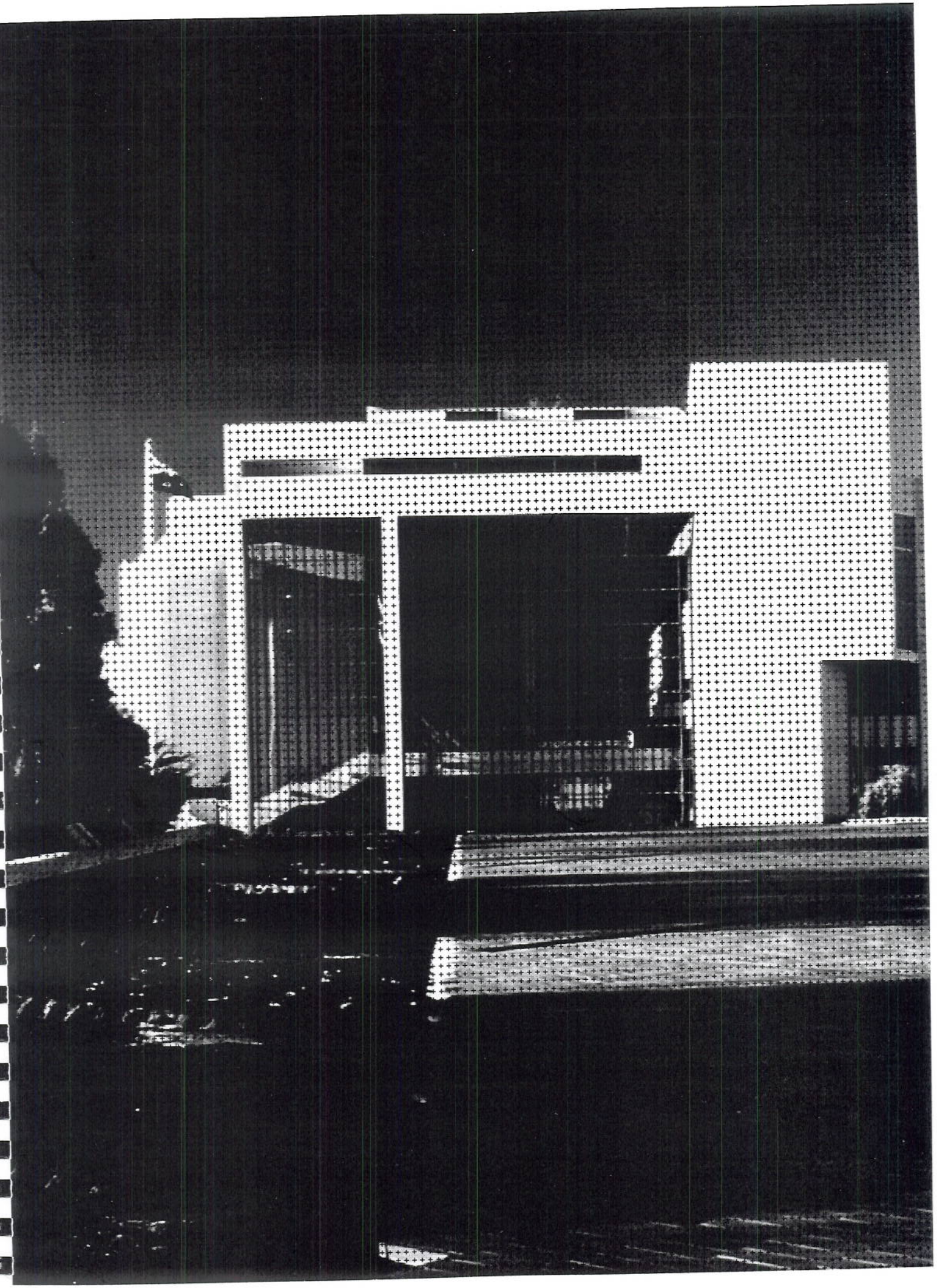

Date of Issue.	Revision Description.	Author.
05 March 2009	Revision C	Andrew Wilson, Director

Project
Water Fountain Waterproofing Scoping Study

Client
High Court of Australia,
Parkes Place, Parkes ACT

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High Court of Australia Water Fountain Waterproofing Scoping Study

Contents

1.0 Introduction

The High Court of Australia (HCA) has sought a scope of work definition study to rectify significant water leaks in the external water feature, on the southern approach to the High Court.

The High Court of Australia (HCA) construction was completed in 1980. The construction at the time is assumed to have utilized a bituminous asbestos membrane (presumably Nuralite) in waterproofing the water feature. The membrane was laid over a suspended concrete slab then a screed of 'formed' and tiled concrete to achieve a cascading water pattern as a surface expression on the western edge of the main pedestrian access ramp from King George Terrace.

Associated with this rectification work investigation there has been a request to look at the hydraulic system operation including a suitable addition of the algal control equipment, debris and dust filtration equipment together with evaluation of potential water harvesting and a proposal for a future maintenance schedule.

The High Court Building and its precinct, including the water fountain, is a listed place on the

Commonwealth Heritage List and the National Heritage List. Therefore, any works undertaken must be consistent with a Heritage Conservation Management Plan and the International Council on Monuments and Sites (ICOMOS) 'Burro Charter' principles.

The external water fountain has been previously maintained by the National Capital Authority (NCA). This responsibility was transferred to the High Court in 2008. The Court wish to refurbish and maintain the asset in a sound operational condition.

HBO+EMTB and Cardno Young have been engaged by the High Court of Australia, as their Architect and specialist consultant, to undertake a technical investigation and scoping study for asset protection and improvement works at the HCA building and the precinct -including the external water fountain. HBO+EMTB provide specialist advice upon:

- refurbishment of the building fabric consistent with maintaining the architectural design integrity
- coordination of the advice and services of specialist advisers who address, the structure and any movement in it, the hydraulic and electrical services, the membrane and screed upon which it is laid.

In preparing this study, destructive site investigation has not been undertaken. Consultation by HBO+EMTB and Cardno Young has been undertaken with membrane suppliers and/or contractors to ascertain the likely technical solution that will provide the longest serviceable life.

Cardno Young provide specialist advice for refurbishment of the water fountain including the hydraulic services and the membrane and screed upon which it is laid.

2.0 Executive Summary

The background to the project is that in approximately 1997, demolition and reconstruction of the membrane and finishes was undertaken around the perimeter of the fountain and adjacent to all sumps nearby in the ramp. This work achieved only temporary rectification of leaks. Subsequent leaking has occurred and been accentuated by some movement of the fountain structure possibly resulting from excavation work undertaken to provide vehicular access to the adjoining National Portrait Gallery. A site inspection with HBO+EMTB was carried out on Thursday 21 March 2008 with the High Court Chief Marshall, Mr. Joe Pelle. Subsequent inspections and testing were carried out later in March, April and July 2008, concluding in February 2009.

General Observations

The water feature has not been in operation for some time.

The design of the water feature includes a concealed pump system beneath the lower feature storage tank in the underground car park. This is fed from the lower collection tank at the end of the feature. Spray outlets supply the pressured water at the head of the feature from the pump set in the car park below via under slab exposed pipes.

The southern approach ramp to the High Court, adjacent to the water feature, is a quarry tiled structural slab with expansion joints which transverse the slab diagonally. The expansion joints continue through the water feature surface and grated drains, (which catch rain as surface flow from the ramp). Captured storm water is directed to sumps contained within the concrete slab. These are drained through piping below the slab and discharged to storm water waste. The grated trench drains and pumps ore lined with "Nuralite" bituminous membrane which has deteriorated considerably since construction.

These sumps show obvious signs of previous leaking under the slab in the car park.

The structural slab expansion joints are caulked across the concrete ramp to the water feature. The pattern of the expansion join through the water feature is a 'zig-zag' pattern, across the clay tile work paving, terminating at the long section expansion joint running the western length of the ramp structure.

Evidence beneath the concrete slab suggests the bituminous membrane no longer functions as per the original design intent. Water leaks are evident around the grated trench sumps. The North- South western edge expansion joint shows signs of failure in numerous locations, and it is evident beneath the slab as a source of water ingress into the void space to the west of the block wall, in the underneath car park.

Having been out of use for some time there was no sign of algal growth. However, algal growth would be addressed in the design and maintenance review. Leaf litter and grit built up is evident, particularly extensive build up of leaf and twig litter since the water feature has been turned off.

2.0 Executive Summary

HBO+EMTB and Cardno Young have identified, and indicated on "HCA Water Fall – Base Screed Set out Typical Bay" on page 13, the following possible causes of water leakage:

- At position `A,' we consider that there has occurred the 'turning up' of the screed where it is narrower than the general mass of the screed, possibly causing a fracture of the membrane beneath,
- At `B,': where the membrane is turned up from horizontal to vertical, possibly in a `zig zag' pattern and possibly without `fillets' to ease the membrane through the change of direction. The `zig zag' pattern, if covered with membrane with multiple joints, would be a potential area of water penetration due to the multiple seams in the membrane,
- At `C': again at the transition from horizontal to vertical without `fillets' to ease the transition of the membrane and,
- At `D': where structural movement may have `torn' the membrane

Further we note, although outside the bounds of this study, the expansion joint identified on page 12, HCA Water Fall – Paving: Ceremonial Ramp (Part 2) is clearly a site for ingress of water. This expansion joint, its cracking and loss of elasticity is a position in which water penetrates into the tile substrate.

Given the many unknowns that apply to the suspended slab expansion joints and water feature membrane we have taken a holistic approach to the feature's performance, being mindful of the cost, the time required or 'program' and the disruption to access to the High Court from King George Terrace for the pedestrians, during any remediation work.

The addressed in this report is the definition of the scope of work required to rectify the water feature for a 25 year serviceable life span.

The design consultants are engaged to identify:

- the areas of leakage
- the requirements for rectification of leaks
- research alternative materials and techniques for rectification including:
- alternative membrane types, e.g. liquid applied or injected, rubber or bituminous compounds. Note. The existing membrane is expected to be 'Nuralite Fabric' containing asbestos.
- The scope of work required to achieve a 'leak free' fountain, possible removal of all the fountain.
- Preliminary Budget Cost Estimate for execution of the selected scope of works (Option 3)

Issues that the HCA wished to be addressed are:

- Investigate water harvesting possibilities and,
- Additional capacity to store 100% of the water required to serve the fountain

2.0 Executive Summary

_ Note the portion of water that can be stored in the 'ponds' structure

_ Consider filtration of harvested water and

_ Attempt a sustainable water supply i.e. limit the flow into storm water

_ Outline of a 'Maintenance Schedule' for 'whole of life costing purposes'.

A 'maintenance schedule' is to be prepared under a subsequent consultancy engagement, to undertake research existing tiles, construction techniques and finishes to ensure that the architectural integrity and heritage criteria can be maintained. We have progressed this research in part in at this time.

3.0 Scope of Services

Water Feature: Building and Membrane Works

Based on our initial site inspection, the water feature repair has been considered from the point of view of three possible modes:

1. Option 1: Minimum Repair

Injection of a commercially available waterproof agent into the existing expansion joint and at all identified locations of leaks around the storm water sumps and the horizontal to vertical transitions of the membrane to offer a waterproofing solution.

