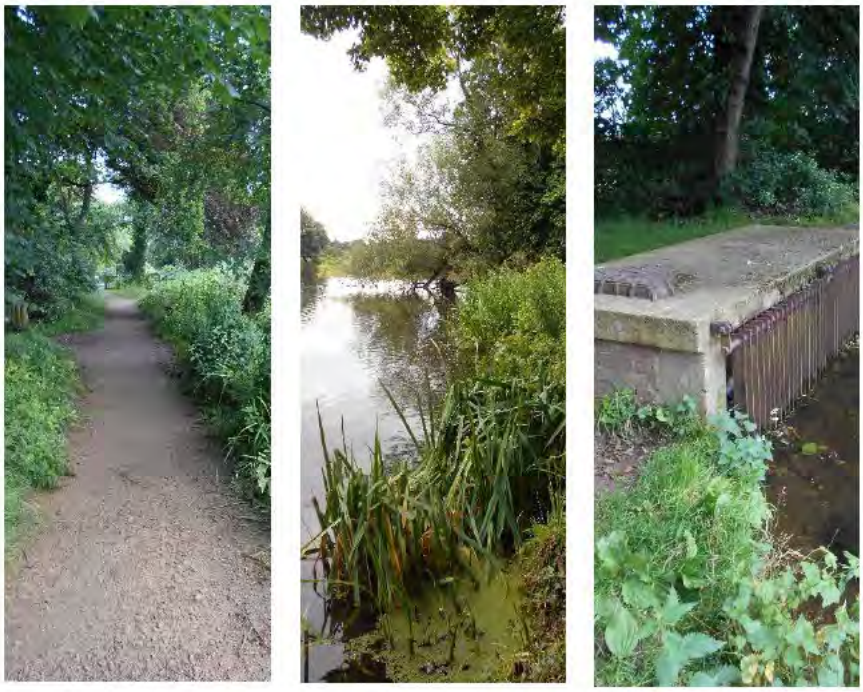

Reservoirs Act 1975
Poynton Lake Reservoir

Report of an Inspection under Section 10(2) of the Act

August 2016

Cheshire East Council

Mott MacDonald

Reservoirs Act 1975
Poynton Lake Reservoir

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Cheshire East Council

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Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
A	23rd August 2016	[redacted]	[redacted]	[redacted]	Final Issue

Information class: Standard

Contents

1 Name and Situation of Reservoir, including the National Grid Reference of the Approximate Centre

The reservoir is situated just to the north of Poynton village in Cheshire. It is an elongated body of water that extends in an approximate north to south direction alongside the main A523 road that connects Macclesfield and Stockport.

The National Grid Reference of the reservoir is SJ 923845.

2 Name and Address of the Engineer

[redacted] BSc (Eng), CEng, FICE
Mott MacDonald,
[redacted]

3 Name of Panel of which the Engineer is a Member

All Reservoirs Panel.

First appointed to the Panel on 12th December 1997, and the current appointment expires on the 11th December 2017.

4 Name and Address of the Undertakers who Appointed the Engineer

Cheshire East Council

Asset Management Service
Municipal Buildings
Earle Street
Crewe
Cheshire
CW1 2BJ

It is understood that Cheshire East Council took over the role as Undertakers in 2009 following a re-organisation. Prior to this date the Undertakers had been Macclesfield Borough Council.

5 Address of the Enforcement Authority

Environment Agency

Manley House
Kestrel Way
Exeter
EX2 7LQ

6 Name and Address of the Supervising Engineer

[redacted]

Mott MacDonald Ltd
[redacted]

It is noted that at the time of the visit there was no Supervising Engineer in place for this reservoir. [redacted] has only been appointed subsequent to the visit and hence it was not possible for him to participate in the inspection. The requirement for continuous supervision of the reservoir is discussed further in Section 13 of this report.

7 Date of the Inspection

11th July 2016

8 Reports and Certificates of Previous Inspections and Other Information Provided

The following documents were made available to the Inspecting Engineer and have been examined during the preparation of this report:-

- The last report following a Section 10 inspection of the reservoir. This report was dated 5th August 2005 and was prepared by Mr [redacted] of Halcrow, following an inspection that had taken place on 20th May 2005. This inspection was undertaken on behalf of the Undertakers at that time; Macclesfield Borough Council. The report was accompanied by an Inspecting Engineer's certificate that had been prepared under Section 10(5) of the Reservoirs Act. Within the report

there were no recommendations made on matters that needed to be addressed in the Interests of Reservoir Safety.

It is noted however that, contrary to the requirements of Section 10(2) of the Reservoirs Act, there had been no independent, statutory inspection of this reservoir carried out for more than 11 years.

- The most recent annual statement that had been produced by the previous Supervising Engineer [redacted] of Aecom Ltd), which had been prepared in accordance with Section 12 of the Reservoirs Act. This statement was dated 10th August 2012 and covered a period of more than 1 year from November 2010 until August 2012. At that time the Supervising Engineer had been engaged by the new undertakers for the reservoir; Cheshire East Council.

- Two layout drawings of the lake and the surrounding area that had been prepared by the current undertakers (Cheshire East Council.

- A single drawing (Reference V-R5971/100 and dated October 2013) entitled 'Poynton Lake Sewer Outfall – Existing Drainage Plan'. This drawing had been produced by Opus on behalf of the Council.

- Details of investigation and cleaning works that had been carried out to the outfall sewer pipe in November 2014.These works including CCTV survey and root cutting operations were undertaken by the firm Aqua-Jet Drainage Specialists and the information that was provided includes a summary report of the findings, images from the CCTV survey and photographic evidence of the clearance work that was carried out on the buried pipeline.

- Details of the sewer network (as available from United Utilities plc) that exists at the southern end of the lake and how this connects with the stream inlet (Lady Brook) that runs into the Poynton Lake.

There was no Prescribed Form of Record (PFR) made available at the time of the inspection. Subsequent to the inspection efforts have been made to locate the PFR but these have been unsuccessful and it would appear that the Record has been lost. It is understood that a PFR used to exist as this is referred to in the Section 12 statement of August 2012, although it is noted that [redacted] was not able to inspect the PFR at his site visit that had taken place in February 2012. The non-availability of the PFR and the failure to maintain the appropriate records is discussed further in Section 14 of this report.

9 General Description

9.1 Description of Reservoir

The reservoir is an ornamental lake that is located within the grounds of Poynton Park. The majority of the park area is situated to the east of the lake and beyond the park there are housing developments to both the north-east and the south. It is understood that the reservoir was constructed around 1750, although there are no drawings available or other details of its construction. The original purpose of the reservoir is not

known, but for many years it has been used solely as an amenity lake within the park. There is abstraction of water from the lake and thus it stands full for most of the time.

From previous reports it is stated that the surface area of the lake at the Top Water Level (TWL) of 90.711m AOD covers some 6.8ha (68,000m^2). At this level it is also stated that the volume of water retained above natural ground level is 130,000m^3. In other words it is large area of relatively shallow water with an average depth of around 2m. The body of water that is retained is long and narrow; from north to south it covers a length of approximately 800m, whilst the width varies between 50 and 100m.

According to the British Geological Survey the reservoir area is underlain by mudstones of the Permo-Triassic era.

9.2 Catchment

The reservoir has both a direct catchment and an indirect catchment. The direct catchment comprises an area of approximately 1.4km^2 of mostly rolling grassland with some urban development that is situated to the east of the site. The stream that drains this area is culverted beneath the urban area around Anglesey Drive and then discharges in an open channel through the northern end of the park and thence into the lake at its north-east corner.

The indirect catchment has an estimated area of 4.5km^2. This area drains into the upper reaches of Poynton Brook which by-passes the southern end of the lake before swinging round to the north on the western (downstream) side of the A523. The natural drainage regime therefore would be for the flow from this area to by-pass the reservoir. However, at around 200m from the southern end of the lake there is a weir and bi-furcation structure whereby a proportion of the stream discharge can be diverted into a channel/culvert arrangement that connects with the lake. This section of channel/culvert between the bi-furcation and the lake also serves as the outlet for the surface water drainage system of the houses in Parklands Way. At the downstream end of the channel there is a culvert beneath South Park Drive that discharges into the southern-most limb of the lake. It was previously reported that this culvert had a diameter of only 225mm, although from visual observations at its upstream end (see Photograph A13), it would appear that it is considerably larger with an estimated diameter of 500mm. Nonetheless the discharge from the indirect catchment area of the Poynton Brook that feeds into the reservoir, will be restricted by the hydraulic capacity of this pipe and of the channel system that conveys the water from the bi-furcation structure.

9.3 Details of Modifications, Remedial Works and History

There is no information available on the history of the reservoir or on modifications that may have been made during its long existence. The only details of recent improvements are for the CCTV survey of the buried overflow culvert, together with photographic evidence of repairs and clearance works that were carried out in 2014 to remove blockages, mostly caused by tree roots, and to reinstate sections of the pipe where it was identified that partial collapses had occurred.

