

# Cataract Dam

Instrumentation Upgrade Project

Supporting Statement

(To accompany a s60 Fast Track application under the *Heritage Act, 1977*)

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## 1. Introduction

Cataract Dam was the first of four major dams constructed as part of the Upper Nepean Scheme, supplying water to Sydney via the Upper Canal and Prospect Reservoir. Cataract Dam was constructed in 1903-1907 followed by Cordeaux Dam (constructed 1918-1926), Avon Dam (1919-1927) and Nepean Dam (1936). The Upper Nepean Scheme as a whole has State heritage significance as the major water supply scheme for Sydney, operating as originally built for over 130 years with the 4 major dams built between 1903 and 1936 as State significant engineering feats in their own right.

Cataract Dam has heritage significance at the State level for nearly all of the criteria used to assess heritage significance. Cataract Dam in particular has significance in relation to the site's landscaping, vistas, Cataract Manor, detailing on the dam wall and valve houses and the remaining staff housing.

The Dam requires regular monitoring and maintenance as prescribed under the *Dams Safety Act 2015* and the *Dams Safety Regulation 2019*. Recent changes driven by the Regulation has seen Cataract Dam classified as a high-risk dam. To monitor the dam and provide effective information WaterNSW has need to replace and install various dam safety instruments and monitoring equipment at Cataract Dam.

## 2. Location

Cataract Dam located 84 kilometres south-west of Sydney on the Cataract River, downstream from the junction with Cataract Creek. The site is accessed from Baden Powell Drive off the Bulli Appin Road. The site is Lot14 DP1233164 and it is the ownership of WaterNSW. An aerial view of the Dam is shown in Figure 1.



Figure 1 – Cataract Dam Aerial View

### 3. Heritage Listings

The following heritage listings apply to Cataract Dam:

Register	Listing Name and Number	Status
State Heritage Register	Cataract Dam (SHR 01359)	State
Wollondilly Shire LEP 2011	Cataract Dam I55	State
WaterNSW s170 Register	Cataract Dam 4580028	State

## 4. Heritage Significance, Site and Asset Description

The following is taken from the Conservation Management Plan (CMP) (Graham Brooks and Associates, 2003) and Conservation Management Plan (CMP) Update (Extent Heritage, 2018):

Cataract Dam is part of the Upper Nepean Scheme and derives some of its significance from its association with the Scheme, which is itself of State Heritage significance. Completed in 1907, Cataract Dam is the first of the major dams to have been completed as part of the scheme and as such has been part of Sydney's water supply for over 100 years. Cataract Dam was also the first of the major water supply/irrigation dams constructed in NSW.

Up until the completion of Cordeaux Dam in 1926, the impounded water of the Cataract Catchment Area provided the main reserve source of water for domestic and industrial consumption in metropolitan Sydney, the largest city in NSW. In providing water for metropolitan Sydney during this era the dam contributed to the extensive residential, commercial and industrial development of Sydney during the first decades of the twentieth century.

The cyclopean masonry of the dam is the first of its type built in Australia and demonstrates the principal characteristics of this technology. The lower valve house is the earliest example of its type in NSW and demonstrates the principal characteristics of the design of such structures. The water supply system completed in 1907 retains its gallery and rising main chamber in the dam wall which demonstrate the principal characteristics of the design of such a delivery system.

Cataract Dam is arguably the most decorative of all the major dams constructed in NSW in regard to its high standard of rusticated stone finishes on the crest wall, abutments and crest house, the ashlar pattern imparted by the precast concrete blocks on the straight upstream face of the wall, the unadorned functionality of the concrete facing to the inclined downstream face and lower valve house and the setting of the high straight wall within the landscape of the Cataract River gorge. The crest house and complementary elements such as the articulated arches on the crest wall in their innate sense of scale and composition rank with the best of all public works in NSW undertaken in the Federation era.

The dam wall and crest house where the installations described in Section 5 are to be undertaken are assessed as having Exceptional heritage significance.

## 5. Scope of Works

WaterNSW has embraced a risk assessment approach to inform its decision making and to prioritise future investment as part of its Dam Safety Management Program. Cataract, Cordeaux and Woronora Dams all have societal risk ratings and/or highest risk ratings higher than the 'safety threshold' mandated by Dams Safety NSW. WaterNSW as a result is undertaking projects that will lower the safety risk.

