

| Ref. | MIOS relating to lowering reservoir | Reservoir Details | | | | | | | | Previous Drawdown | | Recommended | | Reasons for decision on new drawdown rate | Inflow assumptions | Fixed Capacity | Comments/Other | Drawdown rule/guide applied | | | | | | |
|------|-------------------------------------|---|-----------------|--|--------------------|--------------|----------------|-----------------------------|---------------|-------------------|-------------------|----------------|------------|---|--------------------|----------------|----------------|-----------------------------|---------------------------------|---|---------------------------------------|------|--|---|
| | | Reservoir name | Physical status | Undertaker | Situation | Location | Category | Reservoir Type/construction | Capacity (m3) | Height (m) | Surface area (m2) | Date Inspected | Date built | | | | | | Inspecting Engineer | Mgmt. Region | Rate | Unit | Rate | Unit |
| 1 | Y | Gartmorn Reservoir | | R2 | | NS 920 942 | | Earth | 1,572,000 | 9.20 | 570,000 | 28/10/2010 | | Martin Hewitt | | 75 | mm/day | 200 | mm/day | Siphon used as drawdown is not in use | Q10 | Part | Siphon not used since 1990, needs repair or replacement as required. | Initial target emergency drawdown rate of at 3% (200mm/day) of retained water height at top water level per day with Q10 inflow |
| 2 | Y | Loch Goin Reservoir | | Scottish Water | | NS 535 472 | | Earth | 630,000 | 7.30 | 640,000 | 20/10/2011 | | Martin Hewitt | | 50-80 | mm/day | 190 | mm/day | Fixed rate is less than 50% of required. Logistics of getting enough pumps (aprox.12) on site | Q10: 0.25m3/sec | Part | ALARP Risk based approach required to determine the ratio of fixed/temporary drawdown | Initial target emergency drawdown rate of at 3% (190mm/day) of retained water height at top water level per day with Q10 inflow |
| 3 | N | Kidderminster Flood Storage Reservoir | In Operation | Environment Agency | Near Kidderminster | SO8280078500 | Impounding | Not Known | 600,000 | 3.70 | 380,000 | 07/10/2010 | 2003 | Mr James Penman | Midlands | 44-28 | m3/s | | | | Average | | 4.6m by 1.75wide outlet culvert. Empty from spillway in 12 hours, considered adequate | |
| 4 | N | Moseley's Farm Reservoir | In Operation | R C Browne & Son | Near Flempton | TL8240066700 | Non-impounding | Not Known | 161,500 | 6.00 | 58,800 | 05/11/2008 | 2003 | Mr John Christopher Ackers | Anglian | 162 | m3/hr | | | | | Part | The current situation would lower the reservoir by 0.13m/day. Bringing additional pumps on site has been considered adequate due to good access. | |
| 5 | N | Hall Farm Reservoir | In Operation | R C Browne & Son | Near Flempton | TL8060069700 | Non-impounding | Gravity and Earthfill | 110,000 | 4.84 | 28,200 | 04/11/2008 | 2002 | Mr John Christopher Ackers | Anglian | 160 | m3/hr | | | | | part | The current situation would lower the reservoir by 0.12m/day. Bringing additional pumps on site has been considered adequate due to good access. | |
| 6 | N | Kirk Hall Farm | In Operation | Kirk Hall Farms | Attleborough | TL9920095100 | Non-impounding | Gravity and Earthfill | 81,000 | 12.00 | 16,400 | 04/11/2008 | 2002 | Mr John Christopher Ackers | Anglian | 120 | m3/hr | | | | | Part | The current situation would lower the reservoir by 0.18m/day. Bringing additional pumps on site has been considered adequate due to good access. | |
| 7 | N | Pitsea Leachate Lagoon | In Operation | Veolia ES Cleanaway (UK) Limited | Near Leigh on Sea | TQ7570084500 | Non-impounding | Not Known | 147,265 | 5.00 | 44,762 | 28/07/2010 | 2002 | Mr Christopher Graham Hoskins | Anglian | 100 | m3/hr | | | | | part | Irrigating pump on site providing 60m3/hr, siphon 40m3/hr. Owner advises that he can source a 150mm pump to provide 300-400m3/hr. This all equates to 270mm/day. The available pumping capacity plus high pressure pump is considered to be acceptable for this reservoir. | |
| 8 | Y | Dronfield Dam (Jack Goodhand Reservoir) | In Operation | Environment Agency | Near Dronfield | SK3520079400 | Impounding | TE Earthfill | 88,200 | 10.50 | 38,936 | 08/03/2006 | 2001 | Ian A T Gowans | North East | 4 | m/day | <0.73 | m3/s | To allow reservoir to reach full operating head | Average | | Max drawdown rate of 0.73m3/s. MIOS was raised because the outlet often gets blocked up, an additional means of drawdown is required. | Published criteria for requirements for drawdown capacity are given in the current 'Draft Interim Guide to Emergency Planning' DEFRA, May 2006. This gives a range of criteria for emergency draw-down capacity and indicates that scour arrangements should normally be designed to draw the reservoir down to 70% depth in about six days |
| 9 | Y | Llyn Goddioludon (ID 313) | In Operation | Natural Resources Wales / Cyfoeth Naturiol Cymru | Betws-y-Coed | SH7534158617 | Impounding | Not Known | 26,029 | 0.46 | 56,584 | 16/12/2013 | | Prof Andrew K Hughes | EA Wales | | | | | Review of the rate of drawdown of the reservoir by the scour valve be carried out | | y | The scour valve appears to be an efficient way of reducing water level, recommended for the rate to be reviewed. | No Rule/guide mentioned |
| 10 | Y | Bracebridge Pool | In Operation | BIRMINGHAM CITY COUNCIL | Near Birmingham | SP1000098000 | Impounding | Gravity and Earthfill | 76,600 | 4.20 | 61,300 | 13/11/2013 | 1750 | Keith Douglas Gardiner | Midlands | | | | | Drawdown rate is unknown | | part | Siphon drawdown available but rate is unknown, rate should be assessed. Drawdown beyond the first 2 meters is required. There are also emergency plans to deploy pumps | No Rule/guide mentioned |
| 11 | Y | Longmoor Pool | In Operation | BIRMINGHAM CITY COUNCIL | Near Birmingham | SP0950095800 | Impounding | TE Earthfill | 40,900 | 4.00 | 26,000 | 13/11/2013 | 1735 | Keith Douglas Gardiner | Midlands | | | | | Drawdown rate is unknown | | | Drawdown rate is unknown, the rate should be ascertained. | No Rule/guide mentioned |