9.4 Dam Details

The embankment that impounds the reservoir is approximately 800m long and is orientated in a north to south direction. The reservoir was created on ground that slopes gently towards the west and to close off the basin that forms the lake an embankment of height 2 to 3m over most of length was required. This embankment forms the western rim of the reservoir. The maximum height of the embankment is approximately 7m which occurs at a narrow valley near to the northern end of the reservoir. The A523 road occupies a berm on the downstream face of the embankment. It is not known whether the berm formed part of the original dam construction, but given the age of the dam it is highly likely that the road has been improved and widened on several occasions, thus providing additional width to the berm and support to the downstream face. The level of the road along the berm is not constant and it varies with respect to the water level in the reservoir within a range of 0.3 to 1.0m below TWL

At the upstream (eastern) side of the road there is a low masonry retaining wall that extends over much of the length of the embankment. The wall is approximately 1m high. At the northern end of the dam the wall has been discontinued and the downstream face is simply formed by a steepened slope of height of up to 2m (see Photograph A9).

The upstream slope of the embankment remains submerged and there are no record drawings to show the construction details. It is estimated that the slope is very shallow with a gradient of about 1 in 4 (vertical to horizontal). It appears as if there are silt deposits overlying the original fill and it is thought that there is no formal engineered protection to the face.

The crest of the embankment varies considerably in width along its length. Typically the crest comprises a nearly level area at a level of 90.92m AOD (200mm higher than TWL). Overall the crest has a width of 10 to 12m over much of its length but widens to around 20m at the southern end. In this area, adjacent to the disused Council Yard, the widened area stands at a higher level than the majority of the crest path (see Photographs A4 and A5). There is a 2m wide gravel footpath on the crest that is set back from the water's edge by between 0.5 and 1m. Downstream of the path there is extensive tree growth across the crest to the top of the downstream face.

Over most of its length the downstream face has a slope of approximately 1 vertical to 3 horizontal and the toe is supported by the 1m high masonry wall. Where the wall does not exist the slope is slightly steeper at around 1 vertical to 2 horizontal.

9.5 Overflow Works

The overflow arrangement comprises a concrete intake structure with screens housing an overflow weir. It is located towards the northern end of the embankment where it stands at its highest above the floor of the downstream valley. The length of the weir is 4m and it is formed in two equal sections with a dividing pier. The two screens are hinged at the top to allow them to be opened to give access to the weir if needed.

Behind the weir the spillway drops into a chamber set with a floor level that is approximately 0.8m below the sill level of the weir. The chamber in turn feeds into a 450mm diameter piped culvert with an invert set at the chamber floor level. The 600mm diameter pipe passes through the embankment to the downstream side via two manholes with backdrops. One manhole (MH1) is on the crest of the dam and the other (MH2) is on the downstream side of the road. At the downstream side of the dam the flow is conveyed in two parallel, buried pipelines, one of 300mm diameter and one of 450mm diameter. These pipes cross a field to discharge into the Poynton Brook, which at this point is flowing from south to north, approximately 250m from the toe of the embankment. There are two further manholes (one on each pipe) approximately mid-way along their length. There is a headwall at the discharge into the brook. The layout of the overflow pipelines is shown on the Opus Drawing (V-R5971/100) that was prepared in October 2013 prior to the execution of the CCTV survey and subsequent cleaning works. The route of the buried pipeline which carries the water from the overflow to the brook at the downstream side of the dam is shown in Photograph A12.

9.6 Outlet Works

There is no known outlet from the reservoir. From previous reports it is understood that inspections have failed to find either an intake to a bottom outlet or an outlet pipe. If such a structure did exist it is entirely possible that it has been discontinued many years ago and that any remnants of the outlet works have simply been buried beneath the road. Under normal circumstances there is no requirement for abstraction of water from the reservoir and as such it remains full for most of the time.

9.7 Access

There is good vehicular access to the reservoir site. There is a car park at the northern end of the embankment and from this point there is direct pedestrian access on to the path that runs along the crest. The footpath alongside the A523 extends along the full length of the dam and gives access to the retaining wall and to the downstream face. At several points along its length there are gaps through the wall and steps which connect the footpath with the crest.

In addition there is vehicle and foot access around the southern end of the lake (South Park Drive and Woodside Lane) via which the inlet works and bifurcation arrangement on the Poynton Brook can be reached. The field to the west of the A523 which includes a part of the downstream face is not owned by the Council. At the present time there is only restricted access to this field. This is not an ideal situation and representations should be made to [redacted] in order to improve the access arrangements.

10 Description of the Inspection and Conditions Found

10.1 General

The inspection was carried out on the morning of 12th July 2016. The weather at the time of the inspection was cloudy but dry and the temperature was around 17°C. There had been heavy rainfall on the day prior to the inspection and the conditions underfoot were quite wet in the undergrowth, but nonetheless the ground

in general was reasonably firm. There was very little wind and as a consequence the water surface across the lake was calm and still. It was considered to be good conditions for carrying out the inspection.

The inspection was carried out in the company of [redacted], Property Operations Advisor, from Cheshire East Council. [redacted], Flood Risk Manager for the Council, and [redacted] Flood Risk Engineer, were also in attendance. They had decided to participate in the inspection in the light of recent surface water flooding (June 2016) that had occurred in properties to the south side of the lake in the vicinity of Parklands Way. As noted above, the Supervising Engineer had not been appointed at the time of the visit and was thus not able to attend.

The reservoir was full at the time of the inspection with a depth of approximately 100mm discharging across the overflow weir and into the downstream chamber/outlet pipe. It was stated that this is the normal situation and as there is no abstraction from the lake, the natural condition is for the outflow via the overflow to balance the run-off from the catchment. On this occasion it was noted that virtually all of the flow was that arising from the direct catchment stream. When the inlet from the indirect catchment at the southern end was visited it was observed that there was very little incoming flow via this route. A number of photographs were taken during the inspection to illustrate key points and these are included as Appendix A of this report.

10.2 Embankment Dam

10.2.1 Upstream Face

The inspection commenced by walking along the crest path in order to assess the condition of the upstream face. The reservoir was full and as a consequence only a small part of the face that stands above the water surface was exposed. As can be seen in Photographs A1 to A3, there were considerable amounts of vegetation sprouting along different parts of the upstream edge that obscured the view. In addition, the upstream face does not follow a straight line but instead has a gently curved alignment that follows the line of the crest path through the wooded area. Taking all of these factors into account meant it was difficult to make a detailed assessment of the condition, but in general and as observed at different locations along its length, it appeared to be reasonably intact.

There is no engineered protection to the face and it is evident that some areas have suffered minor erosion damage and loss of material as a result of wave action. It is likely that this has been an on-going situation for many years and to minimise the damage timber board revetments have been installed at certain parts of the crest, particularly towards the northern end. A typical example of this timber protection is shown in Photograph A2. These timber boards have been in place for many years and appear to functioning well. However in some cases the boards are beginning to bulge and show signs of decay, or holes have started to form in the fill material behind the boards. In this respect the presence of vegetation and roots pushing down behind the revetment will tend to displace the timber and lead to further damage. From the Supervising Engineer's statement of 2012 it is clear that similar conditions were observed and reported at that time. In fact photographs taken at that time, which were during the winter when there was less vegetation cover, showed various examples where repair work was needed. It is not clear what repairs, if any, have been implemented in the past 4 years. However, the need to inspect and repair the face protection is an on-going

maintenance requirement. I recommend that a detailed and comprehensive assessment of the condition of the boards should be carried out to identify those parts that are in need of repair or replacement. These localised repairs should then be implemented. Typical repair/reinstatement work will involve removal of vegetation (saplings and small bushes) from along the face, filling of voids behind the timber boards, provision of additional timber posts to support the boards and replacement of boards that are found to be rotten.

A further potential problem is the presence of many mature trees that exist on the dam. It is not an ideal situation to have large trees on a water retaining embankment. However given that this is a small dam and that the trees have been in existence for many years, it is acceptable provided that the trees are managed in a proper manner. Walking along the crest it was noted that several trees are leaning towards the water and in some cases the trees have actually toppled over (see Photograph A3). When a tree falls over the movement of the root bowl causes further disturbance to the fill and in the vicinity of the upstream edge this can lead to a weakened area that will then be susceptible to erosion. In conjunction with the repairs to the revetment protection works I recommend that any fallen or leaning trees that are threatening the integrity of the face should be removed. When the roots and stumps have been cleared away, the upstream face should be reinstated to the correct line and new revetment boards should be installed in order to provide erosion protection.

10.2.2 Embankment Crest

The crest of the dam comprises two parts; the gravel path that runs along the upstream edge and the broad expanse of grassy area, sometimes at a higher level than the path, which is located at the downstream side. The path itself was found to be in a good state of repair. It has a good regular surface of gravel type material and appeared to be well maintained. There were a few minor humps and bumps in the path but nothing more than might be expected. There were no signs of excessive disturbance, settlement or cracking that might arise from movement of the embankment. In spite of the recent heavy rainfall the path was reasonably dry and there were no signs of standing water. It is understood that this path is used regularly by dog walkers and other visitors to the park.

