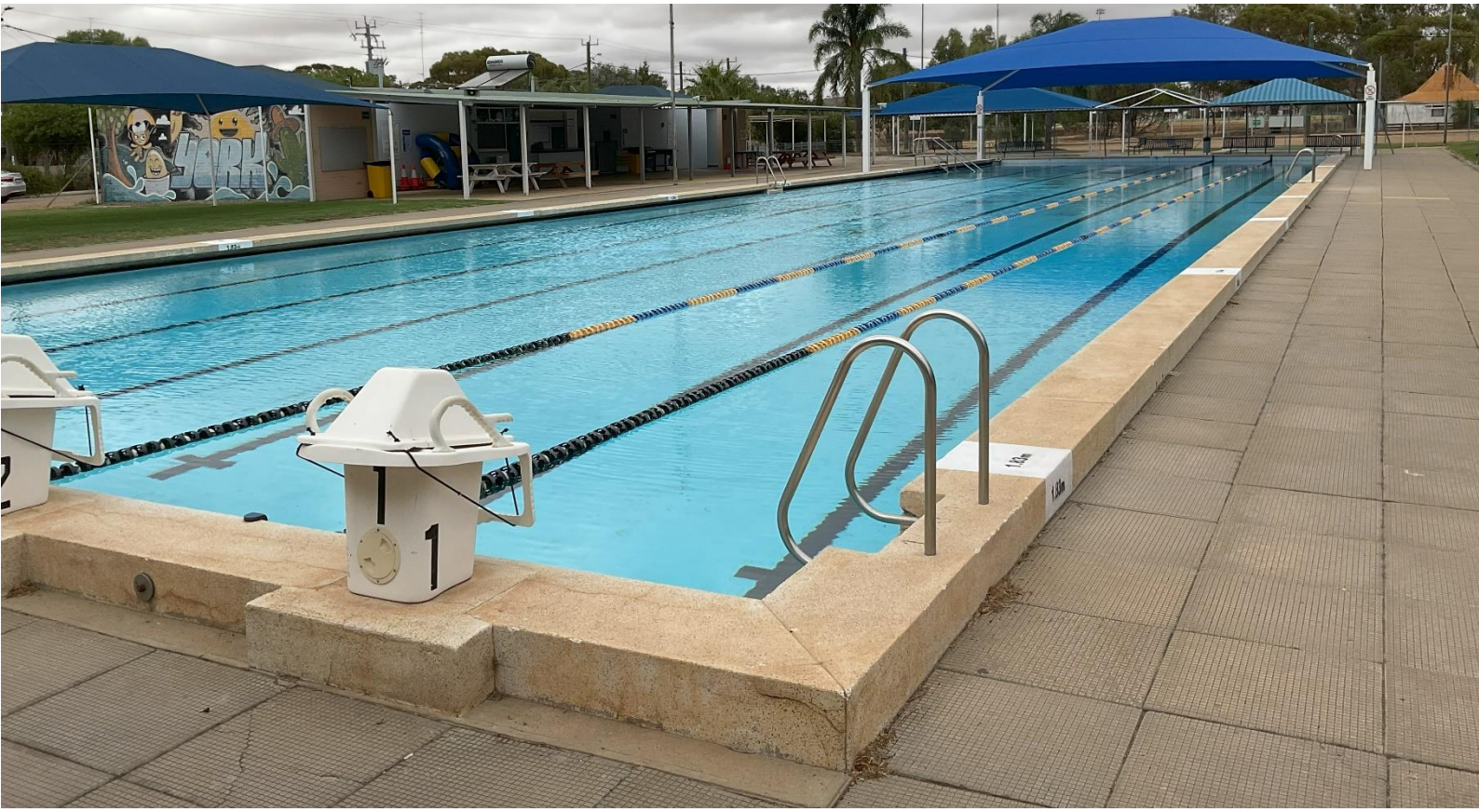
YORK SWIMMING POOL

Review of Pool Condition Reports



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For further information refer to relevant legislations.

INTRODUCTION

The Shire of York has commissioned BEC Ninnes Fong to undertake a review of the existing pool and water filtration condition reports of the public swimming pools located in York, Western Australia.

