CPB CONTRACTORS

Post Entry Quarantine Facility

Australian Construction Achievement Award

2018

TECHNICAL PAPER

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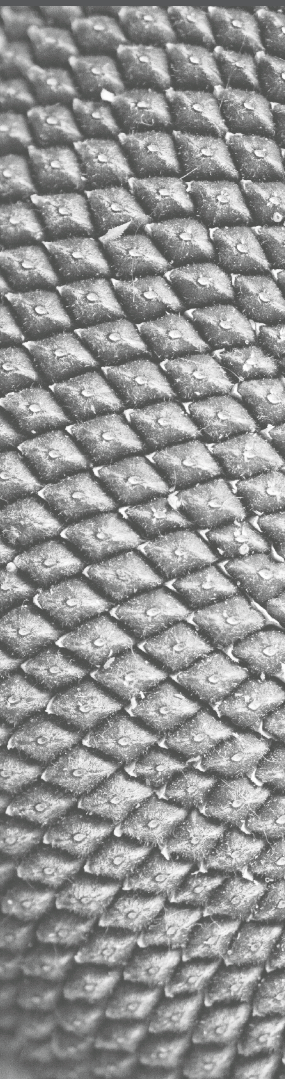


Introduction

The Post Entry Quarantine (PEQ) facility consolidates all post entry quarantine (PEQ) operations previously spread across Australia into one purpose built facility. The new PEQ facility provides international best practice in biosecurity, a safe environment for visitors and staff, and for the animals in quarantine. The facilities incorporate careful consideration of all animal welfare principles and ensures both plants and animals alike are accommodated in appropriate conditions and subject to best practice operating procedures.

1.1 Project need

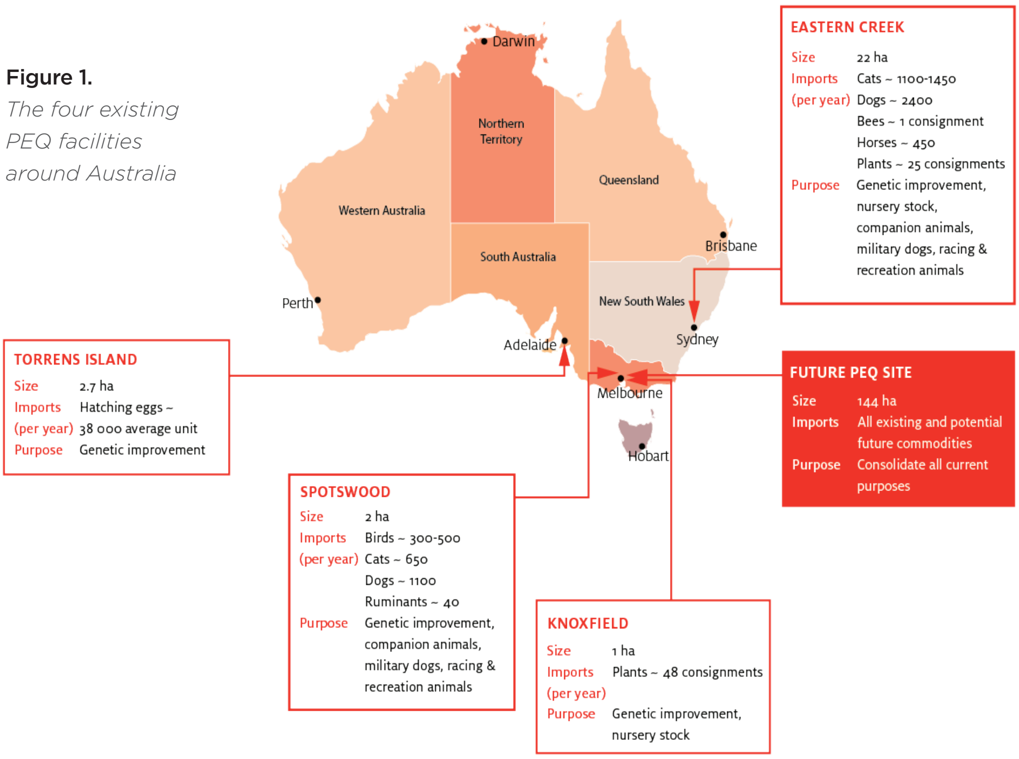
In 2008 the Federal Government commissioned 'One Biosecurity: A Working Partnership' (the Beale review) to investigate Australia's quarantine bio-security arrangements. At the time, the Department of Agriculture and Water Resources (DAWR) leased and operated four PEQ facilities around the country with leases expiring from December 2015 through to 2018.

These included:

- Eastern Creek, NSW
- Knoxfield, VIC
- Spotswood, VIC
- Torrens Island, SA

The Beale review recommended far-reaching changes to the country's biosecurity system, which the Federal Government supported, including new biosecurity legislation and funding to consolidate existing Post Entry Quarantine (PEQ) functions into a purpose built single integrated facility to replace all existing Commonwealth operations.