The objective of the instrumentation upgrade project is to provide effective real time dam safety monitoring to allow early detection of potential dam safety threats. This will enable WaterNSW to reduce downstream consequences by improving emergency response in providing maximum possible warning times to our downstream communities in the event of an emergency to prevent loss of life in the event of any dam incidents.

The instrumentation upgrade will provide effective dam safety remote monitoring of key dam safety parameters such as movement or deformation, porewater pressure and seepage in near real time. This will aid in identifying potential dam safety threats (the potential failure modes); and detect the possible initiation/progression of a potential failure mode so that timely actions can be taken to prevent failure. The project will also provide real-time monitoring with alarm capabilities that will allow detection of significant changes in the performance or conditions of the dam that could otherwise go unnoticed.

It is imperative that WaterNSW enhance its monitoring regime in alignment with the risk profiles of Cataract Dam. In order to demonstrate due diligence WaterNSW must meet regulatory requirements in effectively managing dam safety risks, and the installation of monitoring systems is essential in meeting these requirements.

As part of the Instrumentation Project, various instruments will be installed at the downstream of the dam wall, on the dam wall and inside the Crest House. These instruments are listed in Table 1. The installation will include necessary cabling, dataloggers and data transmission between the instruments and WaterNSW's telemetry systems at Cataract Dam.

Instrument Type	Instrument ID	Quantity	Preferred Selection	Description	Connectivity
[REDACTED]	[REDACTED]	1	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	1	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	1	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	1	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	1	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	1	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	1	[REDACTED]	[REDACTED]	[REDACTED]

Table 1 – Cataract Dam Instrumentation List.

**V-Notch Weirs**

This work involves replacing existing instruments. Existing V-notch Weirs located along the left downstream groin and toe of the dam respectively (Figure 2 and 3).



Figure 2 – V-Notch Locations at Cataract Dam



Figure 3 – VL4 and VR2 V-Notch Weirs at Cataract Dam

The typical installation to replace existing V-Notch Weirs VL4 and VR2 are shown in Figure 4.

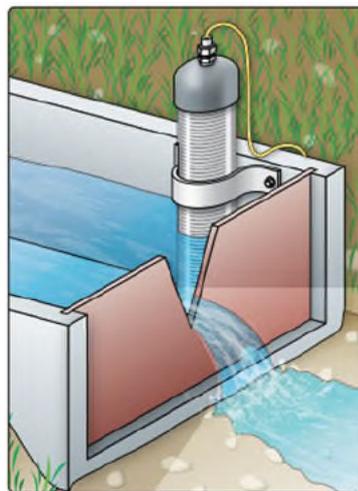


Figure 4 – Typical Geokon Model 4675VL installation

This work will also include associated cabling works which will utilise a combination of different methods:

- steel conduits that will be attached to the dam wall using metal Unistrut and saddles
- existing underground conduits inside the gallery
- attached to the stairwells

Cabling will be installed from the electrical instruments and equipment mounted on the internal walls of the Crest House via existing underground conduits encased in the Dam Crest House and wall. A cable pit located immediately outside the Crest House Door connects to the bottom gallery with existing conduits. This will serve as the main cable run and then utilise existing cable trays to reach the instrument locations in the lower valve house and galleries.

**Tiltmeters**

This work involves installing the new instruments next to the existing instruments. Four new tiltmeters will be installed at Cataract Dam. Tiltmeter locations of the tiltmeter installations are detailed in Table 2 and shown in Figure 5.

Each tiltmeter will have the fastening of a mounting bracket to the dam walls and a protective casing around the sensor (Figure 6). The new digital tiltmeters are shown in Figure 7. The cabling installation will run via using existing cable trays and conduits inside the galleries.

Dam	Tiltmeter Station
Cataract (Non-Submersible)	V290E, V290W,
Cataract (Submersible)	V250E, V250W

Table 2 – Tiltmeter Stations at Cataract Dam



Figure 5 – V250E, V250W, V290E and V290W tiltmeter stations (CAT29-C, PL 2019/00893).



Figure 7 – Jewell Model D820-SB-D (Submersible) and C750-200 (Non-submersible) Digital Tiltmeters

### Crack Meter

An existing crack meter is located on the downstream ledge of the crest approximately 58m from the crest house towards the left abutment (Figure 8). A new crack meter will replace the existing installation, including a cover if required (Figure 9).