The existing received documentation to review:

- Survey and Council Report – Brian Beech, 2008
- Concrete Condition Assessment – Extrin, 2016
- Facility Condition Assessment – Lucis Consulting Australia, 2019
- Email Advice – GNFP, 2021

The facility consists of a 50-meter lap pool, a wading pool, and a toddler's pool, all constructed with reinforced concrete. Historical records indicate that these pools were built in 1967.

The purpose of this report is to analyse the current condition of the pools, water filtration systems, and buildings within the facility based on previously prepared reports. The desktop study will include repair options and building a new facility. The aim is to provide the Shire with sufficient information to make an informed decision about the future of this community asset.

The structural and aquatic engineer, Arek Prasek performed a visual inspection on 13th March 2024. During the site visit, all pools were filled with water.

Generally, we observed the crack's numbers, length and width were worse than described in the provided reports. The size and causes of the cracking in the pool and the exact investigation were not part of this project.

1 GENERAL INFORMATION ABOUT THE AQUATIC COMPONENTS

1.1 POOLS STRUCTURE

50m Pool

The 50m x 12.8 m concrete pool has 6 lanes and a concrete perimeter upstand (coping). Access to the pool is via the attached movable stairs. There are 2 expansion joints.

The scum-gutter style overflow channels are located along the pool. Depth ranges from 1.07m deep at the shallow end to 1.83m at the deep end. The pool surface is painted with tiled swimming lines and one row of tiles below the gutter channel, and one and a half top rows at the ends.

The pool is partially covered by a shade sail at the shallow end.

The return line is in the middle of the pool. The water outlets are sighted as a series of holes in the base of the pool.

Wading Pool

The Wading pool is 9.2m x 6m and consists of a concrete shell with a perimeter upstand. The scum-gutter overflow channel is located at the shallow end. The pool surface is painted with half tile row below the gutter channel and one top row on other walls.

The pool depth is between 0.55m and 0.75m.

The return line is along the deep end. The water outlets are sighted as a series of holes in the base of the pool.

Toddler's Pool

The Toddler's pool is 6m x 4.5m and consists of a concrete shell with a perimeter upstand. The pool surface is painted and tiled walls.

The pool depth is between 0.2m and 0.24m.

The return line is along the deep end. The water outlets are sighted as a series of holes in the base of the pool

1.2 WATER FILTRATION

- The Balance Tank, constructed from reinforced concrete, has a capacity of 99m^3 but operates with a water volume of approximately 64m^3. It does not have a top cover.
- The Backwash Tank constructed from reinforced concrete has an estimated capacity of 99m^3. It does not have a top cover.
- The water filtration system circulates water in all three pools.
- Gravity sand filter
- Air scour blower for gravity sand filter backwash
- Sodium Hypochlorite - disinfectant
- Sulfuric Acid - pH regulator

2 FINDINGS IN THE REPORTS

2.1 SWIMMING POOL FILTRATION & WATER TREATMENT SURVEY REPORT FOR WAR MEMORIAL SWIMMING POOL AT YORK

This report, prepared by *Brian Beach* in February 2008, provides a detailed description of the pool and its equipment and relates this to the new Department of Health WA Code of Practice requirements.

Selected failures:

- Foot Valve - reported that it would not hold water during shut down period.
- Pre-Pump Strainer - badly corroded. Urgently require replacement.
- The main circulating pump is not fitted with a discharge control valve, so the head cannot be accurately controlled from this point on. Ability to achieve the turn over time of approximately 6 hours (all three pools). There are no Pressure & Vacuum Gauges fitted to the pump. The pump is not suitable for any upgrade to the required flow rates.
- The Backwash Valve is slightly leaking.
- Filter. Pipes not suitable for an upgrade to the required flow rates. Corrosion of outer pipes and leakage when entering the concrete tank. A few other small areas of corrosion are noted within the plant room wall of the filter.
- Pipework. The pipework within the plant room is generally severely corroded and in poor condition, and it will need to be replaced as soon as practical. It was reported that there was some water loss in the underground pipes.
- Balance & Backwash Tanks are in poor condition and need replacing for any major upgrade.