Figure 1.
The four existing PEQ facilities around Australia



1.2 Project timeline

The project was programmed to ensure that operational capacity was available in the new facility to match the expiring leases for existing facilities and the governments committed expenditure of the 7-year forecast. This required a staged approach to the construction works, with facilities to be operational as follows:

- **Bees** – April 2015
- **Horses, Cats, Dogs** – August 2015
- **Plants** – December 2015
- **Ruminants** – July 2017
- **Avian** – December 2017
- **Functioning Support Facilities** for plants, cats, dogs, horses and bees by December 2015
- **Functioning Facilities** for further cat and dog capacity, ruminants and avian by December 2018

1.3 Form of contract

CPB Contractors were engaged as Managing Contractor under a Defence MCC-1 2003 form of Contract to provide oversight during the finalisation of the design as well as manage the construction and commissioning of the new facility. The Design Services Consultant, Jacobs, was novated and CPB Contractors engaged a number of complimentary design consultants to advise on quarantine compliance and animal welfare among other things. The reasons for choosing this form of Contract were that it facilitates early contractor involvement, enables the Principal greater control and promotes a collaborative working relationship aimed at developing best for project outcomes.

1.4 Project scope

The Post Entry Quarantine (PEQ) facility consolidates all of the Commonwealth's previous quarantine facilities into a single, integrated and fit-for-purpose facility that meets contemporary quarantine standards and operations.

The PEQ facility has a gross floor area of over 50,000m^2, consisting of seven principal quarantine compounds and numerous administrative and support buildings across an 80-hectare site. PEQ operates 24 hours a day, seven days a week and is staffed by up to 150 people.

The facility includes:

- **Administration building** – up to 1900m^2 gross floor area (GFA).
- **Dog and cat receiving area** – up to 950m^2 GFA.
- **Avian compound** – up to 3800m^2 GFA.
- **Dog and Cat compound** – up to 10900m^2 GFA combined.
- **Ruminants compound** – up to 1800m^2 GFA.
- **Bee compound** – up to 220m^2 GFA.
- **Plant compound** – up to 8500m^2 GFA.
- **Horse veterinarian compound** – up to 85m^2 GFA.
- **Horse facilities** – two compounds accommodating up to 160 horses.

The project scope also included an extensive civil and services element throughout the expansive site, including:

- Construction of a new access road with a 4-way signalised intersection at Donnybrook Road.
- An all-weather perimeter fire and security track following the extent of the site boundary.
- Central Utilities Building (CUB) and site wide trunk service reticulation system.
- An area of EPBC-listed grassland located on the project site which needed to be retained and protected by a buffer zone of up to 25m and surrounded by protective fencing.

Site safety challenges

2.1 Interface of civil and building works

The PEQF project involved both a large amount of civil engineering and building trades working in close proximity and to a challenging staged program. Collaboration and meticulous planning was fundamental to achieving program objectives and to maintaining site safety. Controls put in place to mitigate risks associated with trades working in such close proximity across multiple work fronts included:

- Information boards, Vehicle Management Plan (VMP) boards and top 5 risk boards providing quick, accessible, and easily understandable information to all employees and escorted visitors right across the site
- At the beginning of the project, a key safety objective was separating people and plant. To best manage this CPB Contractors divided the site into approx. 13 "Zones". All bulk earthworks were programmed to be complete in each one prior to commencement of building trade activities. These can be seen in the site plans over page.
- After completion of the bulk earthworks all subsequent civil work within these zones was managed by having each building completely separated with full perimeter fencing, access was controlled with secure dedicated walkways and physical barriers separating plant activity. The progression of the bulk earthworks and building works throughout the site can be seen in the following site staging plans.
- The majority of the building works / activities occurred in the eastern half of the project so access and completion of civil works in this part of the site was made a priority. This minimised the need for major plant movement where there was significant construction activity and pedestrian movement.
- CPB Contractors co-ordinated the completion of all civil works within each "Zone" prior to handover of a any buildings to the Commonwealth. While completion of civil works was not required under the Contract to achieve completion of a separable portion or stage, CPB Contractors set this target and programmed the works accordingly to avoid any integration of plant and any other trade with Commonwealth and Industry stakeholders.

The adjacent image shows the **site layout soon after the site was established**. Red zones were primarily focused in the eastern part of the site where the majority of building work was located.

Civil and building teams worked closely to co-ordinate access into areas to facilitate both building and civil works. Regular coordination/ programming meetings were held and the issuing of site vehicle permits was tightly controlled to reduce the number of light vehicles permitted to drive on site.

Vehicle Movement Plans were displayed prominently and movement of personnel was tightly controlled with 'red zones' – pedestrian no-go areas with entry approval granted via two-way radio.