| 12 | Y | Grassholme | In Operation | Northumbrian Water Ltd | Near Mickleton | NY9380022400 | Impounding | Gravity and Earthfill | 6,060,000 | 34.00 | 570,000 | 28/05/2013 | 1914 | Ian Charles Carter | North East | 4.5 | m3/s | 25% | % of reservoir volume in 28days | | Winter Q50 flow | y | Outlet via 27inch scour main and 18inch compensation main provide 4.5m3/s discharge at full capacity. The undertaker has plans to improve the discharge capacity significantly at the reservoir modifying the pipework configuration inside the outlet tunnel. It is intended that the nre mainfold pipework will be installed as well as a connection that allows outflow to be passed though a 250kW turbine. this proposal is considered to be a welcome development and a major advance in improving the safety of this reservoir. | No rule/guide referenced: The pipework and valve configuration of the outlet mains shall be modified so as to increase discharge capacity such that the reservoir level can |
| 13 | Y | Ulley | In Operation | ROTHERHAM METROPOLITAN BOROUGH COUNCIL | Rotherham | SK4550087600 | Impounding | Gravity and Earthfill | 580,000 | 14.00 | 120,000 | 19/10/2007 | 1875 | Mr James Robert Claydon | North East | | | | | To small, Poor condition, when used it causes leakage through the abutment, it discharges into an unsafe structure. | | | It is recommended in the interst of safety that the scour pipe is replaced with a larger diameter pipe discharging to the channel downstream of the dam. | |
| 14 | N | Cheveney Farm Upper Lake (No. 1) | In Operation | Cheveney Farm | Maidstone | TQ7143049630 | Non-impounding | Not Known | 26,000 | 3.50 | | 13/08/2010 | 2000 | Mr Micheal Heading | South East | 0.03 | m3/s | | | | | | This rate of drawdown equates to about 75% of the recommended (320mm/day) and is considered to be acceptable, if required could be supplemented by pumps in an emergency. With the inlet pipe closed time to empty will be about 11.5 days from full. | |
| 15 | N | Spring Lodge Methwold | In Operation | O.W. Wortley & Sons | Near Methold | TL7540094800 | Non-impounding | Gravity and Earthfill | 138,600 | 8.50 | 18,750 | 27/10/2006 | 2000 | Dr Andrew K Hughes | Anglian | | | | | | Inflow can be totally controlled | N | To lower the reservoir pumps would have to be employed. The Construction Engineer has put a restriction on operation such that abstraction should not exceed 150m3/hr. Recommendation (not in the interst of safety) that drawdown does not exceed 150m3/hr. | |
| 16 | N | Berners Hall Farm | In Operation | Saker Estates Ltd | Near Roding | TL5883009900 | Non-impounding | Gravity and Earthfill | 418,600 | 15.00 | 97,000 | | 1999 | Mr John Christopher Ackers | South East | 90 | m3/hr | | | | | | Abstraction pump can be used to lower the reservoir level with a max output of 90m3/hr, this equates to 0.022m/day assuming no inflow. At this rate it would take 45days to lower the reservoir by 1m. In the event of the reservoir level having to be drawn down more rapidly in an emergency it would be necessary to bring some pumps or siphons onto the site, and there is good enough access to enable this to be done. | No Rule/guide mentioned |
| 17 | N | Lliedi Lower | In Operation | Welsh Water (Dwr Cymru Cyf) | Near LLanelli | SN5180003200 | Impounding | Gravity and Earthfill | 700,000 | 18.00 | 135,000 | 19/02/2014 | 1878 | Prof Andrew K Hughes | EA Wales | 95 | MI/day | | | | | y | "Inflow can be controlled by use of the Upper Reservoir. By fully opening the 600 mm diameter scour and the 450 mm diameter washout off the supply chain I am informed that the reservoir can be lowered by more than 1 metre a day – a rate of more than 95 MI/day. I conclude this to be satisfactory." | No Rule/guide mentioned |
| 18 | N | Lliedi Upper | In Operation | Welsh Water (Dwr Cymru Cyf) | Near Llanelli | SN5130004300 | Impounding | Gravity and Earthfill | 827,000 | 16.00 | 125,000 | 19/02/2014 | 1905 | Prof Andrew K Hughes | EA Wales | 3 | m3/s | | | | | y | "There are means of controlling inflow into the reservoir via the penstocks at the head of the reservoir. The scour has a capacity of some 3 cumecs which would, in an emergency lower the level I am informed by more than 2 metres a day. I consider this situation to be satisfactory." | No Rule/guide mentioned |
| 19 | N | Tittesworth | In Operation | Severn Trent Water | Near Leek | SJ9930058700 | Impounding | Gravity and Earthfill | 6,440,000 | 23.50 | 765,000 | 18/09/2013 | 1963 | Mr Brian Charles Morris | Midlands | 4.5-5.5 | m3/s | | | | | part | "The scour discharges through a jet disperser at the upstream end of the tunnel. The capacity of the scour pipe has been estimated at 4.5m3/s. This could lower the water level by 0.5m per day. The additional use of the washout from the draw off pipe into the tailbay would increase the total rate of discharge to 5.5m3/s and the water level would be lowered by 0.63m per day. This is lower than the recommended minimum rate of draw down of 1m/d for a Category A reservoir in an emergency. However, given the condition of the reservoir and its appurtenant structures, the draw down rate is acceptable. If a faster draw down were required this would need to be achieved using temporary pumping plant over the wave wall with discharge pipes diverted into the tailbay. Satisfactory access exists to the crest for delivering such plant." | "This is lower than the recommended minimum rate of draw down of 1m/d for a Category A reservoir in an emergency." |
| 20 | N | Barrowford | In Operation | Canal & River Trust | Near Barrowford | SD8690040100 | Non-impounding | Gravity and Earthfill | 453,850 | 9.00 | 67,000 | 12/03/2013 | 1885 | MR J D Gosden | North West | 4.79 | m3/s | | | | Winter daily average inflow of 170l/s | y | The reservoir record quotes a discharge capacity of 4.28m3/s for the draw-off into the spillway shaft and 0.51m3/s for the low level outlet. The Canal & River Trust Emergency drawdown plan indicated a drawdown to 50% volume within 5days. The emergency drawdown plan indicated that the reservoir can be lowered by 1m in 4.5hr and 3.7m (50% capacity) in 2.8days. The plan allows for a winter daily average inflow, although it is not clear what this represents as it also assumes that the inflows from the canal are stopped. This arrangement is considered satisfactory. | No Rule/guide mentioned |

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| | | Reservoir name | Physical status | Undertaker | Situation | Location | Category | Reservoir Type/construction | Capacity (m3) | Height (m) | Surface area (m2) | Date Inspected | Date built | Inspecting Engineer | Mgmt. Region | Rate | Unit | Rate | Unit | | | | | |