The advantage of this rectification, if it is available and practicable, is the minimum disruption to the insitu clay tile payers and minimum downtime and disruption to the feature's operation.

The main disadvantage would be the possible incomplete penetration of any waterproofing product that could complete this rectification. The most significant reason for not recommending Option 1, minimum repair is that the manufacturer/supplier warranty would be limited, if given at all.

2. Option 2: Partial Reconstruction

The extent of work for a 'partial reconstruction' will require the removal of sufficient of the stone payers as necessary to fully expose the existing expansion joint sealant, the membrane around the storm water sumps and the perimeter edges of the fountain, and reconstruction of the caulking and membrane to the full extent of the expansion joint within the water feature and adjacent grated trench, to the east, and longitudinal expansion joint to the west of the water feature.

An advantage of this method is a high degree of success with the reconstruction of the expansion joint with physical access to the full length of the expansion joint within the water feature.

The disadvantages of this proposal are: the incomplete nature of the repair

- the necessary removal and replacement of existing clay tile payers
- possible damage to those payers during the process
- the additional cost over any insitu rectification method
- that warranties and guarantees on the leak free performance of the works would not be provided because the contractors will not certify the joining up of new work to 'others' work.

3. Option 3: Total Reconstruction

The total reconstruction will require a contractor to completely remove the water feature stonework, according to fully documented methods for the entire length and width of the water feature and then renew all the associated membrane affecting the expansion joints and under screed areas within the water feature.

3.0 Scope of Services

The advantage of this refurbishment option is the opportunity to renew the entire water feature waterproofing which should provide an application warranty for the feature's performance. The total reconstruction is recommended, and to be undertaken in accordance with the ICOMOS principles and the impending Heritage Conservation Master Plan.

A disadvantage with this proposal is the additional cost to the alternate rectification methods and the longer disruption to the High Court access.

HBO+EMTB and Cardno Young recommend that the High Court of Australia adopt the scope of work proposed as Option 3: Total Reconstruction.

3.0 Scope of Services

Water Feature: Hydraulics System

Cardno Young assessed the serviceability and capacity of the hydraulics system based on inspections in March, April and July 2008 and February 2009.

The pump system associated with the water feature has been assessed by a hydraulic engineer as to capacity and function. Given the pump's performance since commissioning it is not envisaged that the pump, or pump components, should require upgrading. In the event this requirement is identified in the future, the replacement of all pump component parts is readily accessible in its current configuration and location below the feature storage tank.

We confirm that there would appear to be no advantage in undertaking such an upgrade currently until the water feature is operational.

The definition study investigation of the water feature at this stage has focused an possible additional water treatment equipment to manage the algal growth in the water supply to the feature, and water 'harvesting' from the surrounding storm water system into additional water storage capacity.

It was noted during the site visits that chemical control equipment had been added recently to the pump system for algal control, but no records are currently available as to that equipment's operation and maintenance. This should be investigated as part of the overall feature water supply and operation criteria.

The existing pump system has been evaluated with the exception of the current algal controls in place where we have been unable to assess their effectiveness because the water fountain is not in operation. Recommendations as to upgrading or renewing the pump system are as follows:

Cardno Young report that the asset component inventory list is provided at Cardno Young report: Annexure D, and the following are reported in the body of the Cardno Young Report at Appendix

1. This report addresses:

_ Functional assessment

_ Condition assessment/life expectancy

_ Serviceability

_ Maintenance/Restoration recommendation

A Preliminary Cost Estimate is provided at Appendix 3, by Wilde & Woollard.

Water Feature Expansion Joint Sealant

Cardno Young, in conjunction with a sealant specialist supplier inspected the feature to assess the three repair options evaluated in Table 1 on Page 9 Factors considered

3.0 Scope of Services

included:

Membrane Repair or Replacement

- Suitability to injection
- Warranty/Guarantees on offer
- Success rate probability
- Extent of time removed and replacement material
- Rectification Programme.

Grated trench inspection

Factors to be considered included:

- Condition of membrane and extent of rectification necessary
- Repair methods in-situ for trench drain and sump.
- Sump repairs under the ramp slab.

Water Pump System Inspection

Factors to be considered included:

- Capacity
- Serviceability
- Functionality verification for algal control, removal of debris and dust filtration.
- Maintenance required for performance and function.

Operation and Maintenance

Factors to be considered included:

- Inspection regime for the pump system and water feature
- Cleaning and general maintenance schedule for the water feature, trench drains and pump filters.
- Routine pump system servicing

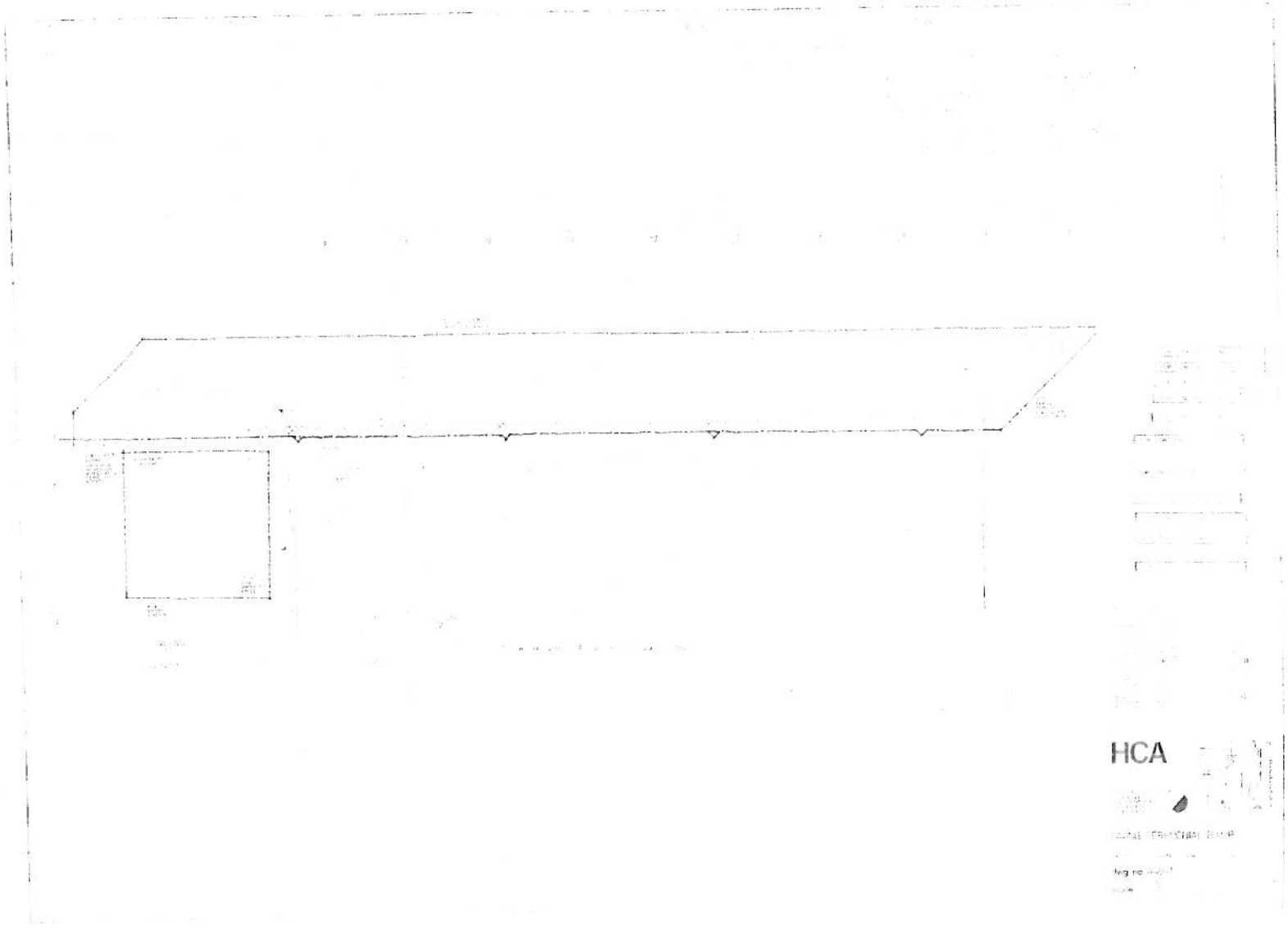
3.2 Summary Recommendation

The scoping study advises the High Court that the total refurbishment or reconstruction will deliver a lower risk of failure of the water feature to the High Court. HBO+EMTB and Cardno Young's evaluation criteria and outcomes are summarised in Table 1: Evaluation of Alternative Scopes of Work.

