Upper Thames River Conservation Authority

Operational Plan for Pittock Dam

November 26, 2024

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1 Purpose of Operational Plan

Ontario Regulation 686/21 requires that a Conservation Authority (CA) provide programs and services that support the operation, maintenance, repair, and decommissioning of the following types of infrastructure the CA owns or manages:

- Any water control infrastructure, the purpose of which is to mitigate risks to life and damage to property resulting from flooding or to assist in flow augmentation.
- Any erosion control infrastructure.

Programs and services provided shall include the development and implementation of an operational plan on or before December 31, 2024.

Some water control structures in the Upper Thames River Conservation Authority (UTRCA) watershed are not owned by the CA but are managed through agreement with the owner. These structures also require operational plans.

2 Purpose of Structure

2.1 Flood Control and Flow Augmentation

Design concepts for Pittock Dam were described in the Upper Thames Valley Conservation Report (1952) with the objectives of providing flood protection to downstream communities and improving base flows during the drier summer months. In 1961 engineering design commenced to find the best combination of works in the Woodstock area. Two alternatives were considered, one which had dams on both the Thames River and Cedar Creek. The current location of a single dam upstream of Highway 59 was selected. Construction was started on the dam in 1964 and officially completed in 1967. The cost of the dam and land base at that time was close to $6 million. Figure 1 shows the location of Pittock Dam and the reservoir drainage area.

Pittock Dam and Reservoir are designed for both flow augmentation and flood control. The dam operation follows an annual cycle to supplement downstream flows during the drier summer months. At the beginning of the year, the reservoir is at approximately 1 metre (283.7 metres above sea level, masl, 930.8 feet above sea level, fasl), which is its winter holding level to maintain aquatic habitat. The low reservoir has room to manage winter floods and to store runoff from snowmelt and rain in the winter and spring, which is used to fill the reservoir to the summer conservation level of 3.9 m (286.6 masl, 940.3 fasl). The summer conservation level is the level needed to provide flow augmentation through the summer and fall.

Approximately 5 million cubic metres of water are required to fill Pittock Reservoir from its winter holding level to its summer conservation level. This volume is the equivalent of 20 mm of water covering the entire 245 km^2 area that drains into the reservoir.

Above the summer conservation level, there is an additional 10 million cubic metres of flood storage. This amount is equivalent to 42 mm of water covering the entire drainage area upstream of the reservoir.

The flow augmentation period typically begins in late June. Water is gradually released from the reservoir, augmenting flows in the Thames River downstream to London, providing water quality and aquatic habitat benefits. During a dry summer, this release from Pittock Reservoir provides 30% to 40% (or more) of the flow in the south branch of the Thames River.

By late fall, the reservoir has been drawn down to its winter holding level, maintaining sufficient water for aquatic habitat while increasing flood storage for fall and winter floods and to be ready for the next spring runoff.

During a flood, the structure can reduce downstream flows on the Thames River by storing runoff in the reservoir and releasing it later. The level of flow reduction typically ranges from 20% to 50%, depending on the type (season) and severity of the flood and when it occurs.

2.2 Recreational Use

When the Upper Thames Valley Conservation Report (1952) was released, it made several recommendations about various forms of recreation in the UTRCA watershed, including:

- Beaches and pools for swimming,
- Boating and fishing areas,
- Individual picnic sites and group picnic grounds in parks,
- Individual and group camping areas, and
- Trails for riding, hiking and nature study.

The construction of Pittock Dam and Reservoir included acquisition of the surrounding lands comprising the Pittock Conservation Area (PCA), which over the years has provided the above recreational opportunities. In addition to the services managed by PCA staff some lands around the reservoir are subject to lease agreements, such as with the City of Woodstock which makes them open to public recreational use, and a sailing club.