The downstream part of the crest is shown in Photographs A4 and A5. These areas are grass covered but also support numerous mature trees. Between the trees the grass and other soft vegetation was of moderate length and from time to time this should be cut back as part of normal ground maintenance. Walking through these areas the ground was a little uneven but once again there were no signs of unexpected movement. With regard to the trees it is recommended that they should be managed and checked on a regular basis. Any trees that become unhealthy and which may be in danger of toppling should be removed. If the tree canopy becomes too dense then I recommend that careful pollarding of the trees should be carried out to reduce the height of the trees and to let more light through to the ground beneath to encourage healthy grass growth.

10.2.3 Downstream Face and Retaining Wall

As reported above the downstream face varies; in some places there is a masonry wall at the toe whilst in other parts the face slopes down directly to the path alongside the road. Various views of the face are shown in Photographs A6 to A9. In many places a detailed assessment of the condition was hampered by the vegetation which tends to obscure the ground surface, but in general the slope of the face was fairly regular with no indication of movement or instability. As far as could be determined and taking due account of the curvature of the dam, it appeared that the alignment of the face (both the wall section and the sloping face) was regular and has not suffered any serious displacement. As with the grassy parts of the crest, it is recommended that regular ground clearance activities are carried out to minimise the spread of the undergrowth and in order to expose the dam profile in the areas between the large trees.

The masonry retaining wall is shown in Photographs A7 and A8. The overall alignment was reasonable as it follows the line of the footpath. The wall appears to be stable and there were no indications of imminent collapse. However there were several areas noted (see Photograph A8) where individual stones have been displaced and where localised bulging is occurring. It is recommended that the parts of the wall that have experienced this type of damage and movement should be repaired. Reference to the Annual Statement of 2012 seems to indicate that localised damage to parts of the wall has been a feature for several years. It is not known whether the responsibility for repairs to the wall lies with the undertakers for the reservoir (Cheshire East Council) or with the Highway Authority, but clearly any misunderstanding needs to be resolved in order that the appropriate repair work can be implemented.

Towards the southern end of the dam there is an old and now disused Council Yard that occupies the land between the road and the dam. The yard is now in a state of disrepair and neglect and this includes the perimeter wall at the east side of the yard that forms a boundary with the face of the embankment. It is recommended that the old Council Yard is tidied up in order to facilitate access to this part of the dam and in order that any repairs to the wall within the yard can be carried out.

The highest section of the dam is towards the northern end and at this point the downstream face continues on the downstream (western) side of the road. This section of the face is shown in Photograph A10. This part of the face is within a field that is owned by [redacted] It was fenced off such that there was no access during the inspection. Whilst the overall alignment appeared to be satisfactory it is important that all parts of the embankment structure are accessible. In particular, it would be useful if regular surveillance visits to the reservoir were to include a walk along the downstream toe at this highest section to check for signs of leakage or water egress. I recommend that the Council should enter into dialogue with [redacted] in order to agree appropriate access arrangements into the field and onto the downstream face.

10.3 Overflow Structure

The inlet structure to the overflow is shown in Photograph A11. As can be seen in the photograph the two upstream bar screens that protect the weir were clear of debris and there was a small but steady flow passing through the screens and over the weir. This flow was discharging into the chamber and into the downstream pipe without hindrance. The majority of the overflow works are buried and cannot be readily inspected;

however as far as could be seen the overflow was operating satisfactorily and the modest spill flow was passing through the pipe system to reach the course of the Poynton Brook at the downstream side.

The CCTV survey of the outlet pipes that was carried out in 2014 had revealed considerable problems with the pipes. In fact these potential problems had been referred to in the Supervising Engineer's statement of 2012 where it was noted that a hole along the line of the overflow (first observed in 2009) had deepened. In addition it was reported that other depressions had appeared along the line of the overflow pipe. It is thought that these observations eventually triggered the CCTV survey and the subsequent repair work. A number of problems were encountered including tree roots within the pipes, displaced and open joints, loss of material from around the buried pipes and ingress of material into the pipes. In addition, the buried inspection chambers that exist at the mid-length of the pipes were identified. From photographs that have been provided it is understood that various repairs were executed to rectify the problems. These included replacement of sections of pipe, cutting of roots, removal of blockages and flushing of the pipes. New covers were also provided to some of the inspection chambers to facilitate future access and inspection.

The downstream valley that connects with the Poynton Brook and which represents the route of the overflow outlet pipe is shown in Photograph A12. Unfortunately because of access restrictions it was not possible to walk along this route or to inspect the outfall at the end of the pipe where the water discharges to the brook. This is an unsatisfactory situation which needs to be resolved in order that regular surveillance, inspection and maintenance of the overflow works can be carried out.

10.4 Outlet Works and Emergency Drawdown

As reported above there is no outlet works at this reservoir and no permanent means by which water can be abstracted from the reservoir. For a small reservoir this is not so unusual and need not be a problem. However, in the case of an emergency there might be a need to lower the water level in the reservoir in order to reduce the hydrostatic load on the embankment. The retro-fitting of an outlet pipe through the embankment is probably not practical, but in such circumstances alternative means of drawing down the reservoir level must be considered. These might include the provision of a siphon pipe (either permanent installation or temporary) to carry water over the embankment, or the provision of temporary pumps to lift water out of the reservoir. In both cases the water could be discharged to the downstream watercourse via over-ground pipes or it could perhaps be conveyed to the stream via the exiting outlet pipes from the overflow. Whatever method is considered, should be practical and proven to work. It is not expected that the reservoir could be lowered during high flood flows but the facility should be sufficient for "normal" conditions. If pumping sets are to be used, their availability at short notice (night, public holidays etc.) should be confirmed, as should their accessibility, locations on site, discharge points and the ability to maintain and re-fuel them at all times.

This is a relatively small reservoir with a low embankment. In an emergency situation a drawdown rate of around 0.3m of water level in the first 24 hours would normally be sufficient. Based upon the volume of water retained and assuming a normal dry weather incoming flow, it is suggested that an emergency drawdown capacity of up to 300 litres/sec needs to be considered. I recommend that an Emergency Drawdown Plan should be prepared for the reservoir. This must consider how the drawdown would be achieved including the methods to be used, the implementation of the plan, lines of communication and responsibilities. It is

anticipated that the Supervising Engineer will be able to provide advice on the content and preparation of the drawdown plan. I recommend that this matter should be addressed in the Interests of Reservoir Safety and in this respect I recommend that the plan shall be completed and agreed within one year of the date of this report.

10.5 Instrumentation

This is a very small embankment dam and there is instrumentation installed within it in order to monitor performance. In view of its size and based upon my observations at the site there is no particular cause of concern, and I am of the opinion that instrumentation is not required at this site.

10.6 Method of Recording Water Levels

The reservoir water level can be read from a graduated gauge board that is fixed to the upstream side of inlet structure to the overflow. At this visit it was found that the board was partially obscured by vegetation growth and it was evident that water level readings have not been taken for some time.

It is recognised that the reservoir remains full or near to full for most of the time. Taking this into account I recommend that water levels should be taken and recorded at least once per month. In addition, exceptionally high levels during flood conditions or low levels that might occur during a drought should also be recorded. In accordance with Section 11(1) of the Reservoirs Act, the undertakers have a legal obligation to monitor the reservoir including the taking and recording of water levels.

10.7 Control of Inflow

For the direct catchment area there is no means by which the incoming stream flow can be regulated or closed off. However the culverted section of the stream (beneath Anglesey Drive) will provide a restriction to the incoming flow in that under flood conditions it will be limited to the discharge capacity of the pipe. Details on the length and diameter of the pipe which will influence the discharge characteristics are unknown.

For the indirect catchment area to the south there will be similar restrictions to the incoming flow from Poynton Brook that would occur during a flood. These will arise from the inlet pipe that passes beneath South Park Drive (see Photograph A13) and also from the operation of the weir and bi-furcation structure that is situated further upstream near to Woodside Lane (see Photograph A14). The inter-connection details between this structure and the local drainage system need to be confirmed. From discussions with local residents and with the representatives from the Council's Flood Management Team, it appears as if part of the piped drainage that should feed into the stream is ineffective, possibly as a result of a blockage. As a consequence, at times of heavy rainfall and high run-off there has been surcharging and backing-up of the system which has caused localised flooding in properties and gardens around Parklands Way. It is understood that flooding in this area occurred most recently in June 2016.

These problems are affecting the area that is upstream of the reservoir and whilst they need to resolved, they do not have a direct bearing on the safety of the reservoir. However, they do represent a restriction to

the discharge that might enter the reservoir. In this regard I recommend that the incoming flow conditions including the characteristics of the bi-furcation should be checked and incorporated in an updated flood study for the reservoir. Further details are given in Section 11.2.