| 21 | Y | Rishton | In Operation | Canal & River Trust | Near Rishton | SD7150030000 | Impounding | Gravity and Earthfill | 615,000 | 10.00 | 135,000 | 06/06/2013 | 1830 | MR J D Gosden | North West | 0.95 | m3/s | | | | Winter daily average inflow of 46l/s | | The reservoir record quotes a discharge capacity of 0.4m3/s for the upper draw-off and a further 0.55m3/s for the bottom draw-off. The Canal & River Trust Emergency drawdown plan indicated a drawdown to 50% volume within 5days. The emergency drawdown plan indicated that the reservoir can be lowered by 1m in1.5days and 2.7m (50% capacity) in 4.1days, this plan allows for winter daily inflow. However at present the maximm drawdown capacity available is reduced to around 50% of the above capacity. this would result in an approximated doubling of the drawdown by 2.7m to around 8days. In order to increase the drawdown capacity additional pumps would need to be brought to site. the emergency drawdown plan has been revised in Feb 2014 in order to make this provision. However only a minimum of revisions has been made to indicate the requirment to bring pumps and their min capacity. "I recommend that the full additional details provided in other Canal & River Trust emergency drawdown plans which require the use of pumps should be included." The tempoary arrangements for lowering the reservoir are satisfactory but to provide better long term security the bottom outlet upstream paddle should be repaired and made fully operational. | No Rule/guide mentioned |
| 22 | N | Luxhay | In Operation | Wessex Water Services Ltd | Near Taunton | ST2020017700 | Impounding | Gravity and Earthfill | 544,000 | 19.00 | 73,000 | 14/08/2013 | 1905 | James G Penman | South West | 0.395 | m3/hr | | | | | | "The on site plan states a maximum discharge of 0.395m3/s for the bottom outlet. This value has been checked and found to be realistic. A discharge of 0.396m3/s equates to a drawdown rate of 467mm/day which is considered to be acceptable." | No Reference: "A discharge of 0.396m3/s equates to a drawdown rate of 467mm/day which is considered to be acceptable." |
| 23 | Y | Langold Lake | In Operation | Bassetlaw District Council | Near Worksop | SK5770086300 | Impounding | Gravity and Earthfill | 181,850 | 6.00 | 81,000 | 25/10/2013 | 1920 | Mr A L Warren | Midlands | | | 300 | mm/day | only 300mm outlet pipe Plan required to meet this drawdown rate using pumps | No inflow | N | "An emergency drawdown plan for the reservoir shall be prepared to specify how pumps shall be deployed to supplement the outlet works to draw the reservoir level down from top water level at a rate of 300mm per day (assuming no reservoir inflow). The plan will specify how suitable pumps will be sourced and how they shall be deployed at the reservoir." | No refence: "pumps shall be deployed to supplement the outlet works to draw the reservoir level down from top water level at a rate of 300mm per day (assuming no reservoir inflow). The plan will specify how suitable pumps will be sourced and how they shall be deployed at the reservoir." |
| 24 | Y | Welford | In Operation | Canal & River Trust | Near Welford | SP6500081100 | Impounding | Gravity and Earthfill | 274,000 | 9.00 | 86,000 | 15/10/2013 | 1838 | Andrew Rowland | Midlands | 0.14-0.23 | m3/s | | | | | part | "The Form of Record gives the capacity of the outlet as 0.14 m3/s. From CRT SCADA flow gauging data for the canal feeder, the outlet flow achieved in the Supervising Engineer's May 2012 visit was 0.23 m3/s with a reservoir water level of 20 mm over the spillweir and the valve fully open. At this inspection, with a water level 2.6 m below overflow level, the recorded flow was 0.18 m3/s. At a flow of 0.23 m3/s, the initial rate of drawdown would be 0.25 m a day. This is less than is currently being recommended and provides a drawdown time longer than CRT's target for a 50% reduction in volume. Accordingly CRT has prepared an emergency drawdown plan using pumps in addition to releases through the outlet in order to achieve that target. It is noted that the plan assumes an outlet flow of 0.14 m3/s and thus may be slightly pessimistic. It would be advisable to check the outflow capacity and to update the drawdown plan when proposed improvements to the outlet have been completed. The drawdown capacity of the outlet, in conjunction with pumping in accordance with the emergency drawdown plan is satisfactory. Improvements to the valving on the outlet is needed as a matter of urgency. Otherwise the scour facilities are satisfactory." | Canal & River Trust (CRT) 's target for a 50% reduction in volume. Does not give the target time for the 50% reduction. |
| 25 | N | Tilbury Flood Storage | In Operation | Environment Agency | Near Tilbury | TQ6500077200 | Impounding | Gravity and Earthfill | 1,506,000 | 1.30 | 2,510,000 | 10/12/2012 | 1972 | Mr J D Gosden | Anglian | | | | | | | | Drawdown using a penstock. The penstock is situated on the main watercourse much of the adjacent general ground level is higher than the lowest ground in the storage basin. The rate of drawdown of the reservoir will therefore depend on the capacity of the internal drainage channels rather than the capacity of the penstock. "I recommend that the means of lowering water levels in the reservoir is reviewed to ensure that the reservoir can be drawn down in a reasonable time period." The primary purpose of this analysis is to ensure that the reservoir is able to deal with rainfall from a succession of events and that the assmption that some of the retaining embankments will never need to retain water is reasonable. | No Rule/guide mentioned |
| 26 | Y | Shipley Lake | In Operation | Derbyshire County Council | Near Heanor | SK4440043900 | Impounding | TE Earthfill | 59,100 | 3.00 | 133,500 | 25/01/2013 | 1930 | Timothy John Ferreebee Hill | Midlands | | | | | | | n | "There is no facility for drawing down the reservoir in an emergency. The previous Inspecting Engineer, Mr Wagner, pointed out that the reservoir is shallow (on average less than 0.5 m deep) and that in these circumstances the need for a bottom outlet is questionable. In discussion with the undertaker it is clear that in places the reservoir is significantly deeper than 0.5m though the exact depth is uncertain. The undertaker has agreed to conduct a boat based survey to get a better understanding of the reservoir volume and maximum water depth. Nevertheless, I concur with Mr Wagner that a dedicated bottom outlet is not warranted in this situation. However, with no bottom outlet facility at all I now require, in the interest of safety, that arrangements be put in place to bring pumps and equipment to site should an emergency situation arise. These arrangements should be documented in the on-site flood plan, see Section 14 above." | No Rule/guide mentioned |