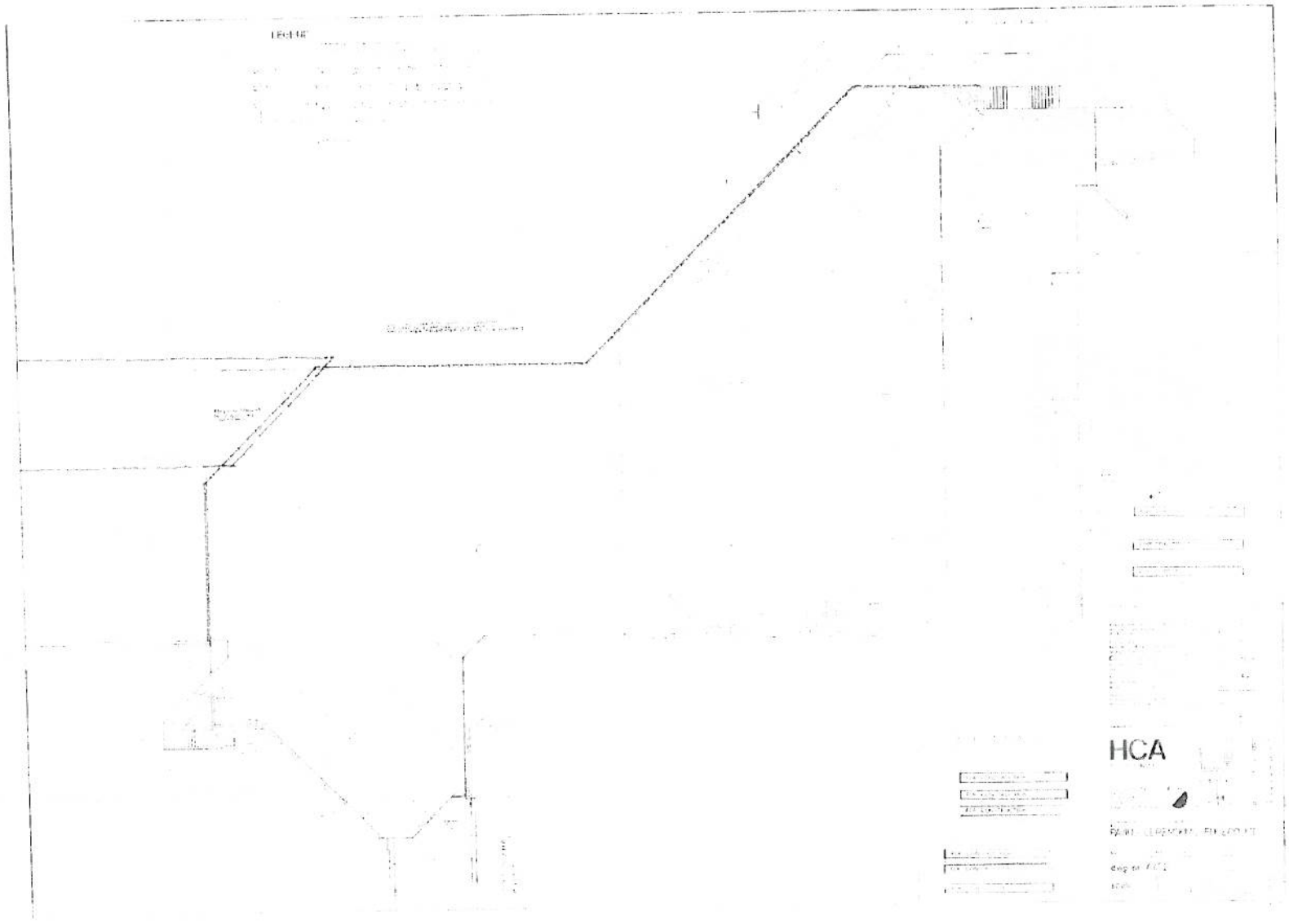
3.0 Scope of Services

Options	Management	Technical Requirements	Guarantee / Warrantee	Programme	Cost
Option 1: Minimum Repair					
			A 25 Year material and workmanship guarantee / warrantee, similar to HCA Trafficable Roofs project, would not be provided by the Contractor because they would not be able to satisfactorily indentify whether leaks are the result of new works or prior works.,		
Option 2: Partial Reconstruction					
			As for Option 1		
Option 3: Total Reconstruction					
Option 3 is preferred because the scope of work would, if combined with the rectification of the ramp and adjacent podium areas and undertaken by one Contarctor, facilitate an effective Guarantee / Warrantee.	Security of the Works is manageable by the installation of site security barriers to prevent unauthorized access to the work site while permitting continued access for the public to the High Court building.	Proceed with the Works in accordance with the Conservation Heritage Master Plan and ICOMS principle with a 'Work Method' that ensures: _ Protection of adjacent surfaces _ Survey and Registration of all components _ Removal with care by a technique of 'pressure lifting' _ Recording and storage all components _ Substrate rectification in preparation for new membrane installation including: • Removal of all irregularities that would damage the new membrane and, • Fillet installation • Joining up of the membrane to the stainless steel sump. • Detailing of vertical stones (edge) • Pavement reconstruction Note: We know that replacement clay pavers for installation on the ramp are not available. We recommend 'reclaiming' clay pavers from east side of the HCA, where the pavement has been uplifted by tree roots. This area may be refinished with an appropriate new pavement.	A 25 Year material and workmanship Guarantee / Warrantee is likely to be obtained that is similar to HCA Trafficable Roofs project Guarantee / Warrantee	We anticipate that the further investigation will be undertaken during the design and contract documentation process, which we consider would take 13 weeks and require the following stages: Document. Tender. Contract. Construction. Practical Completion Defects Liability. Further, we consider the following time periods will be required for: Removal – 3 months Membrane – 2 weeks Installations – 4months Clean up – 2 weeks	

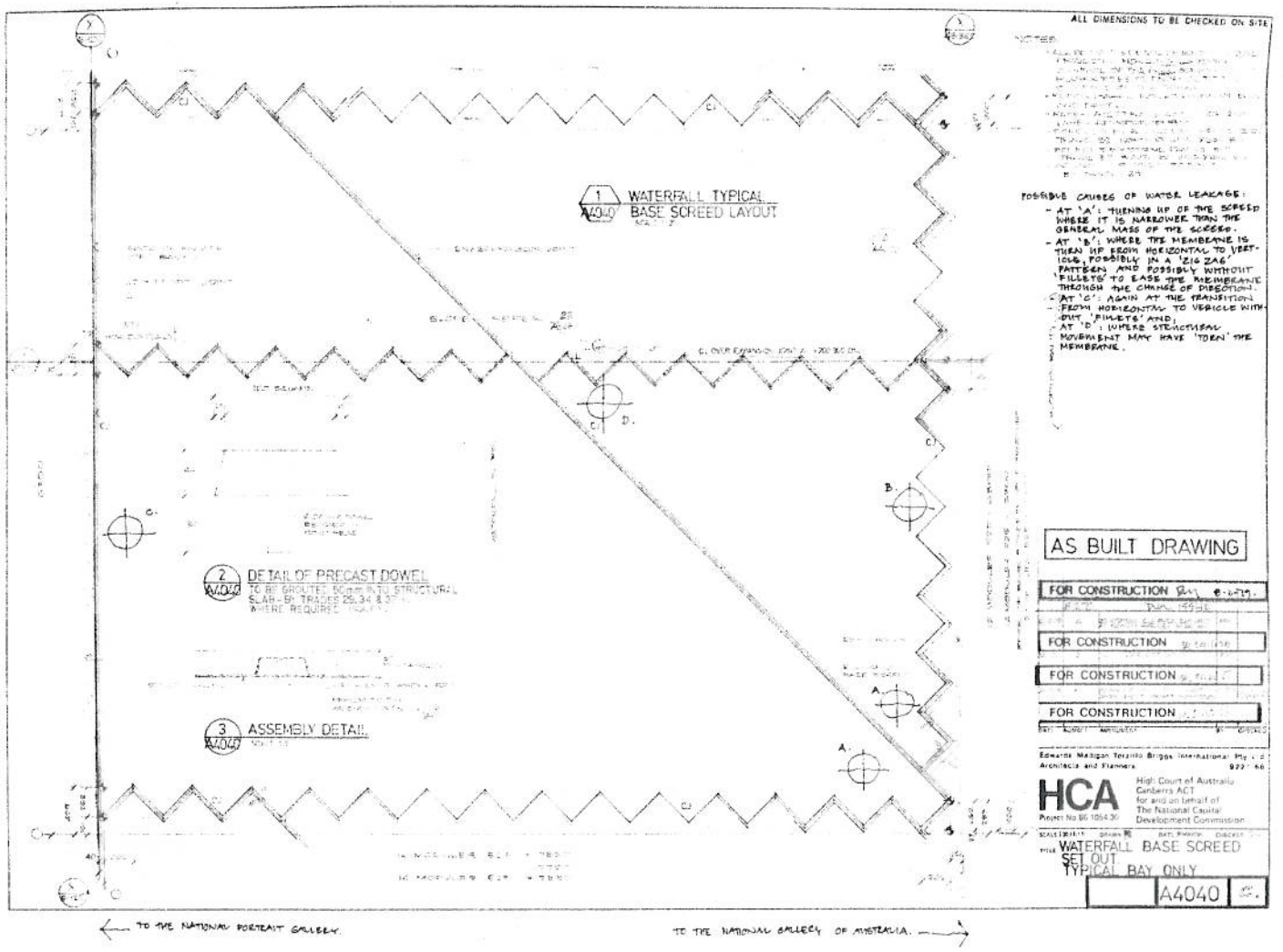
HCA Water Fall – Paving: Ceremonial Ramp (Part 1)



HCA Water Fall – Paving: Ceremonial Ramp (Part 2)



HCA Water Fall – Base Screed Set Out Typical Bay



4.0 Future Actions Required

As a reconstruction or 'restoration' project the scope of works will require careful management, design and documentation. HBO+EMTB outline that the following services are essential:

Subsequent design consultant services will consist of the following components:

_ Design Documentation and Procurement Process

_ Tender Phase

_ Contract Documentation

_ Construction Phase

_ Post Construction

All of these services are to be performed by competent professionals, are elaborated upon as follows.

4.1 Design Documentation and Procurement Process

The design documentation will be based on agreed scope arising from the Client review of the HBO+EMTB Cardno Young Scoping Study. Documentation will be sufficient for a tender to be called on the basis of lump sum contract to reconstruct as a 'restoration' project and will require the following professional consultancy services:

_ Design specification and pre-tender cost estimate;

_ Tender documentation and advice during the tender process;

_ Contract documentation and technical support during the construction phase; and

_ Post constructional technical support during the Defects Liability Period.

_ Repair/restoration technical specification, and sketches as required for the water feature to prevent future leakage.

_ Repair/restoration technical specification, and sketches of the waterproofing system as required for the hydraulic system,

_ Repair/restoration technical specification, and sketches as required for the electrical system including refurbishment and replacement of current lighting.

_ Operation and maintenance manual brief for the refurbishment contractor to compile - sufficient for a separate 0 & M contractor to tender.

4.2 Tender Phase

HBO + EMTB and Cardno Young will provide finalized advice during the tender stage process and assist with the tender evaluation and recommendations.

4.3 Contract Documentation

Prepare contract documents for issue to the successful tenders.

4.0 Future Actions Required

4.4 Construction Phase

We recommend that HBO + [MTB will act as Superintendent for the contract. Cardno Young will provide technical support, respond to RFI's and attend site meetings as required.

4.5 Post Construction

Attendance during Practical Completion, Defects Liability Period and Final Completion inspections, and assistance in resolving technical issues associated with the rectification of defects under the contract

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

Cardno Young
Shaping the Future

Cardno Young Report

to

HBO + EMTB Architects (ACT)

on the

HIGH COURT of AUSTRALIA

WATER FEATURE and FORECOURT RAMP

Waterproof Membrane, Drainage, Water Harvesting and Feature Pump System.

Scoping Study

Dated: 09 February 2009

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

Background

The High Court of Australia was constructed in the late 1970's and opened in 1980. The water feature has operated since the building opened, except for periodic shutdowns for maintenance and repair. The water feature has not been altered and remains as constructed.

With the construction of the adjoining National Portrait Galley immediately to the west of the Water Feature, there was a need to construct an access tunnel through the High Court carpark under the forecourt ramp to the Portrait Gallery, through the western boundary under the Water feature. During excavation for the access tunnel, it then became evident the water feature had serious water retention issues(associated with its function) in the vicinity of the head of the feature, the Source Pool and some areas further to the south, adjacent to the lower Holding pool.

The under ramp carpark had experienced previous leakage problems sufficient to have remedial works carried out to collect water leaking from the ramp grated trench drains, one location in particular. The previous leakage is evident on the carpark west block wall and ramp suspended slab soffit.

As part of the Roof Membrane Work for the High Court building we were requested, through HBO +EMTB the Project Architects, to appraise the current condition of the Water Feature with respect to;

1. The performance of the original membrane in the Water Feature and Ramp,
2. Likely sources of and reasons for the Water Feature leaking,
3. Possible investigation methods to determine the detailed cause and extent of the membrane failure (leaks),
4. Possible membrane rectification solutions applicable to the Water Feature and Ramp,
5. Performance and suitability of the existing pump system servicing the Water Feature,
6. Possible water harvesting options that would enhance the Water Feature storage capacity and allow the Feature's water supply to be self contained and less dependent of Actew's supply, and
7. Possible solutions to control algal growth in the Water Feature and its water supply.

1. After consideration of the original drawings and a detailed site inspection several further investigations were carried out in an attempt to confirm possible membrane failure and/or other leakage modes applicable to the Feature.

