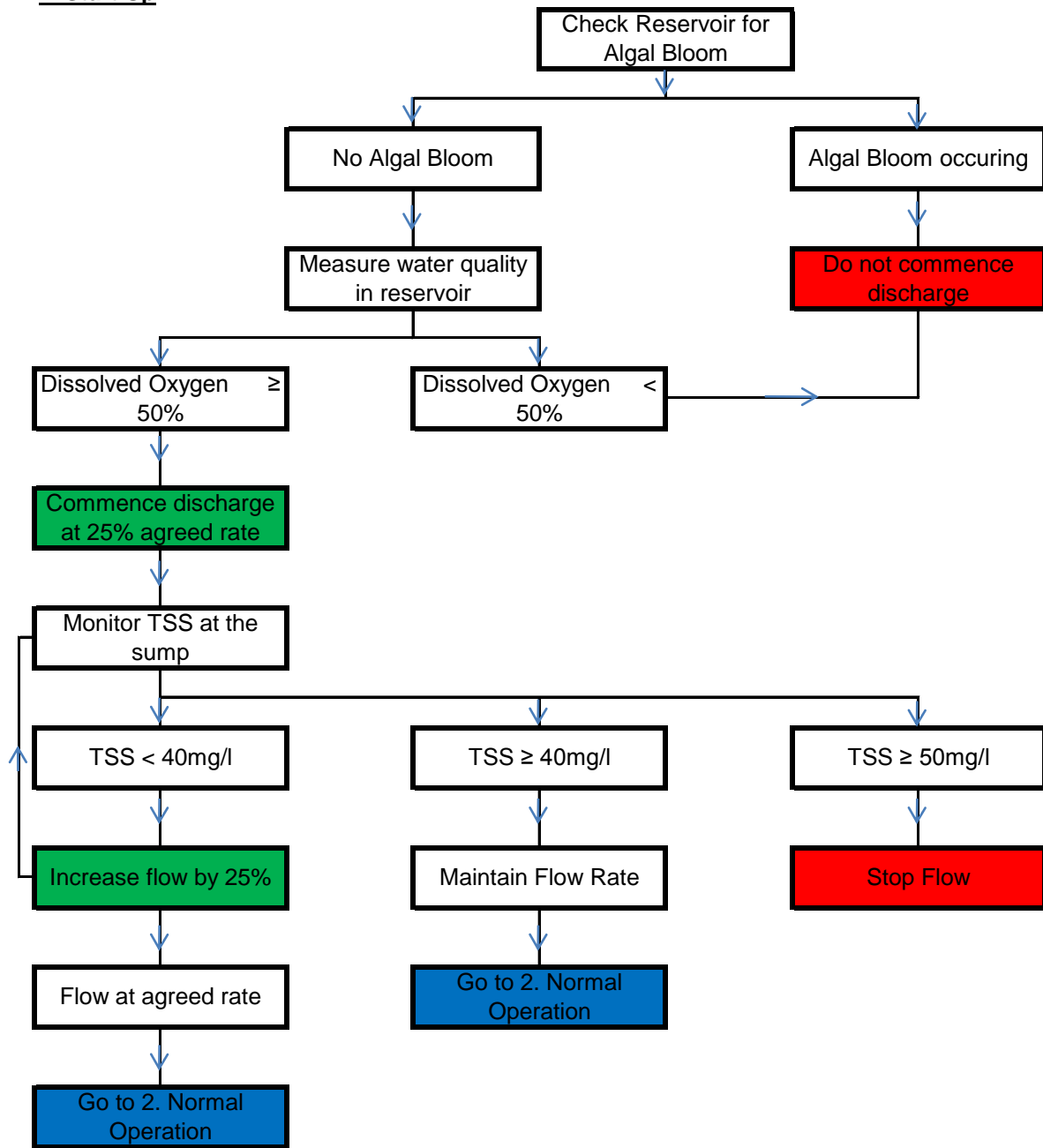
The information contained in this safety data sheet is given in good faith. It is accurate to the best of our knowledge and belief but is offered without guarantee or assumption of any liability and does not constitute or replace the user's own assessment of workplace risk, e.g COSHH, as required by other health and safety legislation.