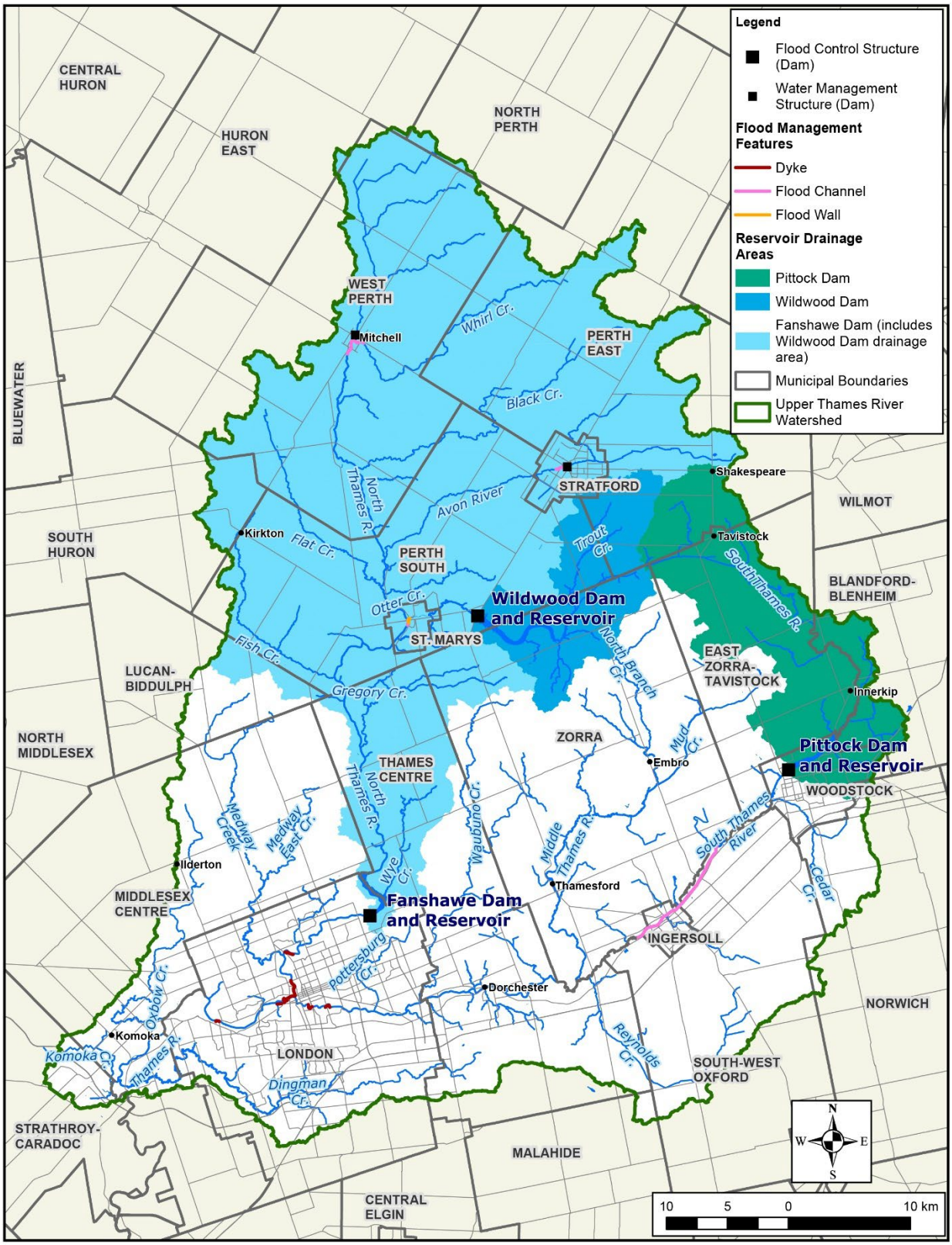

Figure 1. UTRCA water management structures and reservoir drainage areas

3 Level of Service

Level of Service (LOS) refers to the ability of an asset or its components to perform the role for which it was designed and to the level or quantity of use for which it was intended. Because of the importance for Pittock Dam to continue to reduce the risk of flooding downstream on the south branch of the Thames River, as well as its role in augmenting stream flow downstream through London in dry months, the required LOS would be high. The amount of attention to and funding for operation and maintenance must be reflective of the importance of this asset.

LOS will be further considered through Asset Management Planning. As such this section will be updated to reflect that ongoing work.

3.1 Service Life

A concrete/earthen embankment dam, such as Pittock Dam, with proper inspection and maintenance should last at least 100 years. The lifespan of hydromechanical steel structures, electromechanical equipment and control units is shorter than that of the main civil/structural components and are specified by the suppliers, who also provide instruction manuals describing operation and maintenance. Continued routine and preventative maintenance and the timely replacement of equipment will allow the dam to continue to meet its expected level of service and extend the structure's service life considerably.

4 Stakeholders and Beneficiaries

When operating dams, it is important to understand who is impacted by the operations. Stakeholders of Pittock Dam are described below in three groups based on the type benefits they receive from the operation of the dam. Funding for the operation and maintenance of Pittock Dam is levied to the municipalities which shared in the funding of the local share of the dam when it was constructed. While the cost of the construction of the dam and reservoir was originally shared by the local municipalities, with the establishment of the regional government of Oxford County the total 61.1% assigned to Oxford municipalities is levied against Oxford County for operation and maintenance of the dam. The City of London provides 32.9% of the local share, while 6% is allocated to all municipalities based on their relative share of the modified current value assessment of the watershed.