These inspections were conducted on the Feature, Ramp, pumps and Holding Tank.
Maintenance since opening for the Water Feature and pumps has been by the National Capital Authority, with responsibility recently passing to the High Court for these assets. Repairs to the Water

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

Feature membrane or stone joint sealant, the Ramp drain membrane and sumps, and the Water feature pumps and algal control mechanism have been actioned previously s is evident from works on the Feature and advice form the High Court Marshall. Those repairs are referenced in the applicable sections below.

Water Feature Overview

The Water Feature is a self contained reticulation water system on the western third of the High Court Forecourt Ramp. Flow down the Feature is under gravity from the Source Pool at the upper level of the Ramp. Water supply to the Source Pool is via an under ramp pump and pipework network. The Feature runs the full length of the western edge of the ramp and is a prominent feature of the High Court public access. The cascade pools extend from the upper Source Pool to the lower Holding pool are typically 850 mm deep at the most western point on the northern side of the stone weirs. There are ten cascade pools. The lower Holding Poo collects water at the base of the Feature and controls flow into the Holding Tank, at the southern end of the Feature.

The Source Pool fountain is supplied with water via a pump system comprising a main pool pump and a smaller water treatment pump located in the pump room at the southern end of the carpark under the Ramp

The Feature comprises the upper Source Pool with fountain heads and one water treatment outlet supplying flow to ten cascade pools and collection in the Lower Pool, before returning to the Holding Tank. This layout is described in full on the original HCA construction Drawing A1268. See Long Section on Annexure A.

Several previous repair attempts have been made to the Water Feature membrane and stone joints, as is evident by mortar colour changes and sealant application along the eastern water edge, against the Ramp.

Significant water leakage is visible under the Ramp slab, in the north-west corner of the Source Pool, where new works to access the Portrait Gallery have exposed previously unidentified water ingress to the surrounding earthfill and landscape. With the removal of the earthfill material for the access construction, water ingress is clearly visible behind the blockwall on the northern side of the access tunnel. There is no evidence to suggest this is a recent occurrence. Advice from the High Court Marshall is that the feature has leaked for some time, although the escape path and volume of the water has been unknown.

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

Current operation of the Feature results in water losses currently unknown which are 'topped up' from a metered supply to the Holding Tank in the pump room below the Ramp slab. Excess water entering the Holding Tank from the Feature is spilled via a waste overflow pipe to stormwater drainage in the southeast of the lower carpark under the Ramp slab. Water supply is currently from Actew's mains supply, activated by a Ball Valve in the Holding Tank with a Stop Cock adjacent to the Actew meter in the pump room.

High Court Ramp Overview

Rainwater falling on the Ramp flows over the surface until captured by the inclined Grated Trench Drains extending across the ramp to the collection sumps which drain captured stormwater down through the slab for disposal into Lake Burley Griffin.

The Drains were originally lined with a stainless steel drain lining cast into the tile screed bed and 'Nuralite' bituminous waterproof membrane connected to the under tile / screed membrane forming the waterproofing for the water feature and the remainder of the ramp slab for protection of the space under the slab. This area is currently used for car parking and the Water Feature pump operations. The Nuralite membrane shows signs of fatigue and failure in several locations within the drains and particularly where the drains enter the sumps. There is also evidence that the under screed membrane connected to the drain membrane, has failed in providing a continuous waterproof membrane across the ramp slab under the stonework and/or quarry tile finishes. Water ingress to the drains and particularly the second northern sump is evident during the Water Feature operation.

Previous repair works have been carried out by the High Court / NCA to rectify water leaks below the ramp slab. In particular the west sump at approximate Grid Y 170.3 (Second Trench Drain from the northern end of the ramp, See Annexure A.), this sump has had an outer cowling constructed to collect water escaping from the sump , outside the drainage pipe. Evidence can be seen of the water drainage across the slab soffit and down the western block wall. This rectification work has stopped that particular water egress. Inspection of the sump on top of the slab showed no evidence of water present in dry conditions, when the Feature is not operating. When the Water Feature was operational all four trench drains showed evidence of water ingress from the Water Feature into the drain and/or sumps.

Architectural drawing A 1252 shows sections through the ramp trench drain which identify the designed waterproof membrane detail required. The membrane used in the original construction has passed its useful life in so far as traditional bituminous membrane are not designed to provide a waterproof solution for in excess of 20 to 25 years, depending upon the membrane's exposure to ultraviolet light, chemical attack (pool chemicals) and building movement. Where a membrane is traditionally secured

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

as sandwich layers between a concrete slab and an overlying screed bed there is little opportunity for UV damage or building movement to give rise to material fatigue and failure. Failure typically occurs at movement joints, both expansion and construction joints, and changes in direction for both horizontal and vertical movement. The nature of Nuralite was such that the membrane was "spot stuck' with a bituminous paste so minor movement could be a accommodated, but the down side of this application method is the ability of water to move under the membrane (tracking) once it has found its way through the membrane. Our initial inspection of the Water Feature and ramp areas would indicate the water egress observed resulted from water tracking under the existing Nuralite membrane, with the source of the water not being obvious at the time of the inspection.

Water observed egressing on the stairs on the eastern side access (Stair F5) was not considered to be coming from the Water Feature, given the distance, the time the fountain had been operating and the proximity of previous rain water being retained in the adjacent perimeter trench drains. This was not investigated further during this scoping study given the terms of reference of the brief. It is suggested that any further work associated with the ramp drainage and membrane inspection include the Forecourt perimeter grated trench drains as part of understanding the overall rainwater management study and recommendations.

Membrane

The membrane specified and installed within the Water Feature and Ramp areas was a bituminous sheet membrane which was cold-adhesive glued with heat welded joints. The membrane contained asbestos within the membrane carrier. The trade name for this membrane was Nuralite. This membrane is no longer used in Australian construction but is found in other countries, currently without asbestos.

HCA construction drawings (A1252 Section 1. Sump detail) show a single layer membrane application, with reinforcing details and overlaps. What is evident is the Varity of "membrane" types identified on the construction drawings.

HCA construction drawings (Eg. A1252 Section 1. Sump detail) detail the extent of membrane onto the slab at the edge of the Sump (trench drain ?) for only 300 mm, at Grid Y 300, which is understandable where the ramp moves onto earthfill. Other membrane details shown in Detail 2 of A1252 (Trench Detail) show a "Formcell membrane" being applied under a stainless steel trench drain base which is formed within the screed and tile bed.

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

Further "membrane" references are on drawing A1269/B, detail 1, which identifies a "Slip membrane as specified by the membrane Subcontractor trade 29". This "slip membrane' is traditionally a 200 micro plastic sheet which separates the screed for the bonding with the underlying structural concrete slab.

An additional membrane type shown on drawing A1253, Detail 3, Expansion Joint at the top of the Ramp, depicts "2 layers of polyethylene" membrane over the expansion joint and adjacent slab. The extent of the polyethylene membrane is not clear from the available drawings. This Varity impacts on the integrity of the overall waterproofing capability applicable to the Ramp and Water Feature structures. The actual membrane type installed under the Water Feature stonework is unclear, as identified on drawing A1255, Section 3 at the Source Pool where "membrane" has a generic reference.

Current Nuralite Product warranties in New Zealand are 20 years for a single layer system and 25 years for a two layer system. No other system installation was identified for extended warranties on the information available.

The indication is that the Nuralite membrane applied under the Water Feature and Ramp on the High Court is typically beyond the effective life for a single layer system and this needs to be considered in light of any proposed remedial action and costs associated with that remediation.

The membrane inspected as part of this scoping study has been limited to that membrane exposed within the trench drains on the Forecourt Ramp. Generally the membrane joints are in poor condition with little to no adhesion to adjacent membrane or substrate. Water was observed to be readily egressing from beneath the membrane in several locations indicating the membrane has failed in other areas under the ramp quarry tiles and / or the adjacent Water Feature stonework. The extent of any such failure was not determined under this study given the limited access to the membrane and associated mortar bedding and stonework overlays.

Further investigation of the membrane condition, possible failure modes and locations are referred to in the Recommendations Section below.

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

Water feature Pump Capacity and Capability

The existing pump system located beneath the ramp area is the original equipment installed during construction of the High Court. The equipment consists of the following;

- Fountain pump and associated electric motor,
- Pre-filter tank (coarse) for main pump supply,
- Minor pump and associated electric motor for water treatment reticulation,
- Pre-filter tank (fine sand) for treatment supply,
- Post construction Ionisation water treatment system,
- Inlet (Copper), fountain and waste discharge (Steel) pipes,
- Associated valves, and
- Electrical control board associated with the pump operation.

The system has been maintained by the NCA since construction. NCA maintenance personnel were contacted and have provided advice on the operation of the system as a whole. This included an explanation of recent improvements, such as the ionisation treatment system installation, and maintenance Contractor contacts for those involved with the treatment upgrade and subsequent operation maintenance. It was generally agreed that the pump operating system had received the lower end of the required maintenance regime.

Test operation of the main pump system showed the electrical controls and pumps performed as required when tested. What is not known is the condition of pump impellers and housing after 28 years of operation. We did not inspect the pumps further than to test pump operation by manual switching. For pump condition and potential repair assessment refer to the Recommendations Section below.

The pump equipment installed and operating at the Water Feature is;

- Main pump
  - Electric motor: 22 KW 37 Amp 1485 RPM Brooke Compton electric motor, Code T/DF 180 L 4/01
  - Pump: Ajax 200 (inlet) X 150 (Outlet) / 250 (housing size) Type AXO B
  - Pre-filter strainer tank, vertical, feed to treatment pump system.
  - Operational use unknown.
- Treatment pump
  - Electric motor: Pope 3 Hp 5 Amp (4 KW?) 1400 RPM motor, Code D 100 L
  - Pump: Ajax 80 X 50 / 250 Type AXO A.

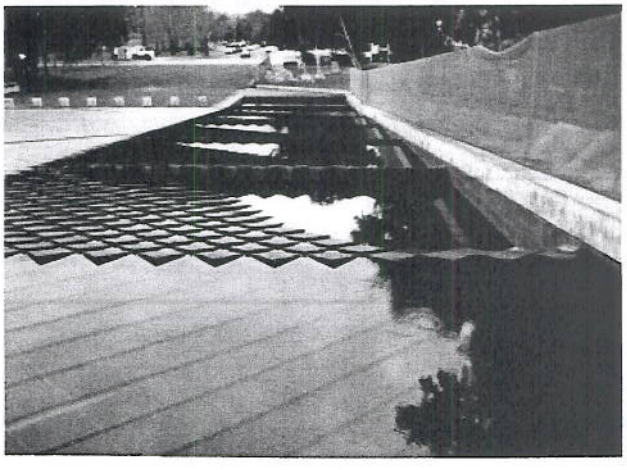
Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

  - Chemical Treatment: Aquatamatic Ioniser mark 9, "Delzone Eclipse 4 Ozonator".
  - Pre-filter: Micron 750 sand filter, vertical.
- Pipework:
  - Inlet for Holding Tank is 200 mm copper pipe feed to main pump through a 200 Isolation Valve and rubber joint for vibration isolation.
  - Outlet to fountain is 150 mm steel with isolation valve, fixed to the ramp slab soffit.
  - Waste outlet is 150 mm steel with gate valve, to stormwater waste.
  - Treatment inlet is 80 mm copper off main pump inlet via Tee junction inside pump room area.
  - Treatment outlet is PVC and associated treatment inlet pointsand valves, prior to sending water to the Source Pool for discharge.
- Electrical:
  - Switchboard: manual and automatic switching for main pump, treatment pump, ioniser power supply and controls, and cut off relay from Holding Tank low water level switch. The switchboard could not be inspected internally, no key to the cabinet door was available.