The cabling will run via the dam wall from the instrument to the front of the Crest House using steel conduit and then into the existing conduits.

Crack meter installation will involve approximately 5 meters of concrete cutting alongside existing conduits inside the Crest House. The new conduits will be encased with concrete which will match as practicable as possible with the existing concrete foundation.



Figure 8 – Existing crack meter with housing and without housing at the dam crest

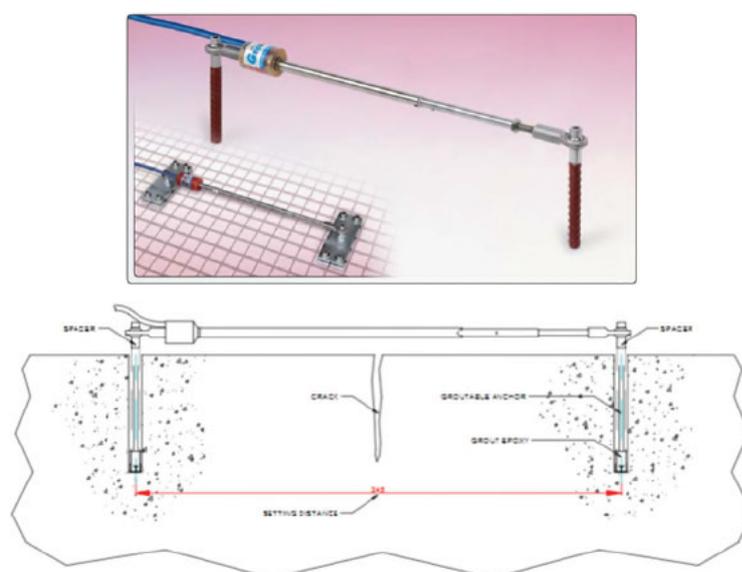


Figure 9 – Typical Geokon Model 4420 installation and proposed installation

### Strong Motion Sensors

Strong motion sensors will provide more reliable site-specific information following a seismic event. Four new strong motion sensors will be installed at the different locations shown in the image below (Figure 10).