From a flood control perspective, the City of Woodstock, the Town of Ingersoll, and their residents and business owners whose flood risks are reduced through the operation of the reservoir benefit the most from Pittock Dam. Flood risk reduction on the Thames River in London is reduced as Pittock Reservoir only controls about 20% of the drainage area of the south branch of the Thames River as it enters the city.

Pittock Dam and Reservoir provide flow augmentation by maintaining flow in the Thames River. This reliable flow is beneficial for the general health of the watercourse

and aquatic life it supports. When planned, the reservoir was designed to provide reliable flow, in part, to assimilate effluent from downstream wastewater treatment facilities at Woodstock, Ingersoll, and London. This flow augmentation function is the likely reason for London's significant share of the costs.

PCA was established around the reservoir to take advantage of the large waterbody formed by the dam. It provides recreational opportunities for those using the facilities for camping, boating, fishing, hiking, cycling, and other day use activities. Lease holders also benefit from the reservoir as well as the people able to freely access the large areas of parkland around PCA through the lease with Woodstock.

The stable flows downstream of the dam also benefit recreational uses in the floodplain and watercourse. The flow augmentation also benefits those drawing water for such things as irrigation.

The conservation area and all the people that are brought into the area also provide various social and economic benefits to the surrounding area.

4.1 Communications with Stakeholders

Communications with stakeholders are important to the operation of the dam. Conservation area and property staff have established relationships with the various user groups around the reservoir and can distribute the messages to these stakeholders. As such, it is important that these staff are kept up to date on any significant variation from typical operating conditions such as unseasonably high or low water levels in the reservoir.

Flood time communications are undertaken directly by flood control staff to municipal flood coordinators. Most operations of Pittock Dam have little impact on Woodstock or Ingersoll, and less on downstream municipalities; however, in the event of a major flood where significant gate operations are necessary at Pittock Dam, communications with the City of Woodstock and Town of Ingersoll would be through their municipal flood coordinator, consistent with the UTRCA Flood Contingency Plan. Discharge from Pittock Dam, when combined with flows from Cedar Creek, may require Dundas Street to be closed.

5 Operations

5.1 Physical Characteristics

Pittock Dam controls 245 km^2 of upstream drainage area. The reservoir has a normal summer surface area of 380 ha and a maximum surface area of 450 ha. The reservoir is controlled by five radial sluice gates, each measuring 24 ft x 21 ft, as well as one 44 x 48 inch low flow control valve. The centre bay of the dam has a series of stop logs (11 logs, each 15 inches high) upstream of the radial gate. The top of the stop logs is 3.99 m (286.689 masl, 940.6 fasl). The centre gate (bay 3) is left open 3 feet, so the bay acts as a passive spillway when water levels rise above the stop log top elevation. In 2022,

to improve aquatic habitat in winter months, two rows of stop logs were installed in bays 1, 2, 4, and 5, holding the winter level to between 0.75 m and 1.0 m. This change was made in accordance with a study completed in 1993 (see section 5.3).

The maximum discharge capacity of Pittock Dam is calculated as 850 m^3/s, with the centre bay and habitat stop logs in place, which is much more than the regulatory flood. With all logs removed, total capacity is estimated at 1120 m^3/s which can safely pass Probable Maximum Flood (PMF). The Pittock Reservoir has a maximum operating level of 6.86 m (289.56 masl, 950 fasl).

5.2 Flood Routing

When Pittock Dam was first commissioned in 1967, a set of instructions on routing floods through the reservoir was provided. There are two sets of routing rules, one based on snowmelt flooding and the other based on rainfall flooding. In the non-snowmelt period, it is assumed the reservoir is full to summer conservation level or being filled, and generally all gates (except centre bay with stop logs) are closed and discharge is controlled with the valve. Dam operations are completed based on the rate of rise of the water level in the reservoir, the water level elevation, and downstream constraints.

During the spring, when snowmelt flooding is assumed, the reservoir begins at its winter holding level, and gates 1, 2, 4, and 5 are all set to 6 inches each. Gates are adjusted according to rate of rise and water level, with downstream constraints considered. During snowmelt floods, the rate of rise before operations are considered is less than for rainfall-based floods, and the volumes to be managed are generally larger. Pittock Reservoir at its summer level (3.9 m) still retains 42 mm of flood runoff storage.