As part of the pump systemand Water Feature assessment we conducted several flow tests over the feature and recorded the observations of flow times, holding capacity, weir retentions and water egress from the feature to adjacent outlets and areas. The initial pump start-up was requested by the HCA Marshall to National Capital Authority (NCA) to initiate the pool pump on 16 Jun 08.. The feature was filled and subsequently the pumps stopped. It is unclear whether the flow stopped as a result of lack of water or the pump was turned off by the NCA.

Observations on 18 Jun 08, after the pump had been stopped the afternoon before, were taken for depth reading below the lowest overflow stonework, against the western side of the cascade pools (weirs) at each step in the feature. The results were;

Source Pool:	50 mm below Weir
Pool 1:	50 mm
Pool 2:	120 mm
Pool 3:	120 mm
Pool 4:	at overflow
Pool 5;	at overflow
Pool 6:	150 mm
Pool 7:	at overflow
Pool 8:	at overflow
Pool 9:	at overflow



Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

Pool 10: at overflow
Holding Pool: 200 mm

During that observation the four Grated Trench Drains were inspected to ascertain the presence of water resulting from the Water Feature being operational. The sumps on the western side of the Ramp were inspected and the results are recorded below, from north to south.

1. (North). Wet around the sump.
2. Making water into the sump, on the pool side of the sump.
3. Wet around the sump
4. (South). Wet around the sump. This sump detail is different to the other three western sumps, refer to drawing A1252, Detail 1 "Sump detail", where it identifies this detail applies only to the three northern west side sumps.

These observations show an association between water being present in the Ramp drain when water was stored in the Feature cascade pools. With particular reference to Drain 2, (Grid Y 170), the water was visibly dripping into the sump from the NW quadrant of the sump, adjacent to the cascade pool. There is clear evidence that there is a hydraulic connection between the pool as a source and the trench drain sump. The nature of that hydraulic connection is unclear with the limited amount of inspection and investigation for this report.

It is obvious that additional investigation work is required to clearly identify the tracking source of the water from the cascade pools to the trench drains on the Ramp. The extent of that investigation, or additional membrane rectification work, is outlined in the Recommendations Section below.

What is clear from the original construction drawings is that the varity of membrane detail is diverse and inconsistent with the perceived application under the Forecourt Ramp and Water Feature. What is central to the Water Feature's function and security of the available water is ensuring that pool water does not have access to the under ramp tile screed to bleed out to the existing ramp trench drains, and thereby out of the pool system, necessitating the need to continually "top up" the pool system through adding water to the Holding Tank.

Whilst it is recognised there may be several sources of water escaping from the pool system, it must be clearly established whether there is a vertical barrier between the edge of the cascade pool and the ramp screed. The available drawings do not currently indicate this was the design detail or intent, apart from a hob constructed on the eastern side of the pools. See drawing A1255, Section 3, and detail on drawing A4029 (drawing yet to be reviewed). See Annexure B.

Pump Maintenance and Monitoring

The existing pump system was previously maintained by the NCA, until recently handed over to the High Court to maintain as part of their asset inventory. Previous Operation and Maintenance manuals are not currently available from the High Court and no attempt has been made to enquire as to their availability from the NCA. The NCA pool contractor who carried out the recent pump upgrade to accommodate the ioniser installation has advised that there is littl, or no documentation available from the NCA with respect to the original construction and installation. The only available documentation would appear to be some maintenance records of past work by the NCA and others. Given the status identified during this study it is considered that any documentation would be of little benefit given the likely scope of future work and inspection to assess the pump system prior to making further recommendations as to upgrade or replacement. Any such decision would require basic Operation and Maintenance Manuals to be complied for the pump system.

Any ongoing monitoring prior to the Water Feature having leaks and substandard pump performance rectified would be of little benefit given the intention to change that performance by the proposed rectification / maintenance regime. This should be revisited as a result of work done to improve the pump performance.

Holding Tank Status

As part of the preliminary investigation into the operation of the Water Feature and associated infrastructure we conducted two pump tests to ascertain Holding Tank capacity and recovery characteristics. The initial feature operation established the flow and possible leakage points under the Ramp slab and into the ramp grated trench drains. The second pump test was to calculate the drawdown of the Holding Tank against pump capacity and the Water feature holding capacity.

The under slab Holding Tank appears to hold a volume of approximately 55,000 litres full capacity, based on site dimensions and Architectural drawing confirmation. The main pump does not have the pump rate noted on the pump identification plate. Enquiries to the supplier confirmed the maximum capacity for the 150 X250 / 250 Ajax pump operation at 1486 RPM is 83 litres / second, at 20 m head. Head applicable to the HCA pump operation is the Source Pool (RL 565.850) to pump location on the floor on the under ramp carpark (RL 559.750), a head of 6.1 m.

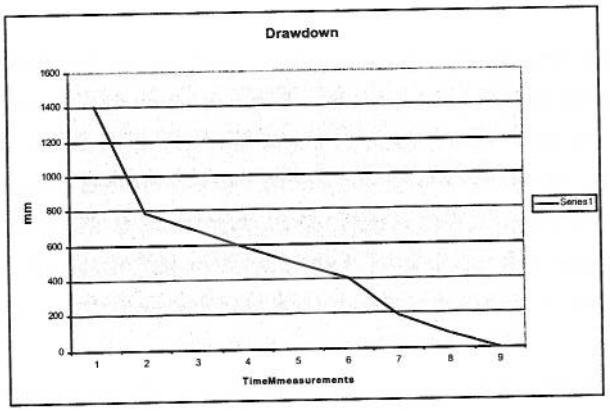
After the initial pump operation on 16 Jun 08 to determine leak locations, and mode, the pump was turned off and the water levels observed in each cascade pool to identify internal leakage between pools. This process was only partly successful in that the design drain hole between each cascade pool

showed signs of not being 100% water tight and some water was observed to be 'leaking' between pools via the drain plugs installed.

In addition it was observed that the vertical grout mortar to the stonework within the cascade pools was showing signs of deterioration by seepage and visible leakage through the stonework mortar joints. This was evident when the pool water levels were measured 24 hours after the pump had been turned off. Those results are listed below. In addition it was noted that the side wall stone joints were sources of water flow to a lower level, particularly from the Holding Pool to the Holding Tank inlet.

Further inspection of the feature on 24 June 2008 showed the cascade pools had continued to leak towards the Holding Pool, and then into the Holding Tank. A pump drawdown test was conducted to determine drawdown and tank capacity with respect to the feature's water volume requirements. A simple measure of drawdown against time was recorded until the pump cut out by activation of the low water level switch in the Holding Tank. There was some water retained in the cascade pools prior to the commencement of the pump test. As no volume was available from the original drawings for the Holding Tank the calculations are based on basic field measurements of distance from the top of the Holding Tank against time from when the pump was started. The results are below.

Time (Min)	Drawdown (mm)
Zero	380
6.00	1000
7.00	1100
8.00	1200
9.00	1290
10.00	1380
12.00	1600
13.00	1700
13.45	1780.



Note: the pump stopped at 13.45 minutes. The tank depth is 1780 mm, except for the sump well to the west, which is deeper and drains to the internal pump below.

This simple drawdown test demonstrated the Holding Tank capacity at the time was less than that required to fill the pools and have sufficient water remaining in the tank to allow reticulation. This makes no allowance for potential long term leakage from the pools. It was noted prior to the pump start up that the water level in the Holding tank and the Holding Pool was at the same level, ie 380 mm below the Holding Tank top level. It is considered that the amount of water retained in the cascade pools, together with the Holding Tank capacity would be of an approximate sufficient volume for the feature to

operate without interruption by low water sensor shutdown if all the pools were dry at pump commencement. If this is so then there is no buffer capacity to allow the Water Feature to run as a self sufficient unit. It would always be dependent upon additional recharge supply from the Actew supply via the metered inlet in the pump room. Without additional initial capacity there would always be the need to 'top up' the Holding Tank when it was operational.

Water Harvesting

Rainwater captured on the Ramp is directed to the inclined Grated Trench Drains across the ramp and down the eastern and western edges of the ramp. These currently drain the captured water to waste via internal downpipes through the slab to the south in the carpark below. This water collects and is discharged from the site at the southeast corner of the lower carpark via a stormwater drain to Lake Burley Griffin.

The redirection of this captured rainwater would be a relatively simple process to redirect this water to additional holding tanks which could be located at the southern end of the carpark below the Ramp. Tanks could be installed to hold sufficient additional water to enable the Water Feature to operate without additional input from the Actew domestic potable water supply.

Existing infrastructure could be utilised to treat this rainwater for removal of debris as a primary filtration through the existing pre-filter in the pump room. It would be a relatively simple process to establish sufficient holding capacity below the ramp to make the Water Feature self sufficient. Excess stormwater would be directed to waste once the new tanks capacity was reached. The new tank water would be connected to the existing holding tank so as to allow the Water Treatment reticulation to treat the new water with the existing Holding Tank water. This would need some reconfiguration of the exis ting pumping system and lines to enable the two sources of water to act as one.

Whilst a design is not part of this initial study it is sufficient to identify the relative ease with which this additional capacity could be achieved. Costs associated with this work could be identified once a suitable design was completed.

It should be noted that any additional water retention capability and/or pump upgrade should include the refit of the existing steel delivery pipe with plastic to prevent pipe failure. The existing pipe is showing signs of internal fatigue with pumps being turned on and off. The internal steel delivery pipe is rusting internally and flaking to such an extent that the steel is forming sand like sediment on the floor of the Source Pool.

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

Water Treatment Capability

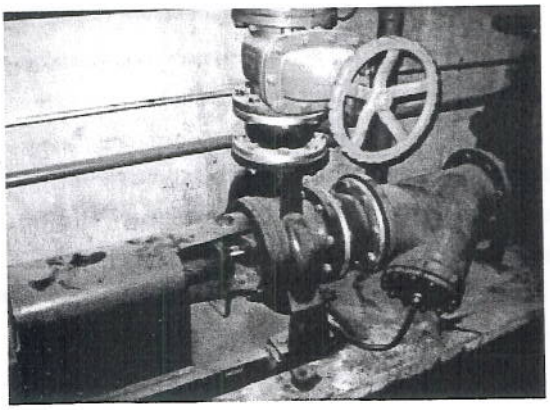
The current water treatment capability is directed to controlling algal growth in the static water created by the feature's design and function. When the pumps are turned off, such as the case with the adjacent portrait gallery construction of the internal access tunnel, the stagnant water is prone to bacterial and algal growth in the Holding Tank and feature pools, where water is retained in those pools. When the feature pump is off, the water treatment pump is also turned off.