2.2 CONCRETE CONDITION ASSESMENT

The report, prepared by *Extrin* in May 2016, was to inspect the existing cracking in the pool and concourse and provide future maintenance planning. The reports consist of the results of concrete testing:

a) Schmidt Hammer for concrete compressive strength. Reading between 32.5MPa to 42.5 MPa.
b) Drummy Survey to detect a concrete abnormality.
c) Chloride profile with depth to determine the chloride penetration of the concrete structure

General information coincides with the previous report from 2008 and the local assessment done by BEC Ninnes Fong.

The inspection and tests were done when the pool was empty.

Selected failures

- The inspector was advised that the pool is losing about 1 million litres per month (1000 m^3)
- It was recorded the cracking, delamination and staining of the concrete pool structure
- Cracking along centre channel
- The drummy survey results indicate delamination or detachment of the concrete (or render or plaster material) from the reinforcement. The total area requiring repair is approximately 1.42m^2 for the walls and 1.73m^2 for the floor.

- The entire length of the concrete upstand has numerous cracks. Around 40-60 linear meters of cracking with a width between 0.5mm to 3mm
- The existing repair patching in concrete was done before 1993
- Chloride ion penetration in the concrete wall in the first 50mm depth is 1.5 times more than the recommended limit
- The concrete tank walls are in poor condition, with visible cracks, spalling, and exposed reinforcement bars
- Suspicion of leakage in the northern expansion joint

2.3 FACILITY CONDITION ASSESSMENT

The report provided by Lucid Consulting Australia in February 2019, includes findings and recommendations from a few discipline specialists:

1. Building Services (mechanical, electrical and hydraulics) - Lucis Consulting Australia
2. Architectural - Hodge Collard Preston Architects
3. BCA Compliance - Resolve Group
4. Aquatic - Aquatic One

The primary objective of this report is to comprehensively identify major defects, safety hazards, and non-compliances, with a focus on addressing them within the scope of renewal works. Furthermore, the report offers actionable recommendations to rectify the identified issues along with estimated costs associated. Each recommendation is strategically prioritized to aid the Shire in efficiently allocating resources and funding.

<u>The selected failures</u>

- Lack of mechanical ventilation in the Plant Room.
- Exposed cable.
- Earth bonding.
- Each pool structure contains notable cracks in the floor.
- 50m pool significant settlement on one side of the pool.
- An open gutter (in each pool) presents a risk of injury.
- Expectation of expansion joints leaking.
- The concrete pool perimeter upstands notable cracks.
- Suspect the pool piping leak.
- The Balance Tank exceeds its design life and presents a safety risk to operators.
- The gravity sand filter is undersized and services three pools instead of individual pool.
- The chemical controller requires a flow-switch interlock to prevent static dosing.
- The Gas Chlorine System present several non-conformances with standards and require reconfiguration.
- Soda Ash System. Dosing and storage equipment is generally in poor condition, with damage to the surrounding area resulting from leaks and spills.
- The Backwash Tank contains algae-filled water and shows signs of structural degradation.

- The Concourse drainage channel is a trip hazard and causes safety and maintenance issues.
- The First Aid Room does not comply with the Department of Health Code of Practice for the requirements of the Design, Construction, Operation, Management, & Maintenance of Aquatic Facilities.
- There is no access or facilities for disabled people.
- The pool is out of level. The difference between the eastern side of the pool and the west is about 15mm.
- Cracking in channel gutter
- The water consumption of the pool was 2000 litres per hour in January 2019.
- The steps to the Toddler's Pool are too high, and handrails are missing.
- Originally, two strainer screens were present in the balance tank. Due to the failure of the concrete, one of the strainer screens retaining slots has fallen away, allowing only one screen to be used.

2.4 EMAIL ADVICE

Geoff Ninnes (of BEC Ninnes Fong), a distinguished aquatic engineer, penned the email in June 2021. With an illustrious career spanning over 25 years, Geoff is an expert in the aquatic discipline. His repertoire includes the design, enhancement, and meticulous forensic examination of more than 400 commercial pools, showcasing his profound expertise and commitment to projects.