| 27 | N | Llyn Maen Bras | In Operation | Rhiwlas Hydroelectric Ltd. | Near Bala | SH9290039600 | Impounding | Gravity and Earthfill | 51,000 | 4.30 | 40,000 | 18/06/2013 | 1870 | Keith Douglas Gardiner | EA Wales | 0.05-0.2 | m3/s | | | | | Part | "The scour can reportedly discharge water at 0.05 cumecs at TWL and the siphon pipe can discharge up to 0.2 cumecs. This will draw the reservoir down from TWL at a rate of approximately 500 mm/d. At about 1.4m below TWL the siphon will cease to operate and the drawdown rate will slow to about 250mm/d. This is considered satisfactory if there is a contingency plan in place to instal temporary pumps within 48hrs in an emergency. I therefore recommend that a contingency plan be written that provides details of where temporary pumps can be positioned to remove water from the reservoir at a rate of approximately 200l/s." | No reference:recommended outflow after 1.4m below TWL appears to be 0.05m3/s from scour pipe and 200l/s from pumps. |
| 28 | N | Wollaton Park Lake | In Operation | Nottingham City Council | Near Nottingham | SK5270038500 | Impounding | Gravity and Earthfill | 115,000 | 5.00 | 75,000 | 13/02/2013 | 1800 | Alan John Brown | Midlands | 300 | l/s | | | | | y | The inflow from Martin's Pond could be blocked, but other inflows cannot be controlled or diverted. The lake could be lowered by up to 2.2 m using the 12 inch outlet pipe, which could have a capacity of around 300 litre/ sec (500 mm/day in top 0.5m). This is acceptable in terms of emergency drawdown in the event of a structural problem. | No Rule/guide mentioned |
| 29 | N | Earlswood Lakes - Engine Pool | In Operation | Canal & River Trust | Near Solihull | SP1110074100 | Impounding | TE Earthfill | 345,000 | 5.80 | 108,000 | 24/07/2013 | 1815 | Mr J L Hinks | Midlands | 1.5 | m3/s | | | | | Y | 1.5m3/s equated to a rate of about 1,200mm/day. | "The English formula on page 8 of Dams and Reservoirs of March 2009 suggests a minimum rate of drawdown of 449mm/day for these reservoirs. This figure is exceeded by a significant margin." |
| 30 | N | Springs | In Operation | United Utilities plc | Near Bolton | SD6910014800 | Impounding | Gravity and Earthfill | 609,000 | 14.00 | 99,800 | 06/06/2013 | 1830 | Prof Andrew K Hughes | North West | 0.35 | m/day | 1 | m/day | Currently not up to standard. 1m/day is required | No inflow | part | Currently can reduce water level at a rate of 0.35m/day from top water level assuming no inflow, this equates to 25% of pool height in 24days. To draw down the reservoir by 1m below full storage level would take 3-4days assuming no inflow. This does not meet 'current' standards which try to ensure the top 1m can be discharged in 24hours. Therefore the theoretical drawdown facility was incresed by providing a pumping plan and a new access from which to launch submersible pumps, downed by the company on to the reservoir. This is considered satisfactory. | No reference: Top 1m discharged in 24hours |

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| 31 | Y | Lawton Hall Lake | In Operation | Haddon; Haddon | Near Kidsgrove | SJ8250055800 | Impounding | TE Earthfill | 127,000 | 11.00 | 38,000 | 08/05/2013 | | Keith Douhlias Gardiner | North West | 0 | | 500 | mm/day | currently no method for drawdown | | n | "There are no means of reducing the water level in the reservoir but siphon pipes or pumps could be used to reduce the water level. I recommend that the owners prepare a contingency plan detailing how the water level will be reduced in an emergency using temporary pumps. I recommend that a rate of drawdown of 500mm per day should be provided which requires a flow rate of approximately 0.26 m3/sec." | No reference: 500mm/day |
| 32 | N | Westbeck Lake | In Operation | Warter Priory Farms | Near Burnby | SE8590049600 | Impounding | Gravity and Earthfill | 44,000 | 7.00 | 21,900 | 05/11/2012 | 1904 | D Gallacher | North East | 0.5 | m/day | | | | | y | "The reservoir water level can be lowered by the lever operated slide valve at the central outlet structure which should be able to lower the reservoir level by about 0.5 m day which is considered to be adequate for a low risk Category C (Minimum Standard) reservoir." | No reference: 0.5m/day is adequate for Category C reservoir |
| 33 | Y | Warbreck | In Operation | United Utilities plc | Near Blackpool | SD3160038500 | Service | Concrete Service | 105,000 | 7.00 | 16,735 | 12/12/2012 | 1929 | Michael John Prisk | North West | | | | | | | Y | 15" scour drains together with the outlet mains were considered adequate for rapid lowering of the reservoir. The reported flooding of property that had occurred due to water released from the Warbreck site caused concern in 2011, however this flooding is not presently thought to have been caused by overflow. I have made recommendations for a physical test to confirm that the scour drain is capable of carrying the maximum inflow satisfactorily. "I recommend that should any inlet, outlet, scour or control valve become inoperable that the reservoir be emptied, if necessary, and the valve repaired or replaced as soon as practicable." | No Rule/guide mentioned |