Appendix D

Updated Flow Charts

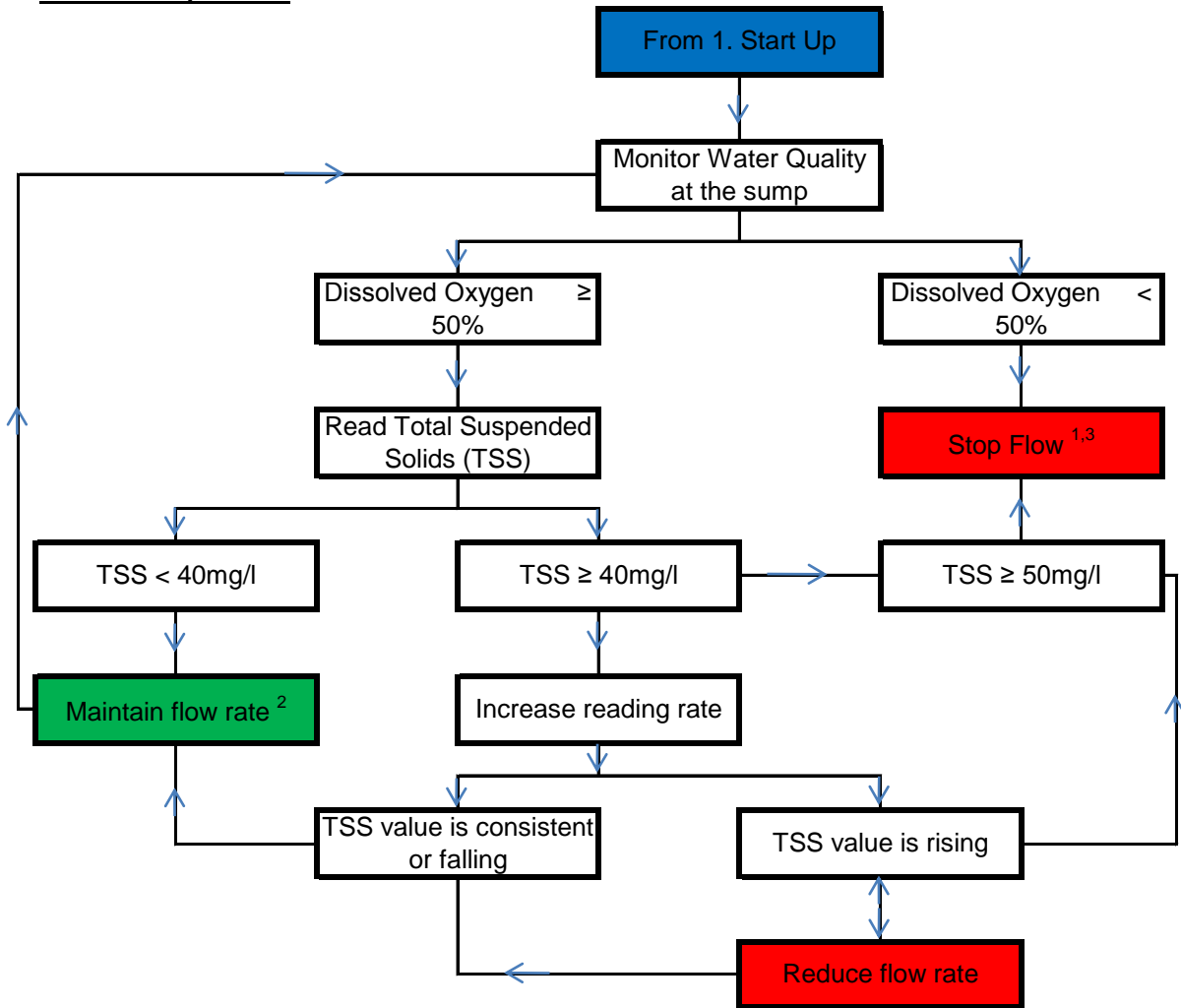
APPENDIX D: UPDATED WATER QUALITY CONTROL FLOW CHARTS

1. Start Up



APPENDIX D: UPDATED WATER QUALITY CONTROL FLOW CHARTS

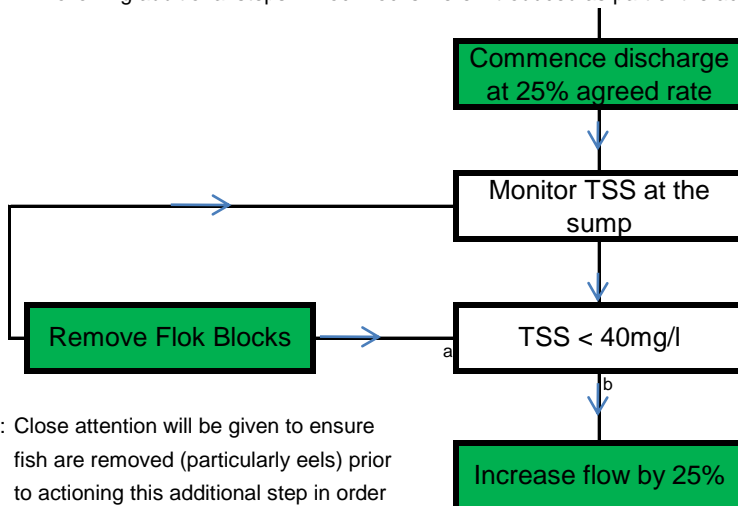
2. Normal Operation



¹ The decision may be taken, in the event of a sudden increase in suspended solids, to insert Flocc Blocks into the channel to maximise the removal of silt whilst action is being taken to stop the flow.

² Or increased if flow rate is less than the maximum agreed flow rate.

³ Time given to allow suspended solids to settle at the source and flow returned as set out in 1. Start Up with the following additional steps if Flocc Blocks were introduced as part of the action to stop flow:



NB: Close attention will be given to ensure fish are removed (particularly eels) prior to actioning this additional step in order to minimise/avoid exposure.