The Shire of York engaged Geoff to prepare a scope of works for repairs and tender specifications. As part of preparing for that scope, Geoff conducted his own inspection and provided a brief summary in his email, outlining the primary findings as follows:

- Very substantial water loss through pool joint or centre return line
- Movement/settlement of the pool sections caused by ground movement due to a water leak under the pool
- Badly cracking in the concourse around children's pools
- No access to the gravity sand filter
- Backwash Tank is very badly cracked
- Two leaking and rusted pipes from the filter to the Backwash Tank
- Suggestion to replace the existing sand gravity filter with the new one
- The Balance Tank mesh screen for the leaf trap needs to be rebuilt and new gutter lines installed

3 VISUAL SITE INSPECTION

50m Pool

The concourse around the pool is significantly cracked. The perimeter concrete upstand has intensive vertical and horizontal cracks. The concourse settled in some areas.

There are cracks in the pool floor along the return line and across with delaminated and discoloured paint and black stains.

The expansion joint in the floor doesn't line up with the joint in the wall. The sealant in the floor joint different width.

There are large numbers of cracked, chipped and debonded tiles.

Wading Pool

The concourse around the pool has some cracking. The perimeter concrete upstand has intensive vertical and horizontal cracks.

There are some cracks in the pool floor, with delaminated and discoloured paint.

There are some cracked and outlined tiles. Most of them have faded colours due to wear and tear.

The paint on the pool floor has delaminated and discoloured.

The concrete step to the pool has two repaired cracks and a chipped edge due to use.

Toddler's Pool

The concourse around the pool has some cracking. The perimeter concrete upstand has many vertical and horizontal cracks.

There are some cracks in the pool floor, with delaminated and discoloured paint.

There are some cracked and outliered tiles. Most of them have faded colours due to wear and tear.

The paint on the pool floor has significantly delaminated and discoloured.

Plant Room

During the on-site assessment, it was observed that Chlorine Gas was replaced by Sodium Hypochlorite and Soda Ash by Sulfuric Acid. It appears that some pre-existing pipes were replaced, while others were refurbished by repainting.

A significant structural crack is visible above the top corner of the entry door.

The old pump was re-used and repositioned slightly higher to accommodate the new piping. However, there is inadequate fixing with the pump bearing on the brick.

There is significant rust on the valve on the backwash line.

A significant structural crack is visible above the top corner of the entry door.

The brick Plantroom walls exhibit detachment from the concrete filter tank. There are some cracks in the brick walls in different locations and signs of chemical penetration into the plaster, timber elements, and paint inside the building.

The disappearance of mortar around the backwash pipe, chip-off pieces of brick in other locations, and significant discolouration were noticeable.

Balance Tank and Backwash Tank

The concrete walls of the backwash tank exhibit severe damage, with exposed reinforcement, rendering the balustrade structurally failed and unsafe. Concrete debris and other types of rubbish were visible inside

the tank. Chemical infiltration from the water storage tanks has led to the exposure of aggregate stones within the concrete structure.

We've observed that a single strainer screen is currently in use. Due to the failure of the concrete edge, the remaining slot lacks the necessary support for a second screen. This issue results in inadequate debris trapping from the pools

There was a different amount of soiled water entering the Balance Tank.

The U-shaped rods embedded within the concrete walls, intended as steps, exhibit deformation and corrosion. No safety rails.

Gravity Sand Filter

The reviewed reports do not mention sand bed replacement or thorough cleansing. Geoff, the current pool operator, couldn't advise when the last time the sand filter was refurbished.

The gravity sand filter media requires replacement every ten years. Serving as a filter media, sand effectively captures dirt particles up to 0.5 mm in size. Failure to replace the sand leads to coagulation due to the accumulation of fats, oils, and skin particles within the water, resulting in inadequate filtration. Failure to remove these particles can significantly slow down the turnover time, impacting the water flow rate. Even during backwashing, not all impurities trapped in the sand bed are removed. The organic remnants become a food source for harmful microorganisms and bacteria, posing a health risk.

Building Facilities

The inspection we proceeded with confirmed the findings from the architect and building surveyor regarding existing building structures.

- No facilities for disabled people
- Lack of separate First Aid Room
- Non-compliant Universally Accessible Toilet (UAT)
- Dedicated general store rooms
- Lack of air-conditioning in the office
- Broken window in Plant Room
- Aging perimeter fence
- Additionally, unsatisfactory roof tie-down next to the cantilever part of the roof
- Dilapidated changeroom

4 FINDINGS INTERPRETATION AND COMMENTS

Our interpretation and comments in this section follow the order of the deficiencies listed in the previous sections. The problems repeatable in the following sections are fully discussed in the first case to avoid duplication.