5.3 Downstream Constraints

The original dam design suggests 113 m^3/sec (4000 ft^3/sec) as the trigger for alerting the town engineer (now the municipal Flood Coordinator identified in the Flood Contingency Plan) that flooding downstream will occur. In modern practice, a threshold of approximately 50 m^3/sec, with the combined discharge from the dam and Cedar Creek, will begin to overtop Dundas Street.

A real-time hydrometric gauge, called Thames River at Innerkip (02GD021), is located upstream of the reservoir. This gauge is operated by the Water Survey of Canada with assistance from UTRCA under agreement. This gauge began recording data and estimating discharges in 1978. While the Innerkip station only measures 148 km^2 of Pittock's 245 km^2 catchment (60%), it still provides a good indication for operation decisions, based on what is occurring upstream.

It is important that operators consider this flow information, snow survey, and precipitation data along with improved forecasting tools, which were not available when the original flood routing instructions were established. This engineering judgement is an important part of contemporary operations of the dam.

5.4 Flow Augmentation

Pittock Reservoir was built as a dual-purpose reservoir, to protect downstream communities from flooding as well as provide flow augmentation during summer and early fall months. Pittock typically begins the spring season at its winter level of 0.75 m to 1.0 m and is then filled with late spring snowmelt and rainfall runoff until it reaches its summer conservation level of 3.9 m by early May. The summer conservation level is the level the reservoir must be filled to, to be able to achieve its flow augmentation. Summer level is held until it naturally begins to decrease, depending on the dryness of the year, and generally as late as the end of June, before augmentation begins. Due to the size of the reservoir relative to the watershed area, it is often possible to fill Pittock with rainfall runoff alone. Historically, filling Pittock Reservoir has not been a problem.

The reservoir was designed to provide 15 ft^3/s (0.42 m^3/sec) through the low flow valve from the end of June until late fall when winter elevation is reached. In the original design, the assumption was that any inflow to the reservoir was balanced by losses including evaporation from its surface. The winter level in the original design was 927.5 ft (0.0 m relative). In 1993, a study was completed to examine alternate drawdown curves, allowing the winter level to be kept higher, partly to improve aquatic habitat over the winter without impacting flood control. As of 2022, the winter level has been raised to 0.75 - 1.0 m through the use of two rows of stop logs in bays 1, 2, 4, and 5. These logs also allow the gates to be left open reducing the risk that they are frozen in place by the ice pack.

Figure 2 is a plot of the annual filling and drawdown guideline. This plot has been developed to reflect the original text description and refined as discussed above. Watershed conditions often provide challenges requiring judgment. The solid green line shows in practice how filling has been achieved historically, showing the long-term median reservoir elevations at the 1st and 15th of each month, from February until early May. This is used by operators as a guide to filling. The drawdown curve, beginning in late June, is also derived from the 1st and 15th of each month's long term median level, and coincides with the design that the reservoir provides 0.42 m^3/sec downstream.

The vertical axis on the left represents reservoir elevation, in terms of relative m, and the two vertical axes on the right show the same information presented in terms of first the percentage of reservoir storage used, and then the remaining mm of runoff storage between empty and maximum operating level.