10.8 Movement of Surrounding Ground

From the inspections that were carried out there were no signs of movement either on the embankment, in the areas downstream of the embankment, along the A523 road, or in the park that surrounds the reservoir. A full walk around inspection of the reservoir was not undertaken but the park area to the east comprises gently sloping terrain along the water's edge. The conditions observed from the embankment indicated nothing untoward around the margins and nothing that would impact on the safety of the reservoir.

11 Review of Flood and Discharge Capacity

11.1 Flood Category

To determine the appropriate flood category for this reservoir, the Inspecting Engineer has examined the conditions downstream, both physically at the site and by reference to Ordnance Survey mapping and aerial imagery of the area. Immediately downstream of the dam the outflow from the reservoir flows in a westerly direction; it passes in buried pipe beneath the road and then along the line of the valley, before joining with the watercourse that is the Poynton Brook. The brook then continues towards the north and west before joining with the Larger Lady Brook that flows through Bramhall and Cheadle Hulme, to the south-west side of Stockport.

In the near vicinity of the reservoir the watercourse runs through open fields and land that is largely rural. However, after about 3km the areas alongside the course of the Lady Brook are partially urbanised. If there was a breach of the embankment then the main infrastructure that would be affected would be the A523 road that is immediately downstream, along with a few properties that are located alongside the road. At the road's lowest point there is perhaps a difference between water and road level of 1m. It is concluded therefore that if there was a breach failure and a sudden escape of water, there could be considerable damage to the road and traffic along the road could potentially be at risk.

Taking these factors into account, it is my opinion that the reservoir should be placed in Flood Category B, as presented in the Institution of Civil Engineers publication ' Floods and Reservoir Safety, 4th Edition, 2015', whereby a breach could endanger lives although not in a community, or could result in extensive damage. The new guidelines recommend that the safety of a reservoir to withstand floods should be assessed against two criteria:-

- The Design Flood – this is the inflow that must be discharged under normal conditions with a safety margin provided by freeboard.
- The Safety Check Flood – the inflow beyond which the safety of the dam cannot be assured, it is acknowledged that under this criterion some damage may occur to the dam, for example by wave overtopping or overflowing.

For a dam of Category B, Floods and Reservoir Safety recommends:-

- The Design Flood should be the 1 in 1000 year return period flood with a minimum wave freeboard of 0.6m.
- The Safety Check Flood should be the 1 in 10,000 year flood.

It is noted that this categorisation is the same as that recommended in the 2005 Section 10 inspection report, but given that there have been no changes in the downstream conditions, I believe that this remains a valid assessment.

The Reservoirs Act 1975 as amended by Schedule 4 of the Flood and Water Management Act 2010 requires large raised reservoirs to be designated as either 'high risk' or 'not high risk'. A high risk designation will be assigned to reservoirs where a breach could result in endangerment to life. At the time of writing this report, the Enforcement Authority are undertaking the risk designation process, but it is understood that the Undertakers for this reservoir are yet to receive the final notification of the risk designation. However, from my knowledge of the reservoir I have little doubt that it will be designated as 'high risk'.

11.2 Design Flood Assessment

It was stated in [redacted] report of 2010 that there was no indication that a complete flood study assessment had been carried out previously. As part of his inspection therefore he prepared a 'Rapid Assessment' in accordance with the Floods and Reservoir Safety Guidelines (3rd Edition) that were in place at that time. This assessment included an assessment of the 30% Probable Maximum Flood (0.30 PMF), which is generally considered to be equivalent to the 1 in 1,000 year flood event. The results of this estimation and of the routing of this flood hydrograph through the reservoir showed that the predicted flood surcharge would rise to within 0.1m of the embankment crest, and that there would be very little remaining freeboard margin to accommodate wave action on top of the flood. These results showed that the estimated maximum inflow to the reservoir at the peak of the flood would be 2.64m^3/sec, although there was no information provided on the amount of restriction to the incoming flow (if any) that had been taken into account to allow for the discharge capacities of the culverts that feed the water from the streams to the reservoir.

In the past few years there have been a number of refinements in the methods that are used to estimating the magnitude of extreme floods. In addition the publication of the 4th Edition of the Floods and Reservoir Safety Guidelines has introduced the new concept of the more onerous Safety Check Flood that needs to be considered as well as the Design Flood. To bring things completely up to date it is important that the expected performance of the reservoir under flood conditions is fully understood. I recommend therefore that an up to date flood study shall be prepared which is based upon the latest estimation methods and the current guidance.

It is recognised that the incoming flows from both the direct and indirect catchment areas will be influenced and to some extent restricted by the hydraulic capacity of the culverts and channels that convey the water to the reservoir. As a consequence the flood study will need to include a hydraulic assessment of these upstream structures in order to determine the inflow hydrographs. As noted in Section 10.7 this aspect is

particularly important for the flow that enters the reservoir at the south end. The new flood study shall consider both the Design Flood (1 in 1,000 year) and the Safety Check Flood (1 in 10,000 year). It should also incorporate an estimate of wave heights and the potential for wave over-topping that could occur during the passing of these floods. To assess the risk to the embankment and the adequacy of the existing freeboard, I also recommend that the study should include an up to date topographic survey of the embankment crest (footpath levels and levels of the raised portions of crest).

This recommendation is made in the Interests of Reservoir Safety and I recommend that the study should be completed within 1 year of the date of this report.

11.3 Flood Plans

The Floods and Water Management Act 2010 requires Flood Plans to be produced for specified reservoir. However, as yet, no guidance has been issued by the Environment Agency. As a pre-curser to the preparation of flood plans, flood inundation maps that indicate the extent of flooding should there be a breach of a dam and an uncontrolled escape of water were produced by the Environment Agency in 2009. These inundation maps are primarily for Emergency Planning purposes, but for information the basic maps showing the extent of the flood outline are in the public domain and have been issued to all reservoir Undertakers.

For a Category B reservoir such as Poynton Lake it is likely that some form of on-site flood plan will be required, although the exact requirement (if any) would need to be determined when further guidance is provided by the Environment Agency and a Direction made by the Secretary of State. A key component of the On Site Plan would however be the Drawdown Plan for the reservoir. The requirement to prepare a drawdown plan is described in the recommendation given in Section 10.4.

12 Seismic Risk

The seismic assessment for the reservoir has been made in reference to the Building Research Establishment Report 'An engineering guide to the seismic risk to dams in the UK, 1991' and the follow up Application Note published by the Institution of Civil Engineers in 1998. Using this guide, Poynton Lake Reservoir would be placed in Hazard Category II on the basis of the preliminary assessment shown in the table below:-

Table 12.1: Seismic Risk Assessment

Parameter	Value	Classification Factor
Capacity	130,000m³	2
Height	7m	0
Evacuation requirements	<100	4
Potential damage	Low	4
Total		**10**

Under this classification, it is stated that a seismic safety evaluation may be necessary to confirm the stability of the embankment. In the case of this location the earthquake loading recommended would be equal to a peak ground acceleration of around 0.15g. The embankment is a very low structure and from the inspection made and the conditions observed on the outside of the embankment, it is considered that the stability would be satisfactory under these conditions. It would be able to withstand this amount of shaking without giving rise to a breach and a sudden escape of water. Any loss of freeboard that might arise from earthquake induced settlement is also likely to be small. Taking these points into account it is considered that no further action is needed on this matter.

13 Supervision Provided by the Undertakers

The supervision that is currently provided by the Undertakers is not satisfactory. Until recently the Undertakers had failed to meet their obligations under Section 12(1) of the Act in that there was no Supervising Engineer employed for this reservoir. This matter has now been rectified and a new Supervising Engineer [redacted] has been appointed.

14 Correctness of Particulars in the Prescribed Form of Record

It is understood that a Prescribed Form of Record (Blue Book) for the reservoir used to exist, although it can no longer be located and therefore it was not made available for my examination as part of this inspection. It is thought that the Record may have been lost at the time that the responsibility for the reservoir was transferred from Macclesfield Borough Council to Cheshire East Council. Irrespective the reason, the current situation is unsatisfactory in that the Undertakers are failing to meet their obligations under Section 11(1) of the Act, whereby they are required to keep a Record of the reservoir in the Prescribed Form, including the recording of water level readings.

A new format for the Prescribed Form of Record has recently been introduced following changes to the Reservoirs Act. The new format becomes a requirement at a reservoir once the final notification of risk designation has been received from the Environment Agency. The new format is substantially similar to the existing format, but includes additional sections for details on such things as Flood Plans, Drawings, Operation of Valves, Monitoring and Instrumentation.

Given that there is currently no record in existence, I recommend that a new PFR book is obtained and that the relevant details about the reservoir are entered into the book. This PFR should also then be used for the recording of the monthly water levels (see Section 10.6). The non-compliance with regard to the PFR is a serious matter that needs to be addressed as quickly as possible. I am therefore including this matter as an enforceable recommendation under Section 10(3)(b) of the Act (Maintenance) and I recommend that the new PFR shall be in place and ready for checking by the Supervising Engineer within 3 months of the date of this report.