| 34 | Y | Alwen | In Operation | Welsh Water (Dwr Cymru Cyf) | Near Denbigh | SH9560053000 | Impounding | Not Known | 14,564,200 | 30.00 | 1,490,000 | 15/01/2013 | 1918 | P. Kelham | EA Wales | 3.8 | m3/s | | | | | Y | "The reservoir level can be drawn down using the dedicated scour pipeline or by using the combined capacity of the scour and supply pipelines. The capacity of the scour is stated to be 3.2m3/s and that of the combined outlets to be 3.8 m3/s. The maximum rate of supply to treatment is reported to be 45MI/d, however the abstraction licence is for 55MI/d. The previous Inspecting Engineer estimated that, with all valves opened to the stilling basin, the combined discharge would lower the reservoir level by about 0.5m per day under conditions of minimal inflow. I have not been provided with figures to support this statement and am unable to confirm the adequacy of the drawdown rate. The capacities stated above also do not reconcile with the previous Inspecting Engineers estimated drawdown rate, although I suspect the former are underestimated. I recommend that the combined capacity of the scour and supply system are calculated for Q10 and Q50 inflows to establish the rate of drawdown. The results of the analyses to be reviewed by an All Reservoir Panel Engineer." | No Reference: Q10 and Q50 inflow suggested |
| 35 | Y | Jack's Key Lodge | In Operation | Environment Agency | Near Darwen | SD7030020300 | Impounding | Gravity and Earthfill | 190,000 | 15.00 | 60,000 | 08/01/2013 | | A L Warren | North West | | | | | | | part | "Riley (2002) states that there is a scour pipe leading from the reservoir area to the base of the spillway shaft. There is apparently a valve at the bottom of the shaft and this is shown in one of the report photographs. Details of the size and alignment of the pipe are unknown. The upstream end of this pipeline is not presently visible within the reservoir area." "An emergency drawdown plan for the reservoir shall be completed with shall detail how pumps shall be deployed in the scenario where the low-level drawoff tunnel collapses, leading to an uncontrolled filling of the reservoir." | No Rule/guide mentioned |
| 36 | N | Westford Flood Storage Reservoir | In Operation | Environment Agency | Near Westford | ST1210020200 | Impounding | Not Known | 45,000 | 6.05 | 30,000 | 19/03/2013 | 1990 | Prof Andrew K Hughes | South West | | | | | | | n | No required changes: "There is no scour pipe, nor any other means of lowering the water level or controlling inflows to the reservoir. In the case of a flood alleviation scheme with an uncontrolled base culvert I consider that to be acceptable." | No Rule/guide mentioned |
| 37 | N | Blithfield | In Operation | South Staffordshire Water Plc | Near Rugeley | SK0600023500 | Impounding | TE Earthfill | 18,172,000 | 16.00 | | 22/04/2013 | 1953 | Prof Andrew K Hughes | Midlands | 10.26 | m3/s | | | | | part | "The reservoir is a large reservoir with large facilities to discharge. The scour has a capacity of 10.26m3/s, whilst up to 140Mld can be supplied to treatment. With only the scour operating it has been calculated that it will take 3.5 days to draw the reservoir down by 1m. The reservoir may be lowered by means of the water supply and scour outlet discharging either to supply or to the River Blythe. The capacity of the scour outlets with the reservoir at top water level is approximately 10m3/s. Under normal operation, the guard valves and operating valves in the valve tower will be open to allow flow into the supply mains feeding the water treatment works. In order to facilitate reservoir drawdown under average annual inflow conditions, one Larner Johnson valve on each pipeline located in the tail bay control house would need to be opened. Opening the valves on the 24 inch compensation outlets would only marginally increase the total discharge capacity, but will have the benefit of reducing the concentration of flow into the stilling basin. this rate of outflow is considered satisfactory to enable the reservoir to be drawn down to half pool level in about 2 months in the event of an emergency. If required, the overall rate of outflow could be increased by the provision of temporary pumps which could be arranged to pump water from the reservoir directly into the spillway channel. Thus, high capacity pumping or siphons will be deployed to assist in drawdown. I consider this to be satisfactory. An on-site plan has been written. I consider the situation to be satisfactory." | No Rule/guide mentioned |
| 38 | Y | Warland | In Operation | United Utilities plc | Near Littleborough | SD9560021000 | Impounding | Gravity and Earthfill | 1,253,000 | 17.00 | 240,000 | 20/09/2011 | 1857 | MR J L Hinks | North East | 0.26 | m3/s | 400 | mm/day | Current rate is 88mm/day, 400mm/day is the minimum recommended | | part | "In their report on Scour Capacity Studies of October 2003 MWH calculated a drawdown capacity of 0.26m3/s at top water level. Taking the area of the reservoir at 25.5 ha this implies an initial drawdown rate of 88mm/day." "within one year of the date of this report a written contingency plan shall be in place detailing how the reservoir may be drawn down at an initial rate of at least 400mm/day with the aid of tempoary pumps or siphons." | "This compares with a minimum rate of about 0.4m/day obtained by using the General Formula on Page 8 of Dams and Reservoirs of March 2009. As a general rule the permanent installed drawdown capacity should be at least half of that given by the formula - in this case 200mm/day. the remaining 200mm/day could be provided either by a permanent facility or made up by temporary pumps." "witin six years of the date of this report steps should be taken to increase the initial drawdown rate to at least 400mm/day. At least half of this capacity should be provided by a permanently installed facility; the rest may be provided by tempoary plant." |
| 39 | Y | Parsonage | In Operation | United Utilities plc | Near Blackburn | SD7000032000 | Impounding | Gravity and Earthfill | 891,000 | 18.00 | 140,000 | | 1915 | Prof Andrew K Hughes | North West | | | | | | | | Drawdown rate is not commented on but is consiered acceptable. The issues raised are because of flooding of the valvehouse. MIOS: "Modification are carried out to the downstream valve house doors or house pipework to enable a scour discharge to be accommodated." | |

| Ref. | MIOS relating to lowering reservoir | Reservoir Details | | | | | | | | Previous Drawdown | | Recommended | | Reasons for decision on new drawdown rate | Inflow assumptions | Fixed Capacity | Comments/Other | Drawdown rule/guide applied | | | | | | |
|------|-------------------------------------|--|-----------------|-------------------------------------|--------------------|--------------|----------------|-----------------------------|---------------|-------------------|-------------------|----------------|------------|---|--------------------|----------------|----------------|-----------------------------|---------------------|---|-----------|------|--|---|