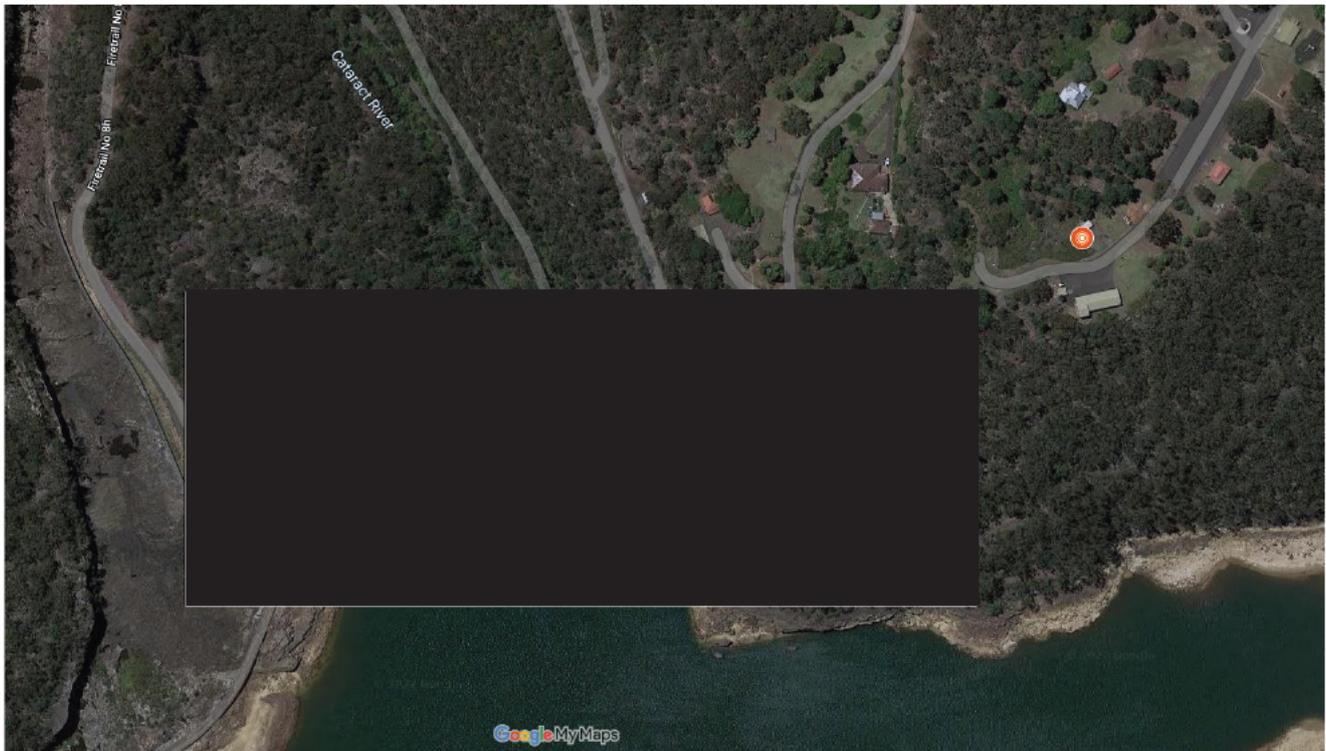


Figure 10 – Four strong motion sensor locations (Orange colour) at Cataract Dam

The locations are provided in the Table 3 and general arrangement are provided in Figure 11.

Instrument	Location	Power Cabling
Dam Crest	A wall cabinet will be installed on the floor within the crest house on suitable space.	Via new cable trays within the Crest House.
Dam Abutment	A sensor will be installed on a suitable location on the Dam Abutment.	Solar powered. No cabling required.
Dam Toe / Gallery	A sensor on the Dam Toe/Foundation/Gallery.	Via existing cable routes within dam galleries.
Free Field in downstream	A free field sensor in the downstream zone at a distance away from the dam toe. This will be installed in the depot area of the Dam.	Solar powered. No cabling required.

Table 3 – Strong Motion Sensor locations and description

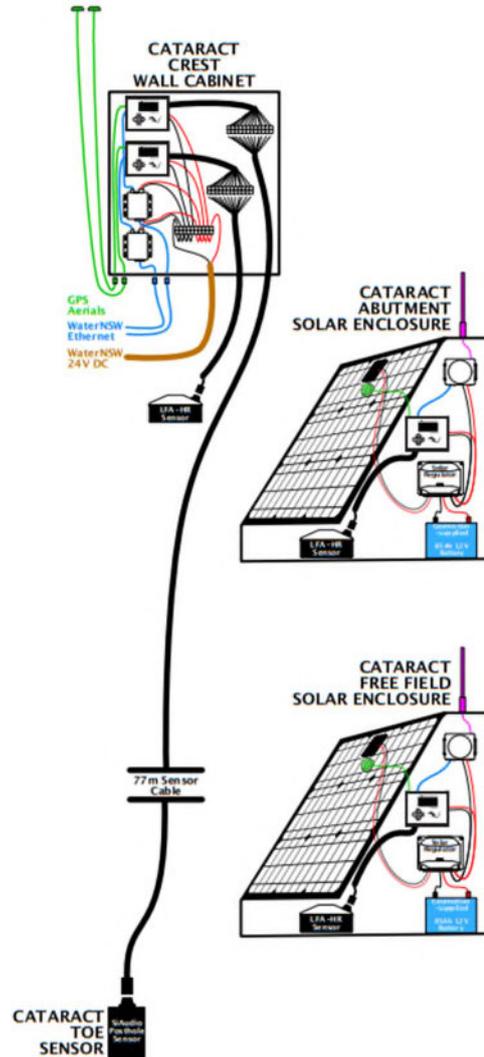


Figure 11 – Strong motion sensor general arrangement

The strong motion sensors will be installed on a concrete pad (Figure 12).