15 Findings and Recommendations of the Engineer

15.1 Scope of Statutory Inspection

The Inspecting Engineer has formed a general opinion of the overall condition of the reservoir. In accordance with normal practice on a periodical inspection under the Act he has not assessed in detail such matters as the design flood, the capacity of the overflow works, the vulnerability to earthquake forces, the overall stability of the structure, the conditions of the foundations, the forces on the foundations, the internal condition of the structural elements of the dam and the condition of buried or inaccessible elements of the works. His opinion is based on his observations on the date of the site visit, examination of the data supplied to him and discussions with the Supervising Engineer and representatives of the Undertakers.

15.2 Findings

My findings as a result of this inspection are that:-

a) The dam falls within Category B as defined by the publication Floods and Reservoir Safety.

b) The dam falls within Category II as defined by the publication An Engineering Guide to Seismic Risk to Dams in the United Kingdom and the Application Note.

c) The reservoir works and the embankment are largely in a satisfactory condition.

d) The overflow arrangements are in satisfactory condition but the capacity of these works needs to be established in order to check the flood rise that will occur during the passing of the Design Flood and the Safety Check Flood.

   The margin between the crest of the dam and the overflow level needs to checked by survey in order to establish the freeboard margin that exists, and so as to assess the risk of embankment over-topping arising from flood surcharge and concurrent wave action.

   I have made a recommendation in the Interests of Safety that an updated Flood Study shall be prepared for the reservoir to address these points.

e) There is no effective means of lowering the reservoir water level and in this respect I recommend that an Emergency Drawdown Plan shall be prepared.

f) No movement of the surrounding land has been observed which might affect the stability of the reservoir.

g) The Undertakers are not complying with their obligations under Section 11 of the Act and I have made further recommendations to address these failings.

15.3 Recommendations as to Measures to be taken in the Interests of Safety under Section 10(3)(c)of the Act

In the Interests of Reservoir Safety I recommend that:

a) An Emergency Drawdown Plan shall be prepared for the reservoir to describe the methods to be used and the procedures to be followed in order to facilitate a lowering of the water in the reservoir by up to 300mm in the first 24 hours of an emergency situation. Further details of this requirement are given in Section 10.4.

b) A Flood Study Assessment shall be prepared for the reservoir. This shall include an estimation of the inflow hydrographs for the Design Flood and the Safety Check Flood, the hydraulic characteristics of the inlet works to the reservoir (direct and indirect catchments), discharge characteristics of the overflow weir and outlet pipe, and flood routing to determine flood surcharge levels. The study should also incorporate an estimate of wave heights and the potential for wave over-topping that could occur during the passing of these floods, as well as a topographic survey of the embankment crest.

   I recommend that each of these matters shall be completed within one year of the date of this report.

15.4 Recommendations as to Measures to be taken under Section 10(3)(b) of the Act (Maintenance)

a) I recommend that a new Prescribed Form of Record (PFR) shall be obtained and that all relevant details of the reservoir shall be entered into the Record including water level readings that shall be recorded each month and entered into Part 1 of the PFR. The completed PFR shall be kept in a safe place so that all future records can be maintained.

   This recommendation shall be completed within three months of the date of this report by which time the PFR should be ready for examination by the Supervising Engineer.

15.5 Other Recommendations as to Measures to be taken in Respect of Maintenance

It is the Inspecting Engineer's opinion that the dam and its associated works are being maintained in a reasonable condition, and in general the works appear to be functioning satisfactorily. It is envisaged that the Undertakers will continue with a regime of routine maintenance, although the shared responsibilities within the Council organisation between the Property Services department and the Parks department need to be clarified to ensure that maintenance work is carried out regularly. To this end the following recommendations are made with regard to continuing maintenance and monitoring:

a) An assessment of the condition of the revetment boards along the upstream face should be carried out to identify those parts that are in need of repair or replacement. These localised repairs should then be implemented.

b) Any fallen or leaning trees that are threatening the integrity of the upstream face should be removed. When the roots and stumps have been cleared away, the upstream face should be reinstated to the correct line and new revetment boards should be installed in order to provide erosion protection.

c) The trees on all parts of the embankment should be managed and checked on a regular basis. Any trees that become unhealthy and which may be in danger of toppling should be removed. If the tree canopy becomes too dense then I recommend that careful pollarding of the trees should be carried out to reduce the height of the trees and to let more light through to the ground beneath.

d) On the downstream face of the embankment regular ground clearance activities shall be carried out to minimise the spread of the undergrowth and in order to expose the dam surface in the areas between the large trees.

e) A detailed inspection of the masonry wall that retains the embankment toe shall be carried out to identify those parts of the wall that are showing signs of distress with missing stones, open joints and bulging of the surface. Localised repair work shall then be carried out to those parts that have suffered damage in order to fill the gaps and to reinstate the wall to the correct profile.

f) The disused Council Yard area at the downstream side of the dam shall be tidied up in order to facilitate access to this part of the dam and in order that any repairs to the wall within the yard can be carried out.

g) The undertakers should enter into dialogue with [redacted] at the downstream side of the A523 in order to agree appropriate access arrangements for Council personnel so that regular surveillance and inspection of the downstream toe and the route of the overflow pipe can be carried out.

15.6 Measures Recommended in the Interests of Improving Monitoring and Supervision under Section 11 of the Act

The performance of the reservoir should be monitored and recorded as follows:-

a) Reservoir Water Levels Monthly (and at intermediate times if level is unusually high).

As part of the monthly routine to check the water levels, I also recommend that the Council personnel that are responsible for the reservoir maintenance should carry out a surveillance visit to check the condition of all parts of the works.

15.7 Recommendations in the Matters of Safety Relating to Personnel and Public

There are no recommendations under this heading.

15.8 Matters to be watched by the Supervising Engineer in accordance with Section 10(4) of the Act

The Supervising Engineer should visit the reservoir at least once per year. As reported above there has been no Supervising Engineer in recent years and I therefore recommend that the newly appointed Supervising Engineer should make his first visit before the end of 2016 (winter visit). A second visit for 2017 could then be organised for the summer so the conditions under different seasons could be observed. In addition to his normal duties he should pay particular attention to the conditions on the downstream side of the embankment and should check the conditions for any signs of movement, leakage or untoward behaviour. His inspections should include a full walk over survey across the downstream toe of the embankment and along the masonry retaining wall to check for signs of deformation or water egress. Provided that suitable access can be arranged he should also check conditions along the downstream toe of the embankment at its highest section.

He should observe the condition of the upstream face to check for signs of erosion damage or movement arising from the instability of the trees, and assess the on-going erosion protection that is afforded by the timber revetment boards. If there is an extreme flood event such that the overflow pipe is required to operate with an unusually high discharge, then it is recommended that the Supervising Engineer should inspect the works after the flood to evaluate the condition and performance of the overflow. He should also monitor progress against the maintenance items included in Section 15.4 and 15.5. It is important that regular surveillance is carried out and the conditions are assessed for any signs of change. In this respect regular contact between the Supervising Engineer and the local staff from the Council, who must carry out routine surveillance visits, should be maintained.

15.9 Recommendation as to the date of the Next Inspection

This report includes two recommendations that are made in the Interests of Reservoir Safety and which should be completed within one year. These recommendations require that an Emergency Drawdown Plan is prepared and that an updated Flood Study assessment is carried out for the reservoir. In due course and in accordance with the requirements of the Reservoirs Act, a Qualified Civil Engineer (QCE) will need to be appointed to supervise and to certify the completion of these safety recommendations.

The report also includes another recommendation which is enforceable (see Section 15.4) and which should be put into effect within three months. This concerns the need to provide and maintain a Prescribed Form of Record (PFR).

Provided that these recommendations are carried out satisfactorily and within the timeframes specified then the next full statutory inspection of the reservoir need not be for a further 10 years, and on this basis it should be carried out on or before 10th July 2026.