| | | Reservoir name | Physical status | Undertaker | Situation | Location | Category | Reservoir Type/construction | Capacity (m3) | Height (m) | Surface area (m2) | Date Inspected | Date built | | | | | | Inspecting Engineer | Mgmt. Region | Rate | Unit | Rate | Unit |
| 40 | Y | Pitsford | In Operation | Anglian Water Services Ltd | Near Northampton | SP7550068900 | Impounding | TE Earthfill | 17,545,000 | 26 | 3,030,000 | 09/08/2011 | 1956 | Andrew Rowland | Anglian | 0.02 | m/day | 0.5 | m/day | at a rate of 0.02m/day it would take over 400days with no inflow to draw down the reservoir. Recommended rate of 0.5m/day | no inflow | part | <p>A precise analysis of the drawdown rate in 2005 showed that using the scour alone and with no inflow the reservoir level can be drawn down at an initial rate of 0.02 m a day and that it would take over 400 days to empty the reservoir. With full abstraction to supply, the time to empty the reservoir reduces to slightly more than 200 days. If the blank flange is removed from the supply pipe and the blockwork infill panels on the end wall of the outlet chamber are demolished, the rate of drawdown would increase to 0.10 m a day and the reservoir could be emptied in less than 60 days. At the last Section 10 inspection in 2007 it was considered that the rate of drawdown was inadequate and the following recommendation was made:</p> <p>The Emergency Draw Down Plan should be expanded to include measures to be taken in an emergency to increase the rate of draw down to 0.5 m a day.</p> <p>These could include:</p> <ul style="list-style-type: none">removing the blank flange from the supply pipe and demolishing the blockwork infill panels in the end wall of the outlet chamber;provision of pumps;any other measures. <p>Anglian Water has subsequently undertaken a study of options for lowering the water level in an emergency. The preferred and most practicable solution is to modify the supply pipe at the downstream end of the tunnel, including extending the pipe through a reconstructed end wall of the tunnel, and to provide a new 750 mm diameter scour pipe through the tunnel to discharge downstream of the end wall of the tunnel. Hydraulic calculations show that this would increase the rate of drawdown to 0.27 m a day and would decrease the time to reduce the volume by 50% to 15 days. Although the general criteria now adopted by AW is that the rate of drawdown at impounding reservoirs should achieve a reduction in volume by 50% in 10 days, I have advised that an upper limit of 20 days is acceptable provided that inflows are taken into consideration. The hydraulic calculations that established the drawdown rates and times for the proposed new arrangement take account of average winter inflows and</p> | No reference: "Although the general criteria now adopted by AW is that the rate of drawdown at impounding reservoirs should achieve a reduction in volume by 50% in 10 days, I have advised that an upper limit of 20 days is acceptable provided that inflows are taken into consideration." "It is recommended that the capacity of the scour is increased so that 50% of the volume of the reservoir can be released in less than 20 days with inflow equal to the winter average flow." |
| 41 | Y | Grafham Water | In Operation | Anglian Water Services Ltd | Near Huntingdon | TL1700067000 | Impounding | Gravity and Earthfill | 57,800,000 | 25.50 | 6,280,000 | 22/09/2010 | 1964 | Ian Charles Carter | Anglian | 5.5 | m3/s | full to empty in 30days | | Current situation would take over 4.5 months to draw down the reservoir | | | <p>The current draw down rate is unacceptable slow and would be ineffective in dealing with a major incident at the reservoir. Detailed study to be carried out to determine how the rate of lowering can be maximised.</p> | No reference: "Complete emptying of the reservoir with zero inflow within 30days. Reduction of level to 50% reservoir storage with zero inflow within 20days." |
| 42 | Y | Springs | In Operation | United Utilities plc | Near Bolton | SD6910014800 | Impounding | Gravity and Earthfill | 609,000 | 14.00 | 99,800 | 06/06/2013 | 1830 | Prof Andrew K Hughes | North West | 0.35 | m/day | 1 | m/day | current rate does not meet current standards | no inflow | | <p>current rate is 0.35m/day from top water level assuming no inflow. The reservoir can drawdown to 25% of pool height in 24days. This equates to a time to drawdown by 1m at full storage level would take 3-4 days assuming no inflow. "This does not meet 'current' standards which tries to ensure the top 1 meter can be discharged in 24hours. Thus, I recommend that the drawdown facility be incresed to somthing of the order of 1 meter a day assuming no inflow. I recommend an on site plan be written."</p> | No reference: current standards are 1m/day assuming no inflow. |
| 43 | Y | Alton Water | In Operation | Anglian Water Services Ltd | Near Ipswich | TM1620035700 | Impounding | Gravity and Earthfill | 9,100,000 | 21.70 | 1,580,000 | | 1976 | Ian Charles Carter | Anglian | 1.94 | m3/s | 33 | mm/day | currently about 150mm/day. AWS standard based upon 50% volume drawn down in 10days | | | <p>AWS=Anglian Water Services LTD. "AWS hae recently adopted a standard based upon a 50% volume draw down in 10days, which is reasonable in my opinion. A preliminary study already identified a preferred option for achiving this standard, which involves modification of the existing scour pipework. This could increase the capacity by 2.5m/s and enable the reservoir to be lowered by at least 300mm/day. This improvement could be achieved at modest cost and i recommend that it be carried in to effect."</p> | AWS standard of 50% volume draw down in 10 days. "I recommend that the draw down capacity be improved by such that (a) the reservoir can be lowered by at least 300mm/day and (b) that the storage volume can be reduced by 50% within a period of 10 days." |
| 44 | Y | Serpentine | In Operation | Royal Parks Agency | Near Hyde Park | TQ2780080000 | Impounding | Not Known | 361,000 | 8.13 | 164,000 | | 1700 | John Graham Cowie | South East | | | | | "unsatisfactory" "Both draw off and scour arrangements are defunct. A replacement means of lower the water level in the reservoir is considered to be essential." | | | <p>"A permanent means of lowering the water level in the reservoir should be provided." No references to any requirements or drawdown rates.</p> | No Rule/guide mentioned |