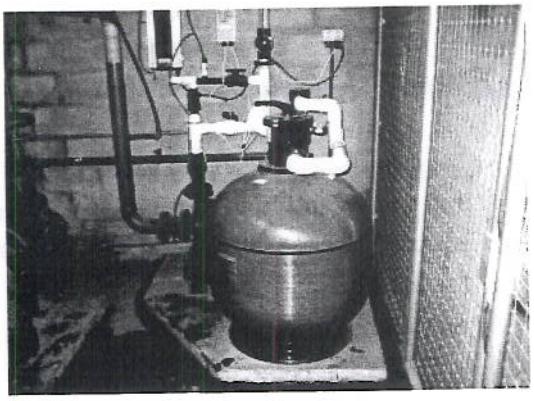
An issue with the current water treatment operation is the supply to the water treatment pump. This supply is currently via a tee junction off the main pump inlet. The effect of this configuration is the difficulty of drawing sufficient water from the main pump supply for the water treatment pump, when the main pump is operating. This has an adverse effect on the availability of water for the water treatment pump. Any rectification work associated with the pumps should enable a separate supply from the Holding Tank to the water treatment pump so as to allow the water treatment pump to run at the same time as the main pump. Currently the pumps are set to operate on different time settings so as not to overburden the water treatment pump. With a separate supply the water treatment pump could run continuously to treat the volume of water in the Holding Tank or as scheduled to run in conjunction with the Water feature operations. A further consideration is the possible need to upgrade the water treatment capability should water storage tanks be augmented for the water feature operation.

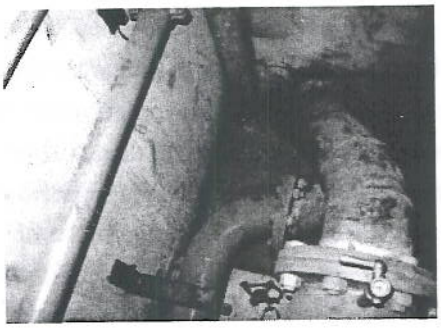
The water treatment pump was not operational during this assessment. The Ajax pump installed is believed to have capacity of approximately 7.5 litres per second, with 17 m head, depending on pump efficiencies given the pump has been installed for 28 years without overhaul. Using a flow rate of 5 litres per second a reasonable expectation would be the Holding Tank turnover of water could be every three hours. This would need to be assessed in combination with the installed Aquatic Ioniser as to suitability for this volume turnover and efficiency. This has not been done as part of this study. Evidence of other attempts at water treatment is in the form of a chlorine tablet container in the Holding Tank, fixed by rope to the access ladder.

Whilst it is evident this has been an issue previously, any water treatment system installed must be suitable for, and capable of, handling this volume of water in this application, given the large surface area exposure to sunlight in a shallow environment in the pools. The need for copper ionisation to kill algae and silver ionisation to kill bacteria needs to be considered in the scope of the water feature's intended future use after the Portrait Gallery construction and any rectification work on the Water Feature is complete.

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System







Summary and Recommendations:

Based on the observations during our preliminary investigation there are several recommendations which relate directly to the proper function of the Water Feature and the integrity of the 'waterproofness' of the Source Pool, cascade pools, Holding Pool and Holding Tank. This integrity is relative to the soundness of the installed membrane in the pools and how that membrane still is an effective barrier to water egress from the Water Feature, and how the Water Feature acts as a source of water which appears to escape from the pools to the east, via the ramp membrane screed and trench drains, albeit the membrane identified in these trench drains show obvious signs of failure.

. The recommendations reflect the current apparent condition of membrane based on what we could see or deduce from our non intrusive scoping study. Recommendations for further and more intrusive investigations are made in order to reduce the inclusions and risk of variations during upgrade work.

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

1. Water Feature Membrane

A. Further investigation is recommended in the north and west side of the Source Pool, to confirm membrane continuity and condition at the horizontal and vertical intersection by removing that stonework necessary to reach that membrane.

B. The eastern edge of the cascade pool, adjacent to the south west ramp trench drain at grid Y 170.3 should have the stonework removed for inspection of the membrane under the stone and tile screed for continuity and condition, between the pool and the trench drain sump.

C. Where it is determined the source of water to the ramp and trench drains is a result of the design being inadequate, a number of options would be available. The situation could remain as is and additional water storage tanks installed to allow for such wastage. Alternatively, the Water Feature edge stone work could be lifted and a vertical membrane wall installed for the length of the Water Feature to prevent water egressing laterally onto the ramp structure. Other leaks identified in the Water Feature could be 'chased' to identify where and how the membrane has failed locally and that area membrane rectified. Then the stonework would be returned to its original position.

2. Ramp Membrane

The ramp membrane adjacent to the trench drain sump at grid Y 170.3 should have the tiles and screed removed to access the underlying membrane around the sump and trench drain for a minimum of one metre along the drain from the sump.

That area immediately to the east of the Source Pool for a distance of one metre, exposing an area of one square metre minimum to assess the membrane as to continuity and condition.

Subject to the condition and continuity of the membrane encountered during this investigation, further recommendations would be made as to the likely rectification methods available. The recommendations above are minimal in nature to minimise the impact on the operation and appearance of the ramp and water feature during this investigation work.

3. Pump Serviceability

The pumps should be assessed as to longevity and serviceability. This can be done by Ajax Pumps, Newcastle. This inspection would involve removing the pumps and having them transported to Newcastle. We have spoken to the pump supplier and they have advised a cost of approximately $500 for each pump to strip the pump down and do a detailed inspection, together with rebuild recommendations. Advice to hand is that a rebuild would be in the order of $2,500. this would provide

another 25 years serviceability. New pumps are in the order of $4,000 each. One disadvantage with new pumps would be the need to refit the pumps to inlet and outlet pipes to suit changes in International Standard Organisation (ISO) requirements since these pumps were manufactured and installed.

Notwithstanding the pump component of the water reticulation system, there would need to be substantial modification to the supply lines to the pump and water treatment pump from the Holding Tank and other additional Holding Tank capacity. This would involve a minimum of one additional discharge for the Holding Tank sump to provide an independent supply to the water treatment pump.

4. Water Harvesting

Stormwater captured on the Ramp is directed to the inclined Grated Trench Drains across the ramp and down the eastern and western edges of the ramp. These currently drain the captured water to waste via internal downpipes through the slab to the south in the carpark below. This collected stormwater is discharged from the site at the southeast corner of the lower carpark via a stormwater drain to Lake Burley Griffin.

The redirection of this captured rainwater to additional holding tanks would be a relatively simple process which could be located at the southern most end of the carpark below the Ramp. Two x 10 KL tanks (3m diameter x 1.82m high approximate dimensions each) are proposed to be installed to hold sufficient additional water to enable the Water Feature to operate with minimised input from the ActewAGL domestic potable water supply.

The existing overflow pipe from the Water Feature tank will be redirected to the proposed retention tanks enabling a minimal wastage of water when the water feature is turned off and therefore self emptied. The water supply from the retention tanks will be connected to the water supply to the existing pump eliminating the requirements of additional rainwater pumps. Two x 150mm solenoid valves / motorised valves will be required – one on the existing water supply to the pump from the holding tank (Sol V1) and the other on the proposed 150mm water feed from the retention tanks to the pump (Sol V2). A further 20mm solenoid valve is proposed for the existing potable water feed to the holding tank.

The function of the system is proposed as follows:-

1. The water feature is turned on, hence draining the 55 KL holding tank of water at a rate of approximately 83 l/s

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

2. A low level is detected within the holding tank and the controller switches Sol V1 off and opens Sol V2 enabling water to be pumped from the retention tanks.
3. Water is then received within the holding tank from the overflow of the water feature and the controller closes Sol V2 and opens Sol V1 and commences normal circulation operation.

Should there be a low water level in the holding tank and the retention tanks are empty, the potable water solenoid valve will open up and fill the holding tank to 20% capacity.

The overflow from the retention tanks will be directed to the existing stormwater within the corner of the basement. A 225mm connection will be required.

Ancillary items required for the water harvesting system include water level probes within both the holding tank and one of the retention tanks, backflow prevention on the potable water supply and containment protection at the water meter pit to the whole site, motorised or solenoid valves, non return valves and possibly another controller to actuate the motorised valves and monitor tank levels although the existing water feature controller could possibly be utilised for this.

The catchment area from the ramp is calculated as approximately 830 m2 which will fill the proposed retention tanks following 25mm of rainfall. The redirected downpipes will enter the retention tanks via a meshed opening at the top of the tanks which would prevent any debris from entering the tanks and would need to be cleaned regularly. Secondary filtration would then be obtained via the existing Water Feature filtration system once the retention tank water is added to the Water Feature.

It should be noted that any additional water retention capability and / or pump upgrade should include the refit of the existing steel delivery pipe with plastic to prevent pipe failure. The existing pipe is showing signs of internal fatigue with pumps being turned on and off. The internal steel in the delivery pipe is rusting and flaking to such an extent that the steel is forming a sand like sediment on the floor of the Source Pool.

5. Water Treatment

Whilst the existing water treatment equipment is considered relatively new it would need to be considered in light of the renewed capacity and function of the water treatment requirement, and what effective turnaround time would be required to combat algal and bacterial growth in the Holding Tanks and the Water Feature. This would only be applicable where additional tanks were installed.

If additional tanks are not installed the water treatment system should be reviewed for performance and function for 24 hour operation.

Currently the water treatment is not operational when the fountain pump is on because of the adverse effect of the one supply line to both pumps. Without additional holding tanks, an additional independent inlet line to the water treatment pump should be installed to provide continuous operation.

The electrical control to the water treatment pump would need be checked to take into consideration the low flow provisions currently in place for the fountain pump, ie. the cut off sensor / switch for the Holding Tank low water level cut off switch.

Next Step

Following further initial subsurface inspection identified above we would be able to make more definite recommendation applicable to the overall membrane system and not only with regard to the membrane adjacent to leaking areas. Whilst the previous leaking around the ramp trench drain sump in the under slab carpark was tolerated by rectification of that particular issue, there is now apparent additional serious leaking at the north west expansion joint over the Portrait Gallery access tunnel, which has resulted in the fountain not being able to operate as originally designed.

A more detailed report would be prepared after the insitu membrane has been exposed and inspected.

The pumps could be assessed now as part of a program to recommission the Water Feature once rectification work has been completed.

Similarly, additional holding tanks and the associated pipe work could commence independently of any membrane inspection or rectification work required.

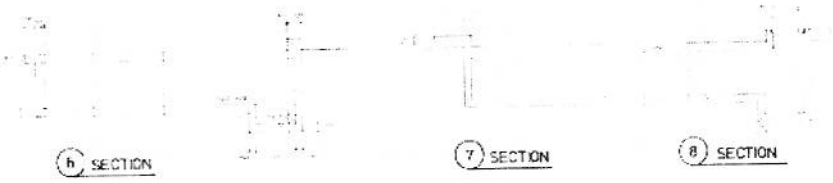
David Lamont
Construction Manager
For Cardno Young

Appendix 1: Cardno Young - Water proof Membrane, Drainage, Water Harvesting and Feature Pump System

Annexure A.