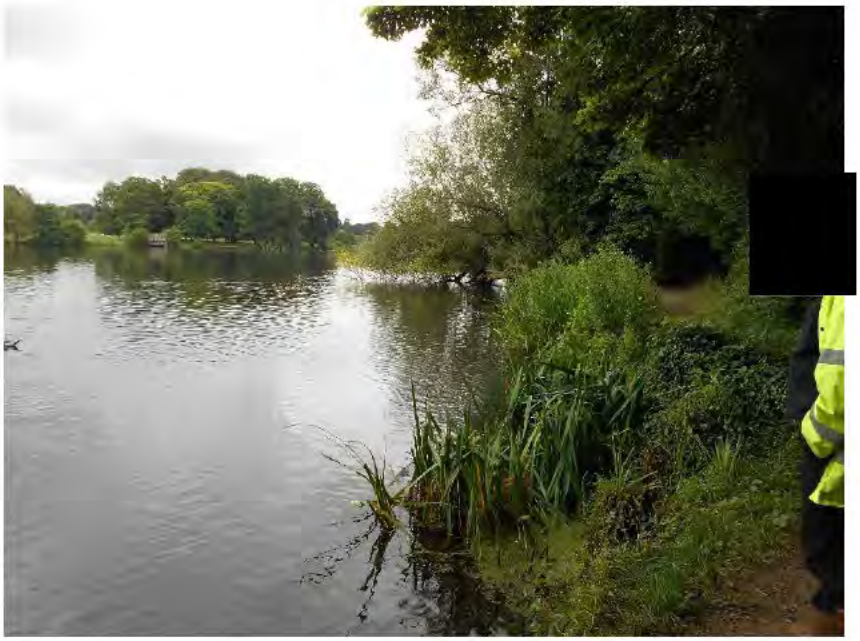
Signature of Engineer:

[redacted]

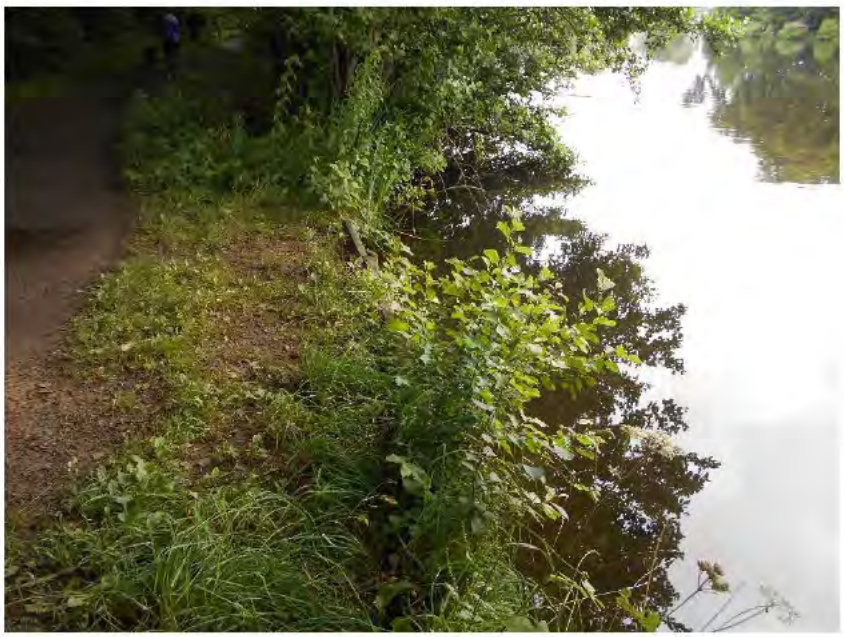
Date of Report: 23rd August 2016

Appendices

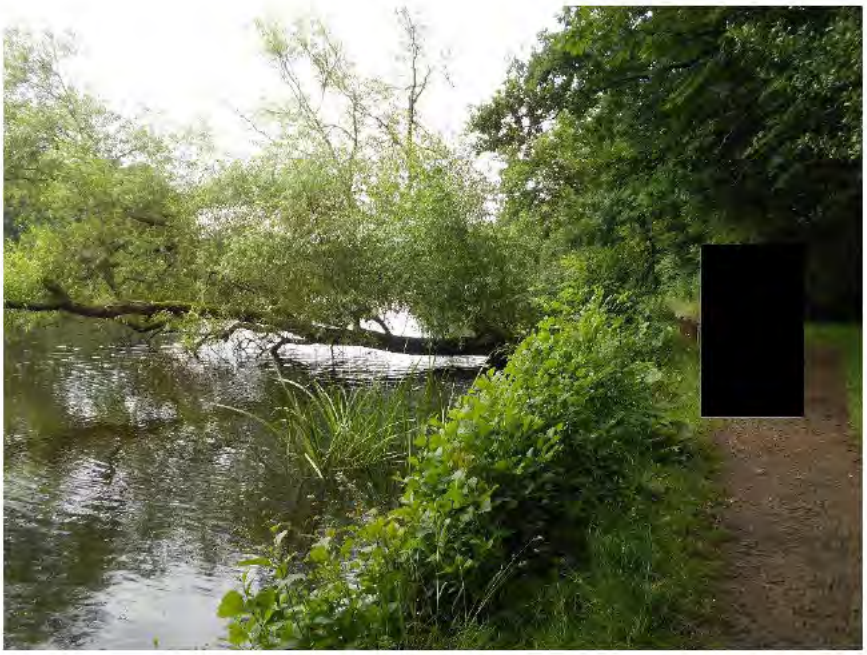
Appendix A. Photographs taken during the inspection on 12th July 2016



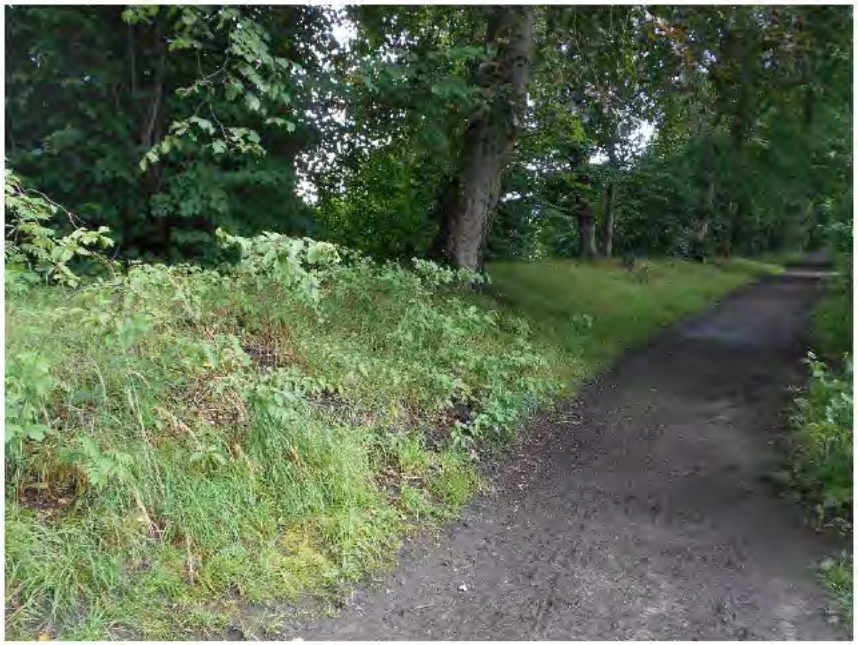
Photograph A1: General view of the lake at the northern end



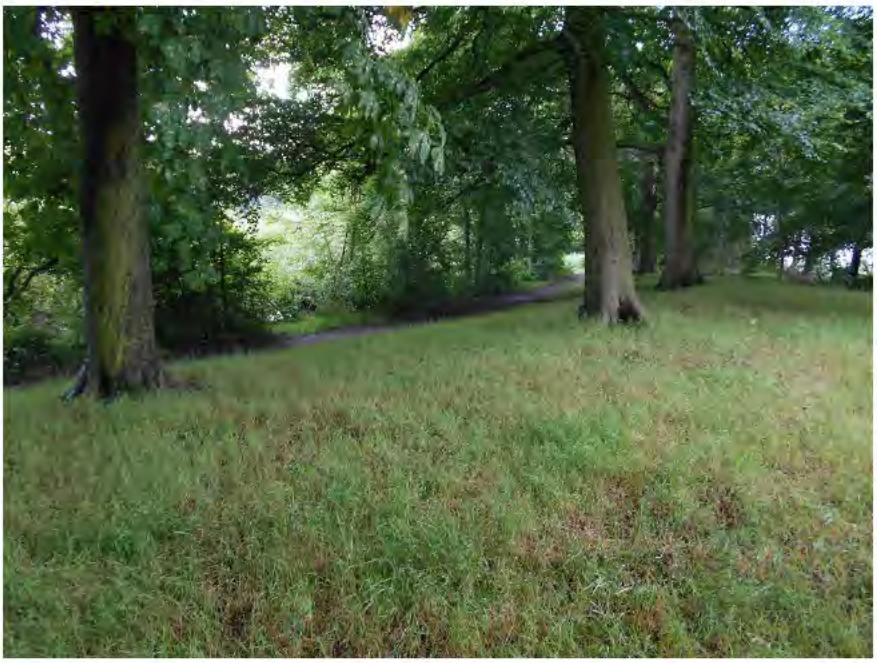
Photograph A2: Section of upstream edge of the crest with timber revetment providing support