| 45 | Y | Crowthorne Service Reservoir (Cells 3 & 4) | In Operation | South East Water Ltd | Near Crowthorne | SU8720064600 | Service | Concrete Service | 36,334 | 5.00 | 4,020 | | 1972 | Prof Andrew K Hughes | South East | | | | | | | | <p>"The scour facility is restricted by the situation around the site." No required changes to the drawdown rate are required.</p> | N/A / None mentioned |
| 46 | Y | Butterley. | In Operation | Canal & River Trust | Near Ripley | SK4000051900 | Impounding | Gravity and Earthfill | 311,000 | 9.60 | 121,000 | | 1795 | Mr J D Gosden | Midlands | | | | | | | | <p>At present the reservoir cannot be lowered as there are no operating outlets. MIOS: " A reliable means of lowering the reservoir in emergency to the general ground level immediately downstream of the dam shall be provided. Possible means of doing this include: developing and testing an emergency plan to operate a temporary pumping facility or construction of a new drawoff facility towards the right hand end of the dam to discharge into the spillway channel culvert running under the business park."</p> | No Rule/guide mentioned |
| 47 | Y | Sutton Bingham | In Operation | Wessex Water Services Ltd | Near Yeovil | ST5540011400 | Impounding | Gravity and Earthfill | 2,614,000 | 15.00 | 575,000 | | 1956 | J. L. Hinks | South West | 1.74-1/82 | m3/s | 500 | mm/day | Wont hold the water level down during periods of flooding | | | <p>curently will lower the reservoir from top water level by 260mm /day. "The above drawdown capacity is considered to be insufficient as has also been demonstrated by the inability to hold the reservoir level down during December 2006 and January 2007."</p> | No Reference: Lower form TWL by at least 500mm/day against inflow of 100l/s into the reservoir |
| 48 | Y | Black Lake, Knowle Wall Farm | In Operation | Prestwood | Near Stone | SJ8560039600 | Impounding | Gravity and Earthfill | 95,000 | 5.00 | 56,000 | | 1815 | M Airey | Midlands | | | | | Current outlet has been blocked up and not in use | | | <p>Recommended that some means be provided of lowering the water level I nthe reservoir, could be done be reinstating the existing draw-off culvert as an operation facility. If this is not the case then an alternative means of lowering the water level would need to be considered. This may involve the installation of a siphon pipe with which to draw water from the reservoir, or the development of an emergency plan.</p> | No Reference: "For a small reservoir like this, it would be normal practive to be able to lower the reservoir lebel by around 0.3m in the first 24 hours of an emergency situation and on this basis a draw-off rate of approximately 0.2m3/s is needed." |
| 49 | Y | King George V | In Operation | Thames Water Ltd | Near Chingford | TQ3740096500 | Non-impounding | Gravity and Earthfill | 13,970,000 | 10.00 | 1,720,000 | | 1912 | Prof Andrew K Hughes | South East | 0.39 | m/day | 1 | m/day | Currently not quick enough for a reservoir that could fail quickly | No inflow | y | <p>Based on a scale model it was found that the drawdown was 39% of which it had been designed for (1m/day). "I consider that if a problem did occur at this reservoir then because of the type of construction the failure made would be quite fast - certainly faster than a homogenous embankment orembankment with core and cohesive shoulders. the consequences of failure are high and although the surveillance provided is good i do not consider that the current rate of drawdown that can be achieved is sufficient. In addition i am of the opinion, having been involved with a number of emergencies, that it would not be possible to mobilise sufficient pumps, install them and get them running in a short enough time to be effective. Thus i recommend that facilities be installed to achive a rate of drawdown of 1.0m/day assuming no inflow and the reservoir is full based on current industry best practice."</p> | current industry best practice': 1.0m/day assuming no infow |
| 50 | Y | Bowmans Green Lake | In Operation | Trustees of the Tyttenhanger Estate | Near London Colney | TL1860004300 | Impounding | Gravity and Earthfill | 250,000 | | 140,000 | | 1984 | Jack Huge Meldrum | South East | | | | | Current pipe is prone to blockage and may be currently blocked or damaged as indicated by the settlement over the pipe. | | | <p>Existing outlet pipe should be replaced.</p> | No Rule/guide mentioned |
| 51 | N | Ryburn | In Operation | Yorkshire Water Services Ltd | Near Halifax | SE0230018700 | Impounding | PG Concrete Gravity | 955,000 | 31.00 | 105,555 | | 1933 | Prof Andrew K Hughes | North East | 1 | m/day | | | | | | <p>Ne required changes to drawdown rate. MIOS:"A much larger drawdown facility be provided through the new weir such that it only causes a surcharge when there is a significant discharge via the overflow or from the scour pipes.</p> | N/A / None mentioned |
| 52 | N | Eglwys Nunydd | In Operation | Tata Steel UK Limited | Near Margam | SS7920085500 | Non-impounding | Gravity and Earthfill | 3,840,000 | 5.20 | 1,052,220 | | 1962 | Ian Charles Carter | EA Wales | 1.5 | m3/s | | | Relitively slow discharge | | | <p>recommeneded that a detailed study be undertaken to estimate the draw down characteristics.No MIOS related to dradown.</p> | No Rule/guide mentioned |

| Ref. | MIOS relating to lowering reservoir | Reservoir Details | | | | | | | | | | | | | | Previous Drawdown | | Recommended | | Reasons for decision on new drawdown rate | Inflow assumptions | Fixed Capacity | Comments/Other | Drawdown rule/guide applied |
|------|-------------------------------------|----------------------------|-----------------|--|-----------------|--------------|----------------|-----------------------------|---------------|------------|-------------------|----------------|------------|----------------------------|--------------|-------------------|---------------|-------------|--------|---|--------------------|----------------|--|---|