Long Section through Ramp, South to North

Holding Tank Sections



Appendix 2: Webb Australia – Electrical Services Scoping Study

HIGH COURT OF AUSTRALIA WATER FOUNTAIN
PART ONE: SCOPING STUDY – ELECTRICAL SERVICES

A. INTRODUCTION

This study is intended to identify the potential scope of electrical works associated with the rectification of leaks and refurbishment of the Water Fountain on the ramped entrance to the High Court of Australia.

In preparation of this study, Webb Australia has undertaken site investigations, consulted with HCA staff and electrical maintenance contractor (Paul Browne, Spotless Facilities Management), spoken with National Capital Authority's Paul Parker (HCA fountain maintenance administrator). Reference material included HCA drawing No. E34 entitled, 'ILLUMINATED HANDRAIL FORECOURT – LEVEL 2" and other HCA drawings supplied by HBO+EMTB.

This Scoping Study includes an assessment of the existing electrical installations including:

- Electrical supply to waterfall pump control panel
- Switchboards and controls for fountain lighting
- Conduit and cabling for fountain lighting
- Fountain lighting

Problems are indentified and recommendations are provided for each of the electrical installations listed.

A scope of electrical works is developed for both full and partial rectification options.
Budget Cost Estimates are provided for inclusion in the project Cost Plan.
A sketch of the existing source pool lighting layout and conduit details is included for information.

B. FINDINGS AND IDENTIFICATION OF PROBLEMS FOR ELECTRICAL WORKS

The following is a brief description of the findings in which problems with the existing installation are identified in addition to problems associated with the rectification works, as they impact on the electrical installations. Recommendations are also provided.

The list is indicative only and is not intended to be exhaustive. Other problems, not identified below, may be encountered during the construction phase of the works, as a result of the final rectification method adopted or due to unforseen site conditions.

1. Upgrade of electrical supply to waterfall pump control panel – findings and recommendations:

(a) Findings

- The existing supply to the waterfall pump control panel is located on DB.F1 in the Main Switchroom.
- The Distribution Board DB.F1 is an original switchboard, nearly 30 years old and is reaching the end of its useful life.
- The protective device for the above submain circuit is a 100A TP Quicklag circuit breaker, which no longer complies with current Australian Standards.
- It is understood the submain cable was replaced in 1995, and is shown as rated 65A. If this is correct, the protection device does not protect the cable against overload.

Appendix 2: Webb Australia – Electrical Services Scoping Study

- The construction drawings show conduits in the slab to the waterfall pump control panel for submain cabling and control wiring. We understand new surface conduit was provided when the submain cable was upgraded in 1995. Assessment of the capacity of the surface conduit to accommodate any increase in submain cable size may be required, when the changes to the load become known.
- Submain cable from DB.F1 to Waterfall Pump Control Panel has been cut and extended below the new entry to the National Portrait Gallery basement carpark (currently under construction). Junction boxes are wall mounted either side of the entry.

(b) Recommendations

- Replace DB.FI with a new compliant switchboard.
- The need to upgrade the submain cable from DB.F1 to the waterfall pump Control Panel will depend on if there is a substantial increase in load with any new plant and equipment installed as part of the fountain rectification works.
- The requirement to upgrade the submain circuit to the waterfall pump control panel will need to be assessed when the requirements of the proposed changes or additions to the plant is known.
- In any case, the protection for the waterfall pump control panel submain circuit must be reviewed to ensure overload protection is provided.

2. Switchboards and controls for fountain lighting – findings and recommendations:

(a) Findings:

- DB.F1 (referred to above) has a 30A TP Quicklag circuit breaker supplying a submain circuit to Distribution Board DB.F2
- DB.F2 is located in the carpark below the fountain and provides the electrical supply to the fountain lighting.
- Like DB.F1, DB.F2 is original, nearly 30 years old and reaching the end of its useful life.
- DB.F2 is a 9 pole distribution board containing Quicklag circuit breakers that no longer comply with current Australian Standards.
- There is no spare space on DB.F2, with one space being occupied by a duplex type circuit breaker and another SP circuit breaker is mounted separately.
- There is no RCD protection provided on DB.F2.
- The vulnerability of the switch board is of concern as it is in a space that does not restrict public access.

(b) Recommendations

- Replace DB.F2 with a new switchboard complying with current Australian Standards, complete with RCD protection and providing adequate spare capacity for current and future needs.
- Consolidate all control equipment into a common compartment, forming part of the new DB.F2.
- Accommodate the new switchboard in a lockable enclosure.

3. Conduit and Cabling for Fountain Lighting – findings and recommendations:

(a) Findings:

- Final subcircuit cabling from DB.F2 to the source pool lighting is run in surface duct and conduit below the slab.
- HCA Drawing E34 shows conduit in the slab linking socket boxes in the parapet wall and the conduit below the slab (Refer Appendix 1).
- Drawing E34 also shows 25mm dia PVC conduit from the socket box in the parapet wall run into the screed to the source pool luminaires.
  Note: Drawing E34 is a "FOR CONSTRUCTION" drawing and not "AS INSTALLED". Therefore the correctness of how this cabling was actually installed is unconfirmed.
- The conduits to the source pool lights is shown as being completely separated from the under slab conduits, only joining in the socket box above the water line of the source pool. The method appears to have been successful in preventing leaks via the electrical conduits.

(b) Recommendations

- Reuse existing duct and conduit systems between DB.F2 and the socket boxes to run new cabling.
- Provided new conduit in screed to all source pool luminaires if full removal and rectification works are undertaken, or
- Extend existing conduit systems to link conduit in parapet wall to conduit in screed if partial removal and rectification works are undertaken.
- Install new final subcircuit cabling to suit new lighting installation.
- Provide new concealed conduit / conduit in screed to waterfall edge lighting.
- Provide new concealed conduit / conduit in screed to waterfall pond lighting.
- Coordinate installation of all new conduit with rectification works.

4. Fountain Lighting Luminaires – findings and recommendations:

(a) Findings:

- The fountain lighting consists of 36 lights in the source pool only.
- The original design included lighting on the parapet wall, however this was not installed.
- The Voltage supplied to the source pool lighting is 112VAC, which is potentially lethal.
- The source pool luminaires incorporate compact fluorescent lamps. We understand the original lamps were incandescent reflector lamps that were replaced with the more energy efficient CFL lamps in about 2002.
- Lamp changes are done without draining the pool – luminaires are lifted above the water level to enable lamp replacement and servicing.
- Lamps in three of the luminaires were not working when a night time inspection was conducted.
- The edge of the waterfall is completely unlit and extends the full length of the fountain. The nearest lighting is the fluorescent handrail lighting on the opposite side of the ramp, which is over 16m away.
- Illumination of the ramp does not comply with the requirements of Australian Standards.
- The edge of the waterfall is a zigzag pattern making positive identification of the edge a complex task at the best of times and totally indiscernible at night.

Appendix 2: Webb Australia – Electrical Services Scoping Study

- A sloping pathway, changes in level, sharp edges and corners, water and darkness are all risk factors that contribute to the overall risk to the public.
- Advice from HCA indicates there have been no reports of accidents related to poor lighting of the fountain for over 20 years, if any at all.

(b) Recommendations:

- Refurbish and remove or replace source pool luminaires. Options to be considered include:-

  i) Reuse existing enclosure and refurbish with new ELV lamp type, or
  ii) Replace with new proprietary ELV underwater light, modified to suit mounting constraints of the project,
  or
  iii) Develop a custom ELV luminaire in conjunction with a luminaire manufacturer, specifically for the project.

- Removal of one sample of the existing luminaires will be required for assessment.
- The provision of minimal lighting, extending for the full length of the fountain, is recommended including:
  - Marker safety lighting of the waterfall edge
  - Underwater lighting of the waterfall ponds
- Although the HCA has had no known reports of accidents on the ramp, attributed to poor lighting of the fountain, that is considered fortuitous and provides no justification for not providing additional lighting as part of this upgrade.
- Upgrade of public lighting of the ramp to Australian Standard requirements is considered outside this scope of works.

5. Lighting Controls – Findings and Recommendations

(a) Findings

- Two 250V/112V transformers are located adjacent DB.F2, one of which supplies source pool lights. The other is not connected.
- Source pool lights are automatically controlled with an override switch at Security.
- A number of enclosures and wiring ducts surround DB.F2.

(b) Recommendations

- Remove redundant transformers and enclosures etc.
- Provide new lighting controls to suit the chosen lighting scheme.
- Accommodation for transformers will be required to power the LED fountain luminaires.
- The suitability of the socket boxes (shown at Appendix 2) to accommodate the transformers is unconfirmed and will require further investigation.
- The provision of conduits and socket boxes to each pool (as shown on drawing E34) is unconfirmed and will require further investigation.
- Alternatively, the transformers may be located in the basement carpark with conduits up the outside (Western) wall of the fountain to a junction box recessed into balustrade wall above the water line. Penetrations through the balustrade wall would be required to enable wiring to the pool and edge lighting.

C. SCOPE OF ELECTRICAL WORKS FOR FULL REMOVAL AND REPLACEMENT OPTION:

Preliminary Scope of Electrical Works - Full

The scope of electrical work described below is based on the complete removal and replacement of the membrane, screed and paving being undertaken for the full extend of the water fountain.

1. Switchboards

- Replace DBF1
- Replace DBF2

2. Submains

- Upgrade submains MSB To DB.F1(subject to requirement - refer B1 above)
- Upgrade submains DB.F1 To Waterfall Pump Control Panel (Subject to requirement - refer B1 above)
- Upgrade submains DB.F1 to DB.F2

3. Lighting Controls

- Remove existing transformers
- Replace PE cell, contactor, time switch controls for fountain lighting circuit, as required (Reuse cabling and retain override capability from Security Desk)
- Provide transformer(s) to suit proposed new fountain lighting lamp type, as required.

4. Conduit and Cabling to Source Pool Lighting

Drawing ESK01 (Appendix 2) indicates the final subcircuit cabling to the pool lights was intended to be installed in conduit in the screed above the concrete slab (i.e. above the membrane). All other conduits are shown in the slab or below the slab. In the absence of information to the contrary the options described below are based on this methodology having been adopted during Construction.

- Examine, test and replace cabling and conduit from DB.F2 to socket box, as required
- Provide PVC conduit (in the screed) between the source pool luminaires and to the conduit entries to the balustrade wall
- Sealing of all conduit joints
- Expansion of socket boxes in balustrade wall to accommodate transformers, or alternatively provide an enclosure in basement carpark.
- Provide cabling from transformers to source pool luminaires

5. Conduit and Cabling to Additional LED waterfall lighting

- Provide cabling in surface conduit in basement from DB.F2 to transformers
- Provision of recessed enclosures for transformers in balustrade wall in basement carpark
- Provide conduit from basement carpark to enclosures above water line at back of balustrade wall
- Provide penetrations through balustrade wall
- Provide PVC conduit in screed to waterfall edge marker safety lighting
- Provide concealed PVC conduit to each marker safety light

Appendix 2: Webb Australia – Electrical Services Scoping Study

- Provide cabling from transformers to LED pond and marker safety lights

6. Luminaires

- Refurbish or remove and replace existing source pool luminaires
- Provide LED marker safety lighting on selected tile edges along the pedestrian ramp edge of the waterfall for its full length
- Provide underwater LED lighting in each of the waterfall ponds

7. Other

- Testing, commissioning
- Maintenance during defect liability period
- As Installed documentation and maintenance manual

D. SCOPE OF ELECTRICAL WORKS FOR PARTIAL REMOVAL AND REPLACEMENT OPTION:

Preliminary Scope of Electrical Works - Partial

The scope of electrical work described below is based on the partial removal and replacement of the membrane, screed and paving being undertaken in the areas adjacent to movement joints, drainage sumps and services connections to the water fountain.