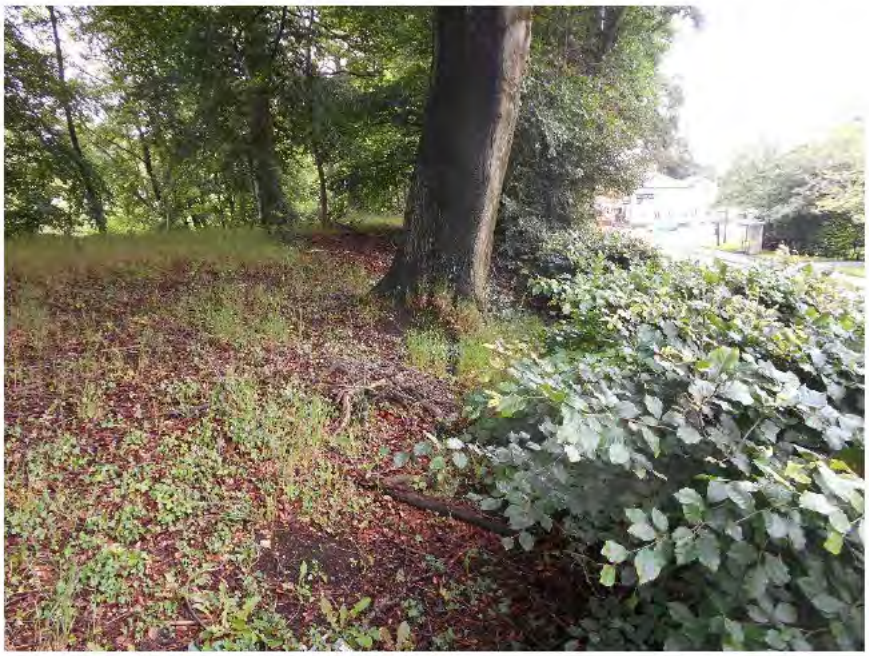
Photograph A3: Fallen tree at the upstream face



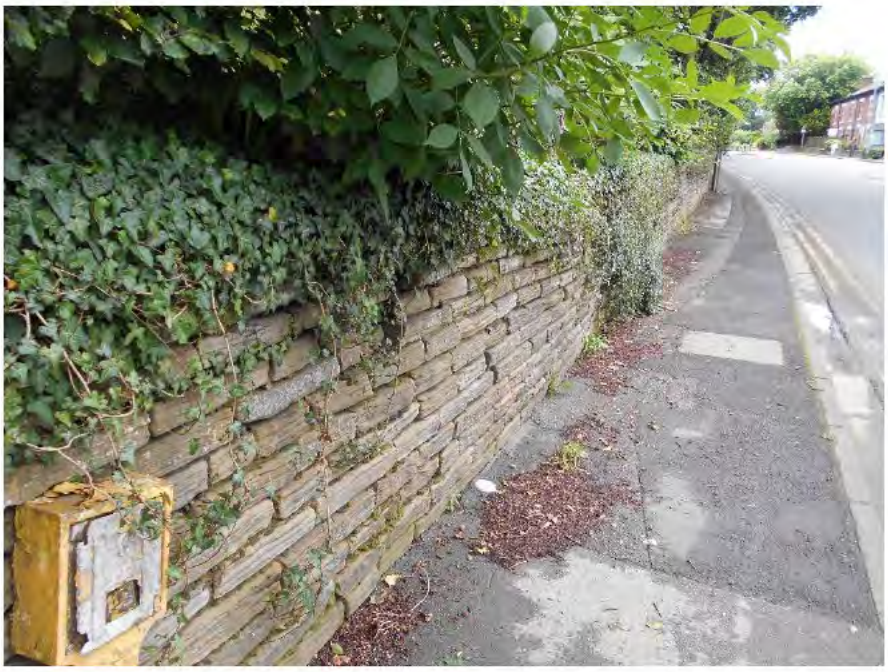
Photograph A4: Crest of dam towards south end with raised area at the downstream side



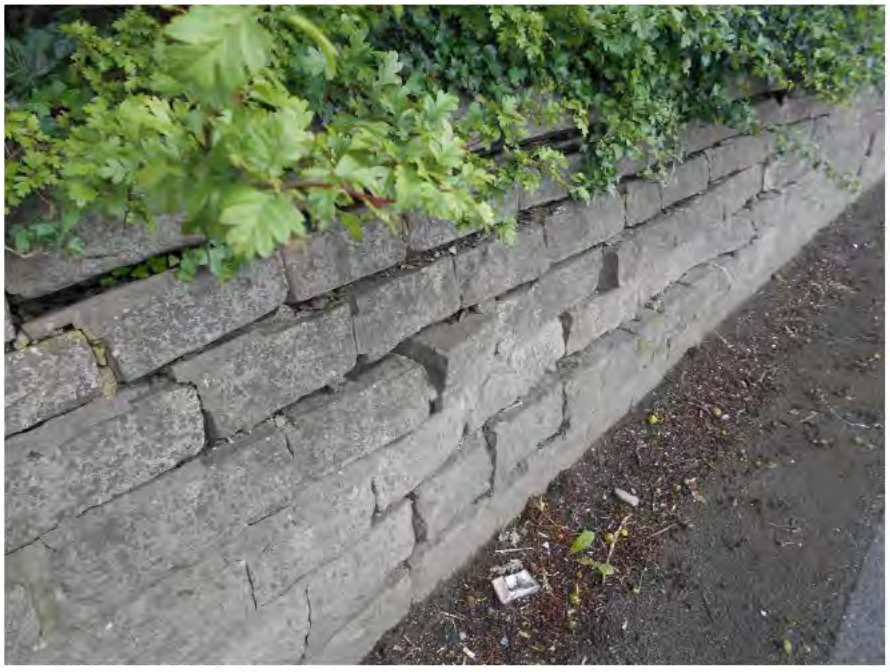
Photograph A5: Broad crest of dam in vicinity of the old Council Yard



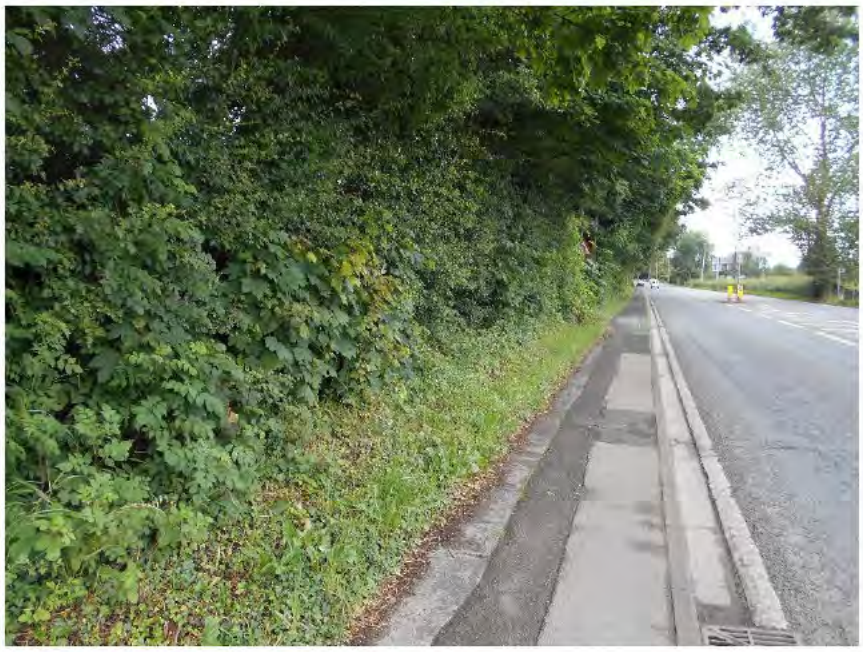
Photograph A6: Typical slope of the downstream face above the wall



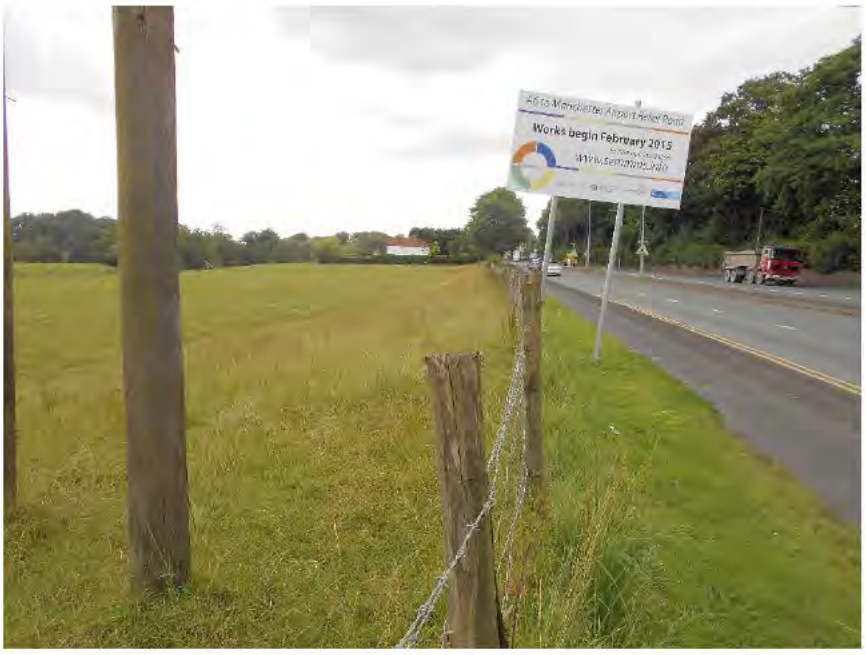
Photograph A7: Masonry retaining wall alongside the A523



