CASE STUDY:
Transforming Perth Zoo’s Water Infrastructure

Claire Wright
Director Community Engagement

Perth Zoo

Snapshot

Opened at 3pm on 17 October, 1898
Opened to public every day since then!

19ha parks and built structures

Operational budget $26M p.a.

695,000+ visitors in 2015/16

160 staff and 300 volunteers

1,200+ animals (180 species)

Native species breeding programs

4,000+ mature trees
Perth Zoo

Site Overview

Basic Site – 19 hectares

Buildings
- 70+ unique structures
- Offices, Workshops, Exhibits, Storage and Food Prep., Public Amenities, Corporate Rooms, Cafes, Solar Pergola, Vet Hospital.

Water Bodies
- >2,500,000L surface water onsite
- 7 largest identified on map
- Almost every exhibit has a water system

Main Services
- Historic below ground services!
- Irrigation (Green)
- Electricity (Red)
- Potable water (Blue)
- Natural gas (Purple)
- Sewer (Brown)

Gardens
- 4000+ mature trees
- Nursery onsite
Perth Zoo

Daily material needs of an elephant!

- **Food**: 80kg (Grasses, browse, fruit and veg)
- **Drinking Water**: 200L
- **Bore Water**: ~3000L (For washdown and pool)
- **Manure**: 80kg
- **Heating**: 10kWh (Winter)
- **Pumping**: 250kWh (Water filtration for pool)
- **Refrigeration**: 10kWh (Chilling fresh food)

50 tonne of ‘animal’
Perth Zoo

Engineering Challenges

“The artificial micro-climates created by Zoo’s present unique engineering challenges for building and environmental services.” – Dan Baker

Above: Elephant cow pool is 250,000L and uses 11% of total site electricity for its plant and filtration (800kWh/day)

It requires 12,000L/day recharge and is not chlorinated (for welfare).
Perth Zoo

Water Systems

1,000,000 litres/day on average

Bore (90%)
– High pressure network (550kpa)
– 5 active bores
– Artificial lakes and pools
– Irrigate gardens, wash down etc.
– Fire.......... 

Potable/Scheme (10%)
– 9 input points
– Staff/public amenities
– Animal drinking water
– Breeding programs
The Integrated Water Management Project

The case

Water systems were past design life (+50yrs)
Regular underground breaks and valve failures

‘Band-aid’ pipework repair history:
- mixture of asbestos, copper, polyethylene, PVC, galvanised steel, cast iron!
- More ‘compression bridges’ than pipe in the ground!

Asbestos to PVC bridge (Rhino potable water leak 2014)
Cast iron – galvanised steel (Bore 7 Artesian)
Water Management

Major Leaks (Potable Water)

Rhino (Jan 2014)

Fractured PVC
6,000,000L lost
$13,000 value

Despite isolation tests and searching, it took 3 months to locate.

Left: Data loggers show flow rates before and after repairs!
Water Management

Major Leaks (Potable Water)

NSBP (July 2014)

Root fractured 50mm PVC

5,000,000L lost
Valued at $10,000

Took 6 months to find despite isolation testing and group searching.

Take home message:
“Monitoring won’t prevent leaks, better infrastructure will.”
Water Management

Major Leaks (Bore Water)

Vet hospital October 2016.

Older piping section failed overnight. Ran for hours and flooded offices and produced deep sink hole.

Left: Data loggers show daily water use spike by **600,000L**.
Integrated Water Management Project

Objectives

Project Objectives

- Reduce maintenance and leakage
- Reduce and reuse water
- Create separate fire main
- Upgrade roads, PA system and communications
Integrated Water Management Project

Overview

$11.9M project

1.8km of new pipework

Largest project in Zoo history

Foreword works package

Main works - 8 stages over 10 months with multiple work crews

Completed in an 7 day a week operating environment
Integrated Water Management Project

Details

Potable main (65mm)
Fire main (200mm)
Bore main (200mm)

Where else to dig the trench, but through the main paths/roads of the Zoo

Data
High Voltage
Low Voltage
Pits
Integrated Water Management Project

Trench Works

Main pathways and roads

Main road through Zoo
Integrated Water Management Project

Trench Works

Alongside historic Fig trees (Mill pt. road)

Just look at these roots
Integrated Water Management Project

Challenge: planning & logistics

Central challenge - planning major road closures whilst remaining functional 7 days per week for:

- Visitor traffic
- Animal servicing and food supply
- Weddings, peak periods and major events
- Infrastructure servicing and supply
- Maintaining revenue/reputation

How we solved it:

- Constant planning and communication
- Daily road closure updates - staff intranet, docent briefings and email, signage and maps.
- 50% reduction for second visit in Feb
- Dinosaurs
Central challenge was switching over to the new water system pipework, pump house, and centralised computer controller. Teething issues below.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple bore main pipe bursts (over pressure)</td>
<td>Replacing weak points in older system parts as they arose and reducing main pump house pressure from 650kpa to 500kpa.</td>
</tr>
<tr>
<td>Bore water storage tank overflow</td>
<td>Improve comms to prevent overflow if data connection is lost.</td>
</tr>
<tr>
<td>Lightning damage</td>
<td>Install additional lightning protection.</td>
</tr>
<tr>
<td>Communications failures to some of the 24 irrigation controllers</td>
<td>Switch problematic areas to 3G modems using mobile phone comms instead of copper.</td>
</tr>
<tr>
<td>Premature failure of bore no.4, sheared shaft.</td>
<td>Reprogram bore scheduling algorithm (5 bores) to reduce start frequency.</td>
</tr>
</tbody>
</table>
Integrated Water Management Project

Lessons Learned

From Consultants

1. Establish the level of communications required between Zoo stakeholders, contractors and project team up front.

2. Ensure the project documentation is developed to reflect the contractual approach, nature of the site conditions and client requirements.

3. Ensure the level of finish is understood by all parties.

4. Ensure consistency of resourcing and appropriate allocation necessary to deliver work within Perth Zoo.
Integrated Water Management Project

Lessons Learned

From Perth Zoo

1. There is no substitute for constant dialogue/communication.

2. Many layers of consultants adds challenges: delays, accountability etc.

3. Some surprising scope misses by everyone (e.g. bore cabinets not upgraded with new electronics)

4. Never ever do anything like this again!