4.1 SWIMMING POOL FILTRATION & WATER TREATMENT SURVEY REPORT FOR WAR MEMORIAL SWIMMING POOL AT YORK

Cracking

The cracks in the concrete, floor, walls, and upstand should be appropriately repaired as soon as they appear to prevent the chloride penetration of the concrete. The current stage of cracking in the concrete upstand to each pool requires a severe capital investment in further forensic investigation to confirm the ingress of chloride into the concrete, cement content, chloride diffusion and the extent of reinforcement corrosion. Depending on the results, the remaining life of the pool may be limited, simultaneously requiring a severe investment in the repairs.

Recent inspections have raised concerns regarding potential chipping or disintegration of render or concrete patches within the next two years. Such deterioration poses contamination risks to the pool environment and escalates the likelihood of injuries.

Expansion joint

The different widths of sealant in the expansion joints in 50-meter pool indicate potential issues with the differential settlement on each pool section. If this is the case, sealant alone is a very short-term solution.

Differential settlement can lead to concrete parts separating, widening expansion joints, damaging sealant, and ultimately causing water loss. This water leakage can further exacerbate issues by washing out compacted soil beneath the pool floor, creating air pockets and loose sand, which in turn contribute to continued settlement.

To assess the presence of air pockets or similar abnormalities beneath the pool floor, Ground Penetrating Radar (GPR) testing would be necessary. Additionally, conducting dye tests can help detect water loss within the pool structure, channel gutter, and piping system.

The pool settlement leads to underground piping damage.

Tiling

The tiling within the pools exhibits extensive wear, characterized by cracks, chipping, and debonding. This deterioration not only compromises the aesthetic appeal but also poses safety hazards due to the presence of sharp edges on the broken tiles, increasing the risk of injury to pool users.

Considering the current condition of the tiling, it is advisable and feasible to undertake simultaneous re-tiling of all three pools. The total square meter area requiring renovation does not necessitate a significant investment. However, it is important to acknowledge the potential risk associated with this renovation process.

Upon removal of the tiles, there exists the possibility that underlying concrete degradation will be exposed. This may include issues such as spalling, delamination, or cracking, which could necessitate additional repairs beyond the scope of the initial re-tiling project. Therefore, a thorough assessment of the concrete

substrate prior to commencing the re-tiling endeavour is imperative to mitigate unforeseen complications and ensure the longevity and structural integrity of the pool facilities.

Paint

Addressing the deteriorated paint on pool surfaces necessitates a comprehensive approach encompassing thorough cleaning, crack repair, and subsequent repainting.

It's crucial to note that the paint used on pool surfaces typically comes with a lifespan and warranty of seven years. This type of paint is particularly sensitive to various environmental factors such as water exposure, chemical interactions, abrasions, temperature fluctuations, and sunlight exposure. In comparison, the warranty for tiled surfaces extends to ten years, with an estimated lifespan of approximately 25 years.

Return line

The main return line required a sufficient water inlet, boasting a wide diameter to ensure ample water dispersion for sustained circulation. We were apprised of sporadic algae occurrences, particularly in the pool's deeper sections, necessitating manual free chlorine concentration treatment.

Presently, the basic water inlets fail to ensure adequate water circulation throughout the pool.

Water treatment chemicals

We were informed that the water treatment system underwent an update in 2019. The replacement of gas chlorine made the system function much safer and significantly reduced the risk of operation. However, there is still room for improvement with the system regarding fully automated chemical control.

Plant Room

The Plant Room lacks mechanical ventilation, which causes chemical penetration in the paint, render, brick walls, timber elements, and pipes. Staying in the building is also unhealthy, as the chemical fumes enter the lungs. Broken glass in the window and large gaps in the opening don't improve the ventilation on unwindy days. The building structure requires an elementary repair to ensure it stays safe.

Balance Tank and Backwash Tank

The Balance Tank and Backwash Tank are neglected and significantly damaged. Considering the advanced age of the structures and the extent of existing damage, a comprehensive renovation may not be feasible.