| | | Reservoir name | Physical status | Undertaker | Situation | Location | Category | Reservoir Type/construction | Capacity (m3) | Height (m) | Surface area (m2) | Date Inspected | Date built | Inspecting Engineer | Mgmt. Region | Rate | Unit | Rate | Unit | | | | | |
| 53 | Y | Firsby (2 & 3) | In Operation | ROTHERHAM METROPOLITAN BOROUGH COUNCIL | Rotherham | SK4940095700 | Impounding | TE Earthfill | 70,463 | 9.00 | 8,000 | 20/12/2012 | 1879 | P. Kelham | North East | | | | | | | | "The means of lowering the water level in the reservoir are no longer operative. The reservoir can only be lowered by using auxiliary pumps." There is an emergency drawdown procedure that allows for pumps. There is adequate turning areas to the north of the dam to allow equipment to be delivered to site. "The procedure was prepared in 2006. There have been changes in personnel. I recommend that the procedure must be brought up to date. Therefore, it must be reviewed annually by the Supervising Engineer." MIOS: "The low level draw-off shaft shall either be made safe or refurbished." | No Rule/guide mentioned |
| 54 | Y | Gilstead Raw Water | In Operation | Yorkshire Water Services Ltd | Near Gilstead | SE1190039500 | Non-impounding | PG Concrete Gravity | 49,800 | 5.30 | 13,000 | 13/02/2013 | 1996 | Prof Andrew K Hughes | North East | 1 | m/day | | | No change in rate | | | No related to rate of drawdown. MIOS: "The scour pipe be piped into the tunnel to reduce the risk of blockage. The scour valve be positioned so it can be operated easily." | No Reference: Over 1m/day is adequate |
| 55 | Y | Marlon Mere | In Operation | BLACKPOOL BOROUGH COUNCIL | Near Blackpool | SD3440035300 | Impounding | Gravity and Earthfill | 239,000 | 4.00 | 170,000 | 11/02/2013 | 1973 | M Airey | North West | | | | | No change in rate | | | The outlet is in need of repair, no mention to any change or adequacy of the drawdown rate itself. MIOS: "Repair and reinstatement of the low level outlet to a fully operational facility shall be carried ou which shall include the refurbishment or replacement of the draw off valve. In addition, the pipline and chamber shall be made good to overcome the effects of excessive movement. It is recognised that these improvements will probably be incorporated within the major re-build of the overflow." | No Rule/guide mentioned |
| 56 | Y | Blackleach Reservoir South | In Operation | Salford City Council | Near Salford | SD7400003800 | Impounding | Not Known | 181,840 | 6.00 | 67,000 | 18/12/2012 | 1890 | M Airey | North West | 0.1 | m3/s | 0.3 | m/day | rate is currently to low | | y | At current rate it would take 4-5 days to lower the reservoir by 0.5m. | No reference: 0.3m from TWL in a 24 hour period |
| 57 | Y | Appleton | In Operation | United Utilities plc | Near Warrington | SJ6020084200 | Impounding | TE Earthfill | 207,000 | 8.00 | 76,900 | | 1848 | Alan John Brown | North West | 50% | % in 3 days | | | | | y | Calculated drawdown is ok. "The scour has two 200mm hydraulically operated butterfly valves. Both scours were operated satisfactorily. However, the flows appeared to be less than would be expected with the pipes running full bore. I recommend that investigation be carried out to ensure there is no blockage in the scour pipes." MIOS:" investigation be carried out to ensure there is no blockage in the scour pipes. If blockages are found then they should be removed or other appropriate measures taken to restore the capacity of the bottom outlet." | N/A / None mentioned |
| 58 | Y | Bretton Park Lakes Lower | In Operation | City of Wakefield Metropolitan Borough Council | Near Wakefield | SE2900012500 | Impounding | Gravity and Earthfill | 289,000 | 9.50 | 150,000 | 17/07/2012 | 1849 | J R Claydon | North East | 1 | m in 3-4 days | | | | | | "The only means of lowering water in the reservoir is to use the siphon pipe. The capacity of the pipe is small and would draw down the reservoir at a rate of no more than 1 metre in 4 to 6 days. This is a much lower rate than the 1 m/day stated in the 1992 Operation and Maintenance Manual. The 300 mm diameter pipe is smaller than would be installed in a new dam. However it is considerable improvement on the situation before 1992. There is good evidence of the benefits of low level outlets in being able to lower the reservoir and thus avert failure, in terms of the historic ratio of serious incidents to failures, however there is little consistency of approach in the United Kingdom to the question of low level outlet capacity. The English formula proposed by Hinks (Ref 22) would require a drawdown rate of about 420 mm/day, which is about double the available capacity at Bretton Park Lower. The British Waterways approach described by Brown (Ref 23) calculates the number of days to lower the reservoir to 50% of volume when full, with inflow of winter daily mean flow. This is related to the consequence class of the reservoir and the frequency of surveillance." MIOS:"Carry out a study to measure the actual capacity of the existing siphon pipe and determine how to improve the drawdown capacity. Works resulting should be carried out to a timescale determined by the Panel Engineer supervising the study." | Hinks: 420mm/day. Hinks Reference: Hinks, 2008, Low Level Outlets for Dams - 1 |
| 59 | N | Denton | In Operation | Canal & River Trust | Near Grantham | SK8700033700 | Impounding | Gravity and Earthfill | 278,000 | 8.00 | 99,000 | 14/05/2012 | 1799 | Timothy John Ferrebee Hill | Anglian | 140 | mm/day | 300 | mm/day | | Q10 | | "The Prescribed Form of Record indicates that the scour pipe can discharge up to 0.16 m3/s. With no incoming flow this would result in a draw-down rate of around 140 mm per day, based on a reservoir surface area of 99,000m2. A minimum rate of 300 mm/day with a Q10 incoming flow is generally deemed adequate, or, in the case of British Waterways, a reduction to 50% reservoir volume in 7 days. Neither of these requirements are met. British Waterways has developed an emergency plan for the reservoir which includes the provision of pumps to enhance the permanent drawdown arrangements. Given the negligible risk to life downstream I consider these arrangements to be adequate, however, hey should be reviewed on an annual basis to ensure that contact numbers and arrangements for pump supplies are kept up-to-date." | 300mm/day with Q10. For British Waterways a reduction to 50% reservoir volume in 7days. |