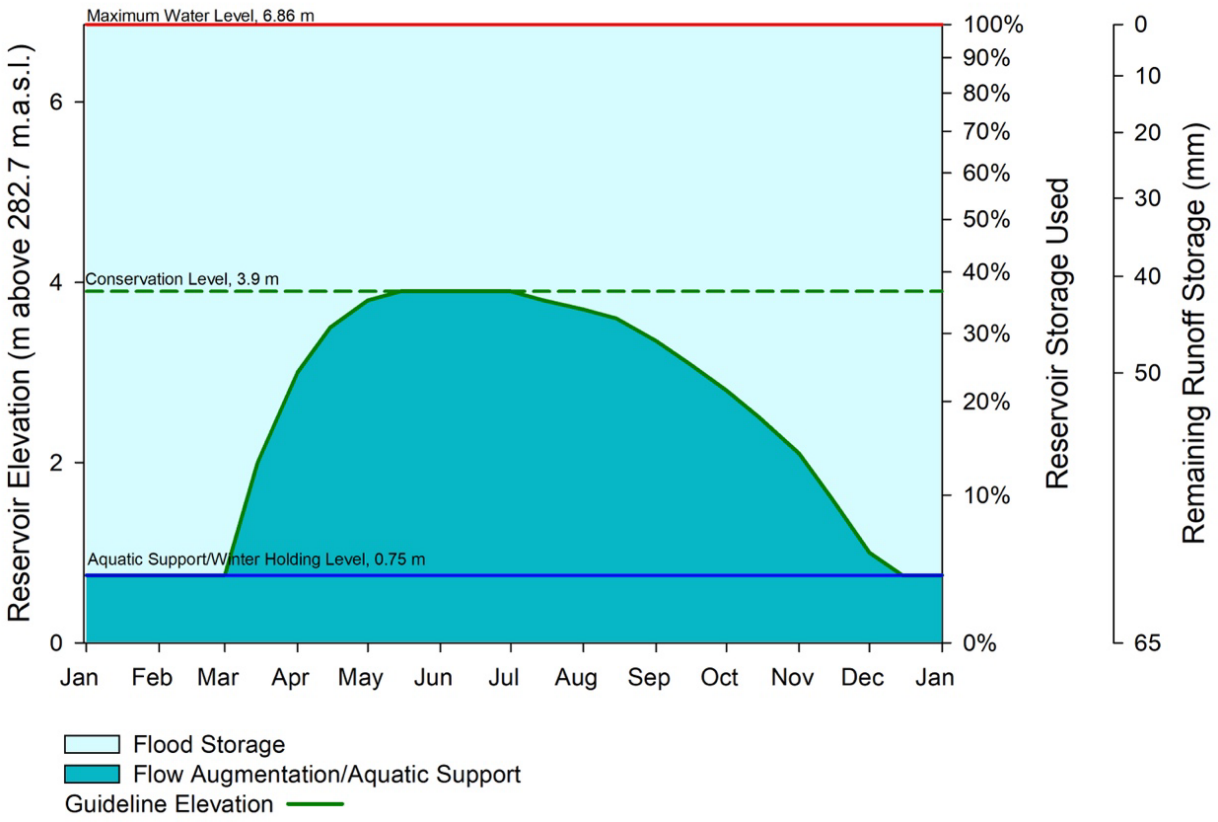

Figure 2. Pittock Reservoir annual filling and drawdown guidelines

5.5 Reservoir Capacity

Pittock reservoir has a relatively small capacity between winter and summer level, requiring the storage of only 23 mm of runoff to meet its summer target elevation. Once at summer level, there remains 42 mm of runoff storage until the maximum level is reached.

5.6 Climate Change Considerations

It is anticipated that climate change may affect reservoir filling. Current trends seem to suggest more precipitation earlier in the year and an earlier loss of snowpack. This raises uncertainty as to whether to capture runoff from early melt/rainfall events or to draw levels back down in January and February to ensure appropriate storage for later spring events, while also ensuring that the target summer level is reached. There is less risk in drawing the level back down at Pittock due to the limited amount of runoff required to bring it up to summer conservation level.

Climate change also appears to present additional challenges during the summer months, with more frequent early summer events pushing reservoir levels towards operation thresholds. This can have a significant effect on recreational reservoir uses.

6 Routine Maintenance

Routine inspection and maintenance are important to ensure the flood and flow augmentation structures are able to meet their purposes. Inspection and maintenance are guided by the structure's Operation, Maintenance and Surveillance Manual (OMS Manual). This manual identifies:

- Weekly inspections – generally carried out by trained park staff, include a visual inspection of the buildings and equipment, and verification of the operation of the discharge facilities (gates, valves) to the extent possible. With reservoir levels at or near the summer conservation level, gate operations must be restricted in order to not significantly increase downstream flows.
- Monthly inspections – generally carried out by the maintenance mechanics.
- Annual inspections – generally undertaken by engineering staff and maintenance mechanics, include a more thorough visual inspection of the dam embankment, buildings, and equipment and testing the operation of equipment.

These inspections are in addition to routine health and safety inspections undertaken by the UTRCA's Joint Health and Safety Committee. Dam Safety reviews and external inspections are also carried out approximately every 10 years.

7 Emergency Planning

As part of the UTRCA's Dam Safety Program, Emergency Preparedness Plans (EPP) and Emergency Response Plans (ERP) are being developed. Responses to dam emergencies that may require communication with watershed residents rely on the Flood Contingency Plan, which uses flood bulletins to communicate conditions to municipal flood coordinators, who then implement municipal emergency plans.

8 Roles and Responsibilities

Operations are directed by senior engineers based on the general principles described in this document. Careful consideration of the watershed conditions and forecasts require the careful application of engineering judgement. Operations are undertaken by trained operators which include conservation area staff, maintenance mechanics, and other trained water and erosion control structure staff. Routine maintenance is undertaken by Dam Maintenance Mechanics and contractors, as necessary.

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