The balustrade doesn't prevent from falling into the tank, the pool personnel need to be very careful around the structure and area totally closed from unauthorised people.

Access to the tank needs to be modernised to provide safety.

The absence of a roof over the tanks exacerbates water evaporation along with the chemicals and allows pollution to get into the water.

The current debris and dirtiness should be immediately removed and tanks regularly cleaned. The dirt in the tanks causes bacteria and microorganism colonies, which enhances the demand for chemical treatment. As there is no automatic control of the water probes of water quality, the pool operator may react with delay, potentially endangering bathers who may ingest contaminated water or experience skin irritation. In severe cases, the pool may need to cease operations until water circulation is fully restored. It's noteworthy that a single filtration system serves all three pools, posing heightened risks to the youngest children.

Pool settlement

During the inspection, it became evident that varying amounts of soiled water from the channel gutter were flowing into the pool. This discrepancy could be attributed to the uneven settlement of the pool structure, leading to an irregular flow rate and prolonged circulation time of pool water.

The *Aquatic One* report specified that the difference between the eastern side of the pool and the west is about 15mm.

4.2 CONCRETE CONDITION ASSESMENT

Water Loss

The water loss is a significant and alarming concern. The average volume of the 50m pool is about 920.75m^3 [50m x 12.7m x (1.07+1.83)/2], which means that more than the content of the whole pool is lost within a month.

1000m^3 /(30 days x 24hrs) =1.38m^3 (1388 litre) pool is losing water with chemical content within an hour.

The *Aquatic One* report also mentions a huge amount of water loss, 2000 litres per hour. Please note that the information is based on the pool manager's statement, the **accurate water loss test was never conducted**.

The loss of such a significant volume of water could result from underground damaged pipes or, in addition to broken pipes, cumulative leakage from expansion joints, evaporation, and cracks.

The dye test should be performed as soon as water loss is detected. This will allow for a more precise determination of water waste, identifying the location of leaks and organizing repairs.

Druminess and inside the channel gutter were not confirmed during our site visit.

The number of repair patching was noticed mainly in the deep section of the pool.

Concrete Cancer

The results from the chloride ion test performed 8 years ago showed dangerous penetration of the concrete surface up to 50mm over 1.5 times the recommended limit. As no preventative measures were taken, chloride was able to penetrate the concrete walls and floors, reaching or possibly approaching the reinforcement surface now.

Preventing reinforcement corrosion in the current concrete structure would be very difficult and expensive work, with no guarantee of successful repair or the extent of the pool's serviceability for about 10 years with further repairs.

4.3 FACILITY CONDITION ASSESSMENT

The exposed cables in several locations required replacement to improve the safety.

Earth bonding

The certified electrician is required to carry out testing and install equipotential bonding in accordance with AS 3000 standards.

Channel gutter

The existing open style scum-gutter occurring in all three pools presents a risk to patron safety as the potential exists for arm or leg entrapments whilst patrons are entering or existing the pool. Especially when a floating toy flows into the gutter and a child wants to get it out.

The cracking concrete over the channel gutter if spalled will be hard to notice as it is out of direct sight. This degradation not only obstructs the flow of water within the channel but also exposes the reinforcement bars to corrosive chemical reactions from both water and airborne fumes.

Non-compliance findings

Non-compliance findings are outside the scope of this report and thus do not warrant our comments. However, should any pool modernisation be undertaken, it is imperative to include necessary updates to adhere to the Building Code of Australia (BCA), National Construction Code (NCC), Department of Health Codes of Practice, Royal Life Saving guidelines, and other legislative requirements.

4.4 EMAIL ADVICE

Geoff's findings in the email are likely derived from the previous report rather than from a physical inspection. The comments on his findings have already been addressed earlier in this section.

5 SUMMARISING

The concrete pool design lifespan is 50 years. The service life depends on regular maintenance, water chemicals, exposure to atmospheric conditions, bath loads, etc.