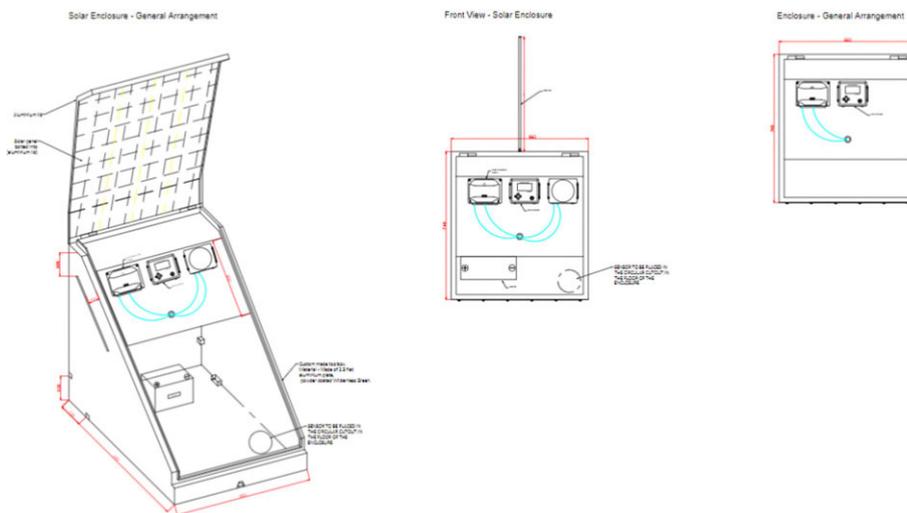


Figure 12 - Solar Enclosure with 740mm x 680mm dimensions

**Datalogger and Barometer**

A new datalogger and a new barometer will be installed inside the Crest House (Figures 13 and 14). The datalogger will be installed in a suitable location at floor level inside the Crest House.

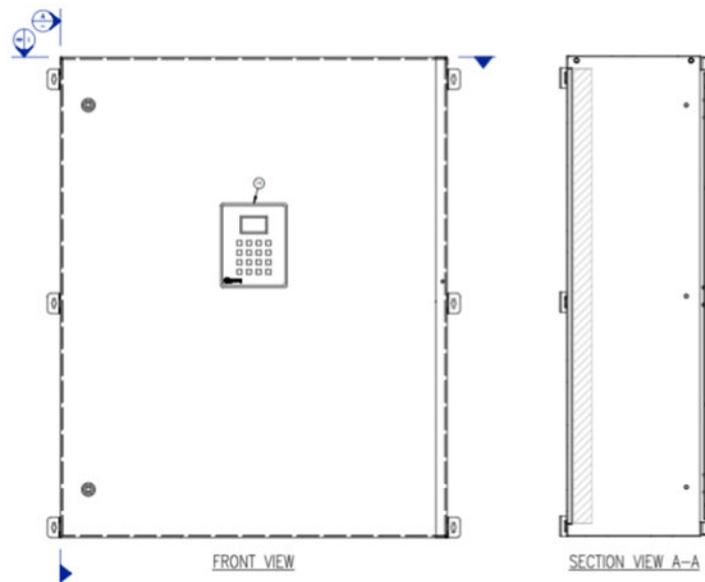


Figure 13 – A stainless steel datalogger panel with 1000 x 800 x 300 (mm) dimensions



Figure 14 – Barometer

**CCTV**

Two new pan tilt zoom (PTZ) CCTV cameras will be installed at the downstream of the dam wall. The list of CCTV instruments is shown Table 4. The CCTV installations will also be accompanied by signage (either on a signpost, existing structures like the stairwell or on the internal of the

dam wall) to notify staff and visitors that the cameras are present.

Item	Description	Make	Model	Dimensions (mm)	Weight
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

Table 4 – CCTV Instruments

The location is marked up in Figures 15 and 16 with one CCTV to be installed outside on an existing walkway and the other installed internally.