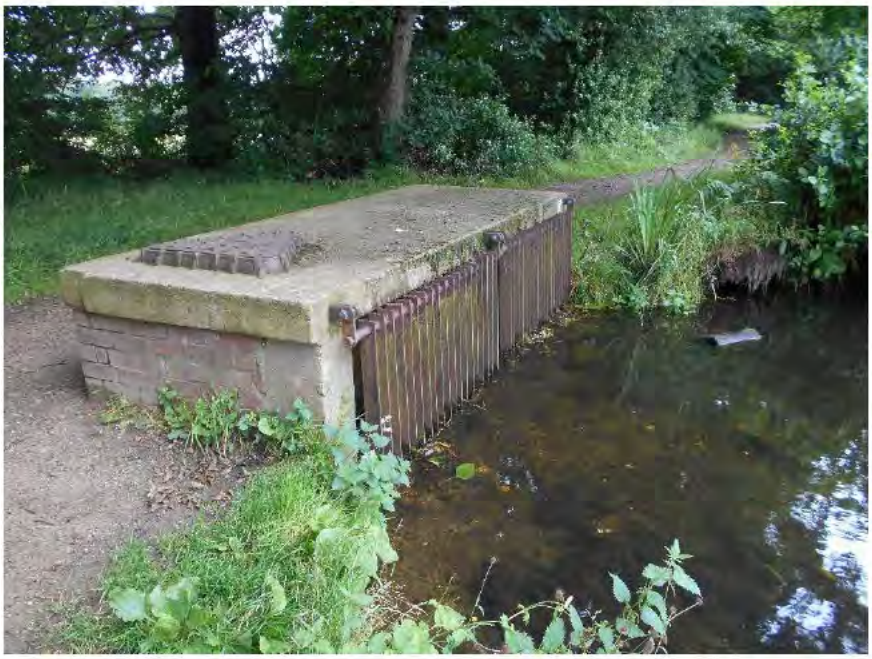
Photograph A8: Bulging and displaced stonework within the wall



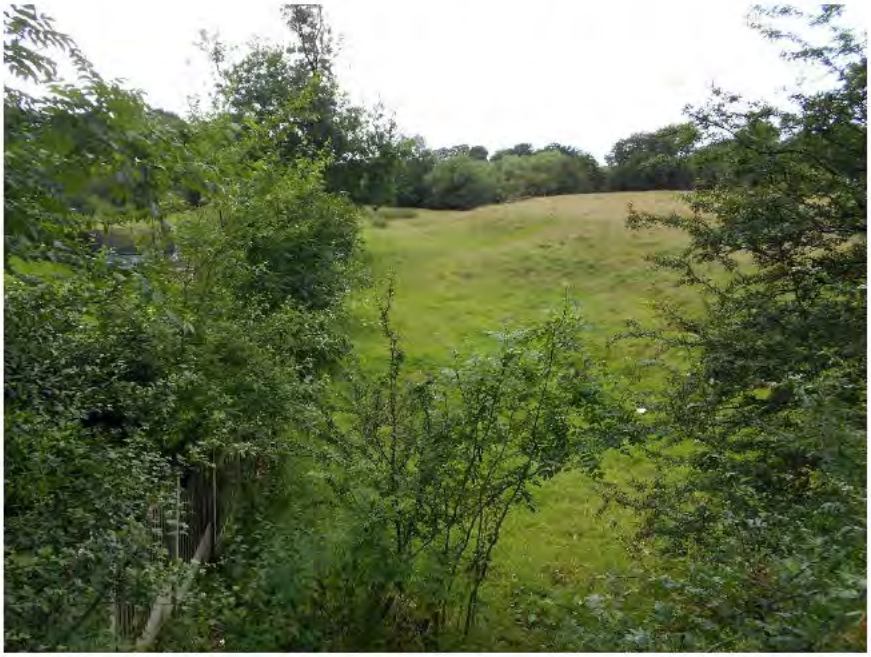
Photograph A9: Downstream face at the northern end (no wall)



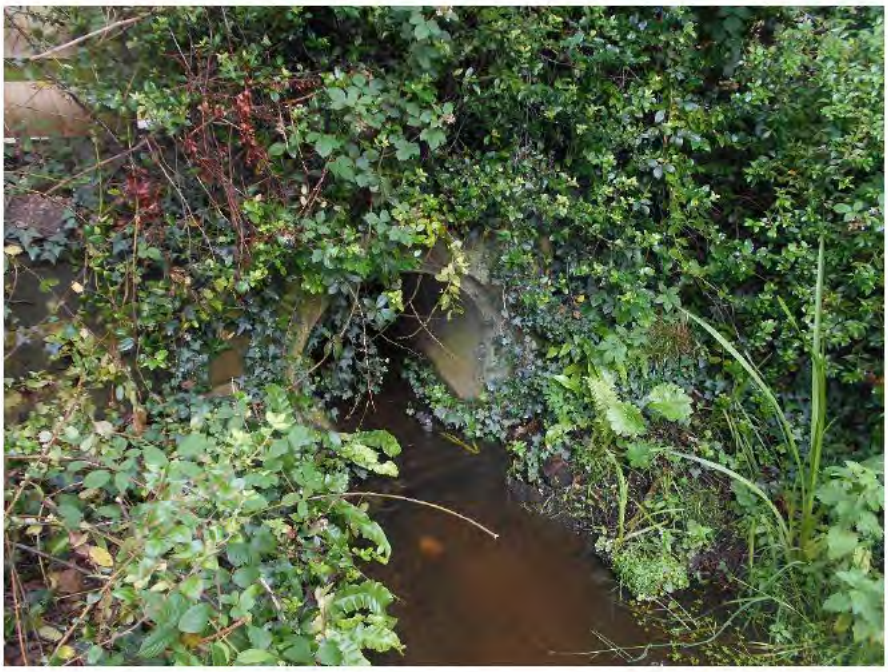
Photograph A10: Downstream face at the highest section as seen at the downstream (west) side of the road



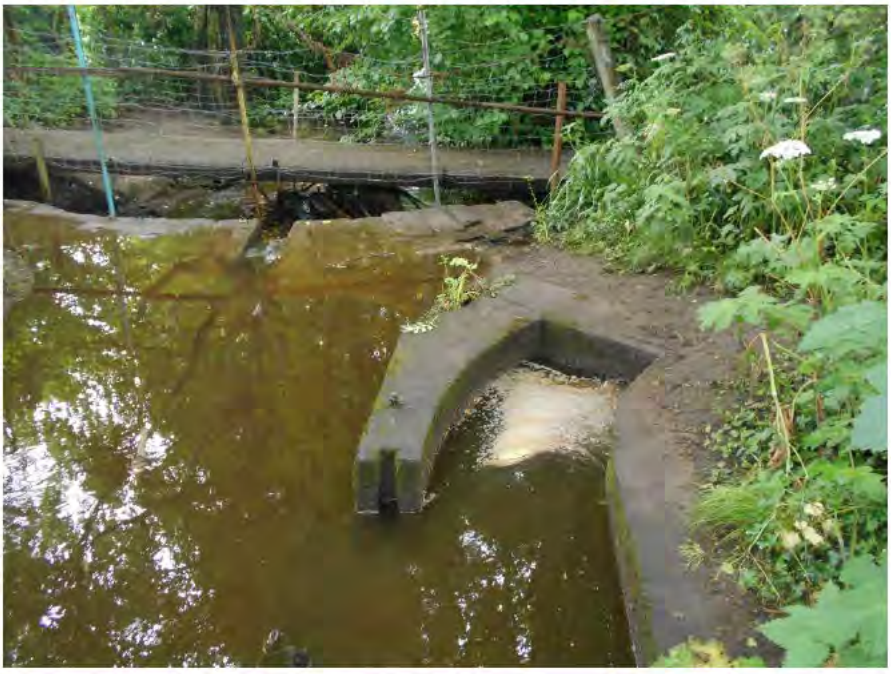
Photograph A11: Inlet structure with screen at the upstream end of the overflow pipe



Photograph A12: Route of overflow pipe in the downstream valley



Photograph A13: Inlet pipe to reservoir at southern end (Poynton Brook)



Photograph A14: Weir and bifurcation structure on the Poynton Brook at upstream side of Parklands Way

Appendix B. Inspecting Engineer's Certificate issued under Section 10(5) of the Reservoirs Act

RESERVOIRS ACT 1975

INSPECTING ENGINEER'S CERTIFICATE UNDER SECTION 10(5)

I [redacted] of Mott MacDonald, [redacted] being a member of the All Reservoirs Panel, appointed by Cheshire East Council to carry out an inspection on the reservoir known as Poynton Lake Reservoir, which is situated near to the town of Poynton in the County of Cheshire and at National Grid Reference SJ 923845, made a report of that inspection on 23rd August 2016, which does include recommendations as to measures to be taken in the interests of safety and also includes recommendations as to the maintenance of the reservoir.

The report does include a recommendation as to the time of the next inspection of the reservoir, which should be made on or before 10th July 2026.

Signature of Engineer:

[redacted]

Dated: 23rd August 2016