The external seasonal pools are at the highest risk of all unfavourable factors:

- Heat from extreme hot weather in WA,
- differential temperature day and night (especially in the winter season),
- emptying and refilling the pool,
- pollution from fauna, like ducks and other birds' excrements, frogs, rats etc.
- pollution from flora, like leaves, flower pollen etc.
- number of bathers wearing sunblock, sweating, open injuries, mucus, and urinating in the pool etc
- own wear out, like paint, tile grout, concrete surface of the upstand, sand from concourse etc

Each of the aforementioned factors influences the requirements of water chemistry, thereby impacting the integrity of the concrete surface. As the presence of chemicals increases, so does their ability to infiltrate the concrete, ultimately leading to its degradation.

All three reports include a list of significant damage to the water facility. Any damage increases operating costs and reduces water quality and patrons' comfort.

The current condition of the water facility is far from today's standards and regulations. The level of destruction of obsolete concrete structures exceeds the profitability of repair.

BEC Ninnes Fong advises against repairing the existing facility as repairs will be a significant challenge. The costs associated with repairing and modernizing the pool structure, tanks, and plant room to meet current standards and regulations are expected to be substantial relative to the benefits obtained. While certain renovations can prolong the lifespan of specific elements—such as water filtration systems for up to 9 years, addressing cracking and surface finish issues for 7 years, and maintaining pool and tank integrity for 5 years—ongoing inspections will be necessary to ensure the upgraded facility operates effectively. Moreover, additional investments for maintenance may be inevitable.

Past experience suggests that new issues may arise during the renewal process, necessitating further expenditures. Achieving compliance with current standards and regulations poses a considerable challenge. For instance, installing a disabled lift or ramp could restrict access, as one lane may need to be dedicated solely to these facilities. Additionally, adding a new lane to the pool may prove problematic due to potential bonding issues between the new concrete and the aged, chloride-permeated structure. Similar challenges may arise with centreline replacement efforts. Addressing these complexities will require careful planning and consideration of alternative solutions.

***BEC Ninnes Fong* strongly recommends the construction of a new aquatic facility** as it will provide residents with the highest standard of quality and safety, with no major problems and lower costs for the next 50-60 years.

A sufficient selection of a water filtration system will notably diminish operational costs, ensuring sustainable management of the pools. Moreover, the automation of the Plant Room will streamline water

quality control, enabling remote monitoring of chemical levels and instant alerts in case of equipment malfunctions, thereby ensuring optimal conditions at all times.

There is an opportunity to enhance the appeal of the children's area could be achieved by incorporating water features or an engaging active tower equipped with a tipping bucket.

Incorporating a ramp into the design of the new pool would not only offer comfortable access for disabled patrons but also ensure inclusivity. Additionally, implementing other facilities tailored to diverse needs would further enhance accessibility and enjoyment for all visitors.

The Shire could explore integrating solar panels into their infrastructure for both building electricity generation and water heating systems. This eco-friendly approach not only reduces operational expenses but also aligns with sustainability goals, offering long-term benefits to both the environment and the community.

While rebuilding the aquatic centre in its current location is feasible due to the available space for slightly expanded facilities, it's essential to consider the inconvenience to residents who would miss out on an entire operational season. Thus, exploring alternative locations might offer a more practical solution.

The Shire of York needs to consider the constantly increasing prices and costs in order to make quick and reasonable decisions that will allow it to save on capital costs.

6 PHOTO DOCUMENTATION

Cracking in the concrete upstand

Cracking along centre line

Different width of the expansion joint sealant

Cracking in the pool floor

Shaded part of 50m pool

Settlement of the concourse

Cracked and debonded tile

Concrete patches at deep end

Concourse cracks and settlement

Concrete upstand cracking

Concrete upstand cracking (no handrail)

Debonded tiles and concrete upstand cracks

Insufficient tie-down

Concourse drainage channel – trip hazard

Broken window in Plant Room

Degradated concrete plinth and brick wall

Sodium Hypochlorite – disinfectant

Sulfuric Acid - pH regulator

Rusted valve

Structural crack above Plant Room door

Insufficient pump fixing

Separation between Filter Tank and Plant Room

Plant Room wall damaged by chemicals

Damaged mortar around the pipe

Damaged Balance Tank wall, rusted pipe and rubbish

Cracked wall and unsafe balustrade

Spalled concrete wall and rusted reinforcement

Spalled brick and lost damaged mortar

Broken strainer screen (Balance Tank)

Damaged Balance Tank

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