1. Switchboards

- Replace DBF1
- Replace DBF2

2. Submains

- Upgrade submains MSB To DB.F1(subject to requirement - refer B1 above)
- Upgrade submains DB.F1 To Waterfall Pump Control Panel (Subject to requirement - refer B1 above)
- Upgrade submains DB.F1 to DB.F2

3. Lighting Controls

- Remove existing transformers
- Replace PE cell, contactor, time switch controls for fountain lighting circuit, as required (Reuse cabling and retain override capability from Security Desk)
- Provide transformer(s) to suit proposed new fountain lighting lamp type, as required.
- Expansion of socket boxes in balustrade wall (subject to requirement, if alternative lamps are employed and voltage drop is a concern, the existing socket boxes in the rear of the balustrade wall may require expansion to accommodate local transformers).

4. Conduit and Cabling to Source Pool Lighting

- Examine, test and replace cabling and conduit from DB.F2 to socket box, as required
- Extend existing PVC conduit (in the screed), between the source pool luminaires and to the conduit entries to the balustrade wall, to replace the conduit removed as part of the rectification works
- Sealing of all conduit joints
- Provide cabling from socket box to source pool luminaires

5. Conduit and Cabling to Additional LED waterfall lighting

- Provide cabling in surface conduit in basement from DB.F2 to transformers
- Provision of recessed enclosures for transformers in balustrade wall in basement carpark
- Provide conduit from basement carpark to enclosures above water line at back of balustrade wall
- Provide penetrations through balustrade wall
- Provide PVC conduit in screed to waterfall edge marker safety lighting
- Provide concealed PVC conduit to each marker safety light
- Provide cabling from transformers to LED pond and marker safety lights

Appendix 2: Webb Australia – Electrical Services Scoping Study

- Complete row of tiles and screed will need to be removed and reinstated in each pond to permit installation of conduits

6. Luminaires

- Refurbish or remove and replace existing source pool luminaires
- Provide LED marker safety lighting on selected tile edges along the pedestrian ramp edge of the waterfall for its full length
- Provide underwater LED lighting in each of the waterfall ponds

7. Other

- Testing, commissioning
- Maintenance during defect liability period
- As Installed documentation and maintenance manual

APPENDIX 1

BUDGET ESTIMATE OF COST OF ELECTRICAL SERVICES

Appendix 2: Webb Australia – Electrical Services Scoping Study

BUDGET ESTIMATE OF COST OF ELECTRICAL SERVICES

(FOR COST PLANNING PURPOSES)

OPTION 1: FULL REMOVAL & RECTIFICATION WORKS

Item	Description	Estimated Cost
1	Switchboards and submain cabling	$75,000
2	Source Pool lighting upgrade, including luminaires, lighting controls, conduit and cabling	$75,000
3	Additional waterfall luminaires and associated conduit and cabling	$125,000
	TOTAL:	**$275,000**

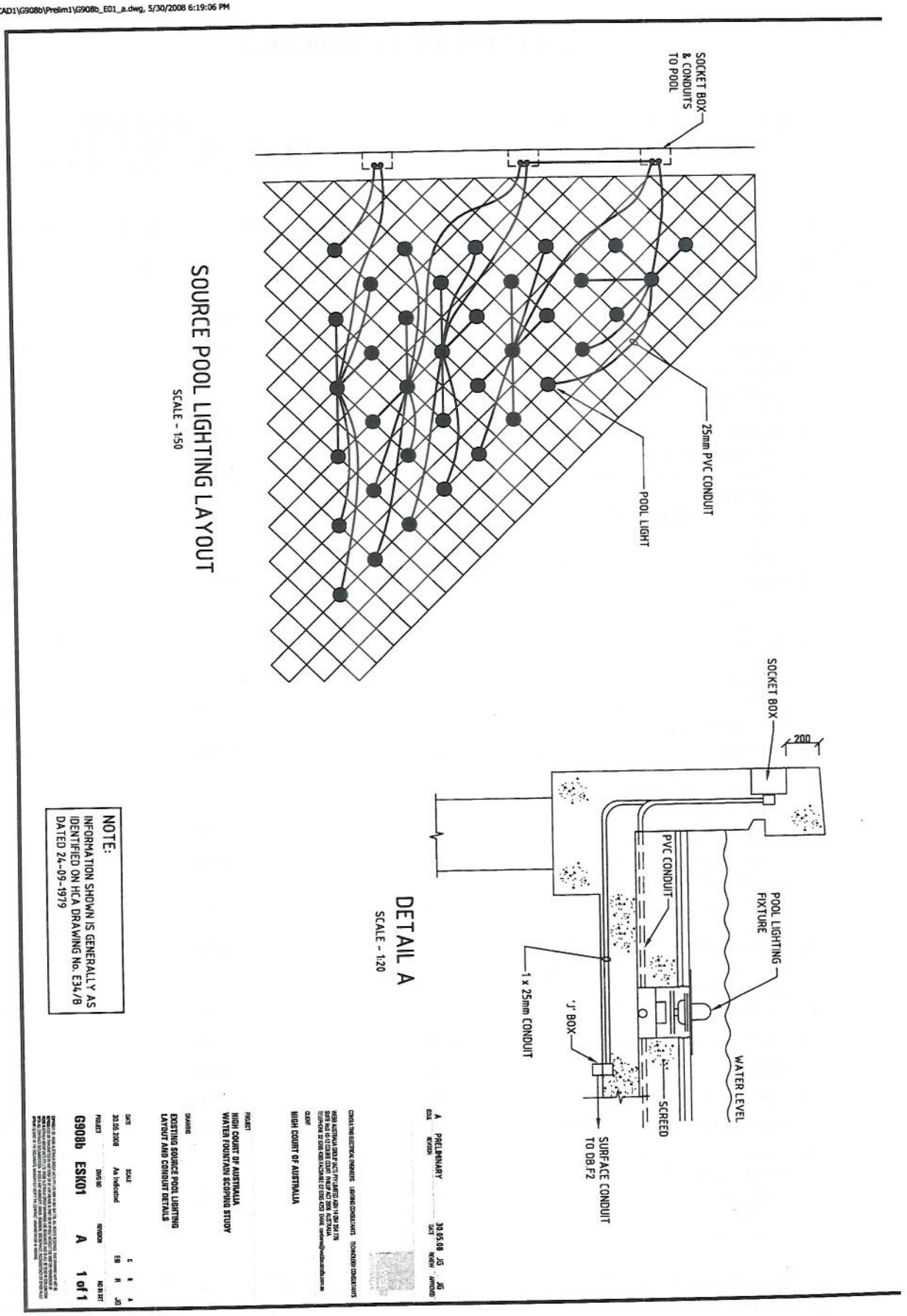
OPTION 2: PARTIAL REMOVAL & RECTIFICATION WORKS

Item	Description	Estimated Cost
1	Switchboards and submain cabling	$75,000
2	Source Pool lighting upgrade, including luminaires, lighting controls, conduit and cabling	$75,000
3	Additional waterfall luminaires and associated conduit and cabling	$125,000
	TOTAL:	**$275,000**

APPENDIX 2

DRAWING ESK01: EXISTING SOURCE POOL LIGHTING LAYOUT
AND CONDUIT DETAILS

Appendix 2: Webb Australia – Electrical Services Scoping Study



Appendix 3: Wilde and Woollard – Budget Estimate

ESTIMATE SUMMARY

Job Name : 4608 HCA FOUNTAIN
Client's Name: HBO+EMTB

Job Description
RESTORATION OF HIGH COURT OF AUTRALIA FORECOURT FOUNTAIN. OPTION 3

Trd No.	Trade Description	Trade %	Cost/m2	Sub Total	Mark Up %	Trade Total
1	Area measurements					
2	SURVEY	0.74		20,000		20,000
3	DISMANTLE, NUMBERING, RENOVATION AND STORAGE OF FOUNTAIN PAVERS	10.36		281,000		281,000
4	REMOVAL OF EXISTING TILE PAVING ADJACENT RAMP	0.70		19,000		19,000
5	REMOVAL OF EXISTING SCREED	1.14		31,000		31,000
6	ASBESTOS REMOVAL - measured 1 metre beyond grid Y200.3 only	2.65		72,000		72,000
7	REMOVAL OF STORMWATER SUMPS - Cardno Young pending receipt	2.21		60,000		60,000
8	REPAIRS TO CONCRETE STRUCTURAL SLAB SUBSTRATE	1.55		42,000		42,000
9	FILLETS see email dated 25 feb from andrew wilson	0.96		26,000		26,000
10	MEMBRANE AND SLIP SHEET MEMBRANES - measured 1 metre beyond grid Y200.3 only	5.86		159,000		159,000
11	CONCRETE SCREED	3.17		86,000		86,000
12	REINSTALLATION OF FOUNTAIN PAVERS	7.19		195,000		195,000
13	REINSTALLATION OF RAMP TILED PAVING	1.14		31,000		31,000
14	NEW STORMWATER SUMPS AND GRATING - Cardno Young pending receipt	5.53		150,000		150,000
15	HYDRAULIC SERVICES	1.29		35,000		35,000
16	ELECTRICAL SERVICES	10.14		275,000		275,000
17	BWIC	1.66		45,000		45,000
18	TRADE PRELIMINARIES	5.64		153,000		153,000
19	PRELIMINARIES AND PROFIT	18.58		504,000		504,000
20	Subtotal TRADE WORKS PRELIMINARIES AND PROFIT					*2,184,000*
21	DESIGN AND CONSTRUCTION CONTINGENCY - 20%	16.11		437,000		437,000

Appendix 3: Wilde and Woollard – Budget Estimate

ESTIMATE SUMMARY

Job Name :	4608 HCA FOUNTAIN	**Job Description**
Client's Name:	HBO+EMTB	RESTORATION OF HIGH COURT OF AUTRALIA FORECOURT FOUNTAIN. OPTION 3

Trd No.	Trade Description	Trade %	Cost/m2	Sub Total	Mark Up %	Trade Total
22	ESCALATION - COMMENCE JAN 2010 COMP JUNE 2010 3.5%	3.39		92,000		92,000
23	TOTAL BUDGET CONSTRUCTION ESTIMATE EXCLUDING MANAGEMENT DESIGN AND GST AS PER REPORT MARCH 2009 REV C (excluding CY report)					*2,713,000*
24						
25	EXCLUSIONS					
26	GST					
27	ESCALATION BEYOND JANUARY 2010					
28	CONSULTANT FEES					
29	CARDNO YOUNG ESTIMATES					
		100.00		**2,713,000**		**2,713,000**

Final Total $ **2,713,000**