Figure 15 – CCTV locations marked up

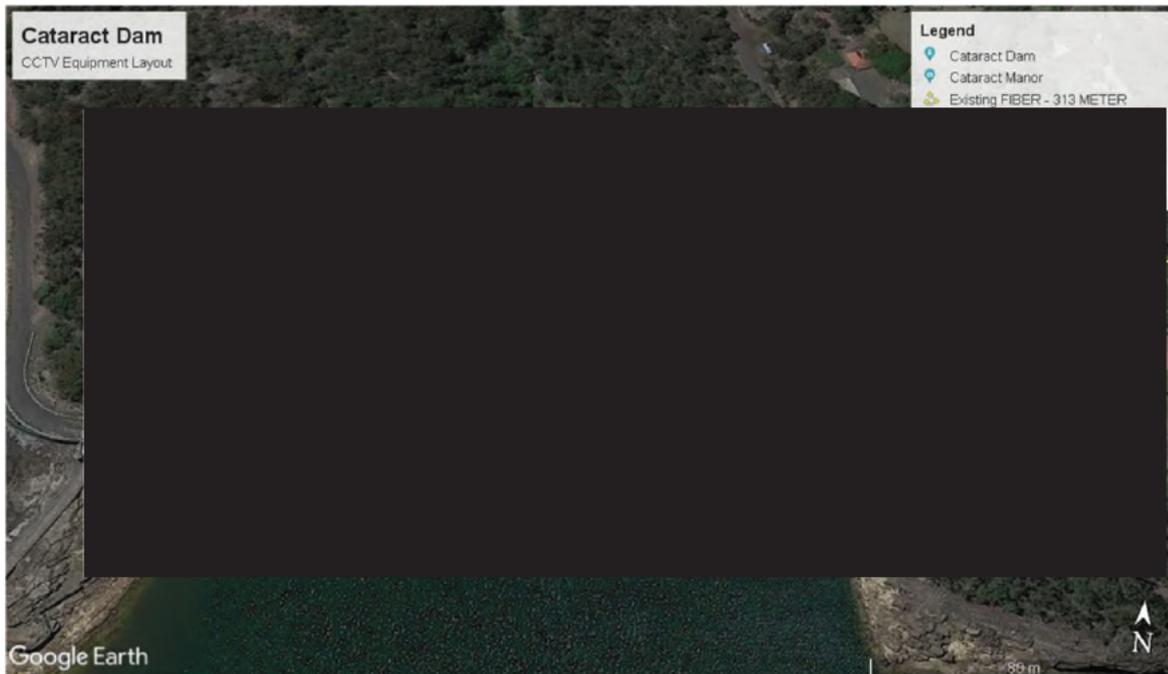


Figure 16 – Aerial view of installation locations

The proposed installation design is shown in Figure 17.

### Mounting on Industrial Platform

**Important Note:** If you have to work from a height, you need to manage the risk of a fall. A fall-prevention device is best because it will prevent your workers from falling. Examples include temporary work platforms, guardrails and scaffolding. All help to keep you safer when working at heights.

Pole Type: Swivelpole™ ST7 - Maxis™ M2  
 Pole Model: ST7-M2-2400-P-HG  
 Material: Steel  
 Finish: Hot-Dip Galvanised  
 Pole Height: 2.4m  
 Pole Weight: 32kg  
 Max Pole Load: 20kg  
 Max total weight: 52kg

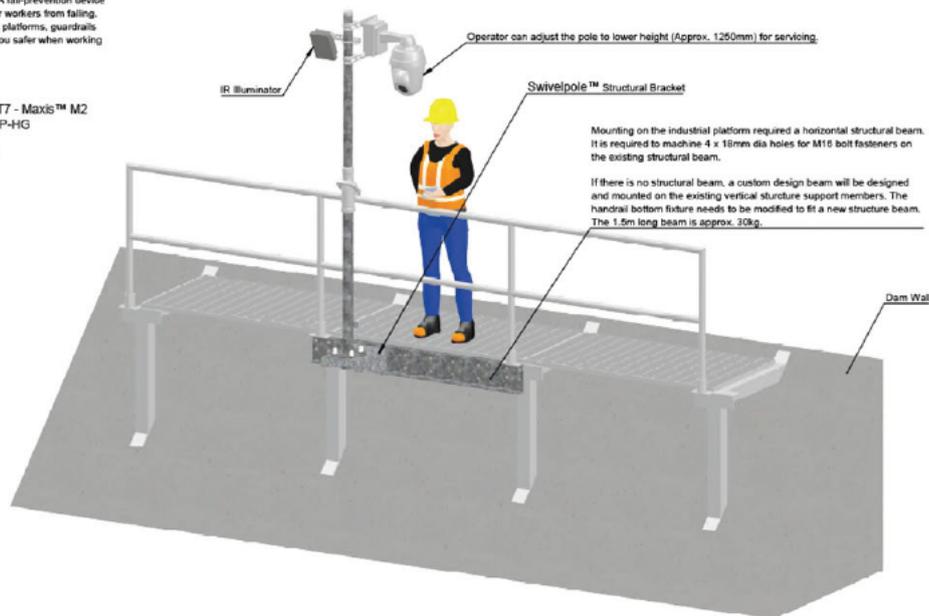


Figure 17 – Proposed installation design

CCTVs will be mounted on an existing walkway (Figure 18).



Figure 18 – Installation location

The CCTV panel location is shown in Figure 19.

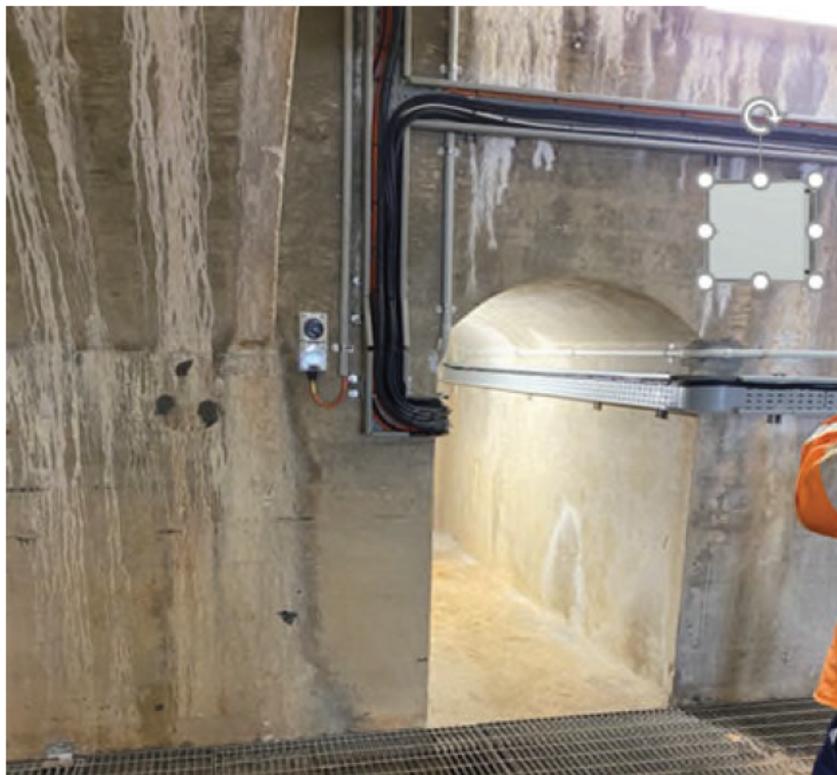


Figure 19 – CCTV Panel will be mounted on the wall inside the dam gallery

WaterNSW will engage a Contractor to deliver the instrumentation upgrades. It is estimated the works will take 4 weeks to install and commission (weather permitting). The equipment will be brought to the site via existing roads. The Contractor will place a transportable site shed at the north side of the existing WaterNSW site office. The lay down area will be behind this site shed.

## 6. Heritage Impact Statement

There will be no significant impact to Cataract Dam's heritage significance. The works are minor in nature and will not impact on the overall significance of Cataract Dam.

The Cataract Dam wall is rated as having Exceptional heritage significance, but the works will not impact the significance of the wall. The installation of the new and upgraded equipment is of a minor nature but is essential to the real time and long-term monitoring of the asset for dam safety purposes.

The installation of the equipment and associated electrical conduits has where possible used existing cable trays, cable pits and solar power to power this necessary equipment. The installations can be reversed and removed from the wall and the crest house if not required in the future.

There is some minor visual impact with the installations of the equipment on the dam wall that can be seen by the public from the viewing areas. There is however other monitoring equipment like survey equipment, survey pillars and markers already installed on the dam wall and in the general area. CCTV is becoming more common on public buildings and areas and is not out of place on public utility assets for monitoring purposes. The installations within the crest house will not be visible to the members of the public visiting the dam wall for tourist purposes.

## 7. Conclusion

The works to be undertaken will not have an adverse significant impact on the heritage item. The works are the upgrading and installation of instrumentation needed to monitor Cataract Dam to enable WaterNSW to meet and mitigate NSW Dam Safety risk assessments. A s60 fast track approval is appropriate as the works are being installed onto the dam wall, galleries and crest house which are significant fabric, but installation cost is approximately \$20,000. The works are essential to ensure the long-term monitoring and operation of the Dam.

## 8. References

Graham Brooks and Associates (2010) Cataract Dam Conservation Management Plan. Prepared for Sydney Catchment Authority (now WaterNSW).

Extent (2018) Cataract Dam Conservation Management Plan. Prepared for WaterNSW.