By late 2014 and early 2015, a number of building hardstands had opened up and the workforce had grown to in excess of 400 Construction Workers. Well over a kilometre of **dedicated and secured walkways** had been constructed to ensure the safe passage of all personnel on the site.

Site Layout - Mid 2014

Site Layout - Early 2015

By the middle part of 2015, site wide services were live including a High Voltage power feed – further restrictions were placed on any excavation or ground penetrating work all services were signposted and marked up on plans located at each VMP board.

It was at this time that individual buildings were being progressively completed and the Commonwealth began taking control of these areas for the purpose of operational commissioning. Strict governance and tightly controlled access protocols were implemented to ensure safe passage and coordinated emergency response procedures.

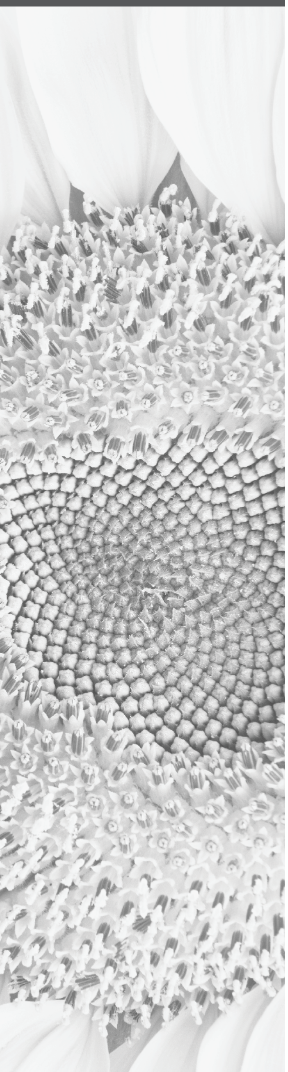
2.2 **Heavy lifting**

The project involved the construction of predominantly steel and concrete precast concrete buildings. Cranes ranging from mobile Frannas through to 200 tonne mobile cranes were regularly in operation on site in close proximity to people, plant and other buildings.

Ground conditions present a significant risk during heavy lifts. This was an even greater challenge at the PEQ site where approximately 45km of underground services had been installed including high and low voltage electrical conduits, communications conduits, stormwater services, pavement subsoil drainage, sewer and hydraulic services. Ensuring the integrity of in-ground services and the risk of ground movement / subsidence under the weight of heavy lifting equipment was critical.

CPB Contractors Construction Safety Essentials (CSE's) for heavy lifting requires that cranes must only travel and be set up on suitable ground – a certified geotechnical engineer must assess the ground conditions and advise on appropriate ground protection to ensure suitable support of crane outriggers. Subcontractors are required to supply geotechnical reports for all heavy lifts performed on site. They are also required to set up their own exclusion zones to eliminate the risk of unauthorised or accidental access during a lifting operation, and their own barricades to outriggers. This rigorous process of geotechnical ground reports is above industry standard and has set the benchmark for all CPB Contractors projects.

Prior to crane set-up CPB Contractors would verify the on-site requirements including location of outriggers relative to existing inground services, any changes to ground conditions (e.g. rain etc), and also coordinate the location of the crane to ensure vehicle and pedestrian access is relocated for the duration. In accordance with our CSE, any proposed crane lifts above 75 percent of the safe working load (SWL) of a crane is considered a heavy lift and needs to be verified by CPB Contractors with a lift plan. No lifts above 90 percent of the SWL are allowed.



2.3 **Electrical work**

The project included a significant scope of work for electrical services, with three scenarios in play at any one time:

1. Live services (high and low voltage, as well as communications, water and sewer)
2. Not live services (a cable installed within the conduit yet to be commissioned)
3. Conduits only (cable yet to be installed).

To minimise the risk of striking inground services, the following controls were put in place:

- HV marker pegs were installed across the entire line of HV power at 25m intervals.
- Energisation Boards were posted at each compound – these were updated regularly to reflect a change in condition, for example when cables were installed or when buildings and/ or cables are energised.
- A surveyor was engaged to consolidate all inground as-built information provided by site wide services contractors. The consolidated CAD file was distributed to subcontractors to assist them when trying to identify the location and proximity of services to their works.
- A GPS rover system was hired, using the consolidated as-built information to verify location of services prior to any excavation works.
- A service locator was purchased and employees trained in its use as another method for being able to verify location of services on site.
- Any change site condition was discussed during each mornings pre-start meeting.
- Penetration permits were revised to include a requirement for subcontractors to attend a dedicated pre-start/revalidation before working near live power
- Permit system implemented for access to certain live buildings based on risk.
- Prioritising and re-sequencing of excavation activities within the proximity of future services to take place prior to energisation of services
- Where the above could not be achieved extensive non-destructive digging was carried out and stabilised sand used as backfill to mitigate the potential for conduit damage.
- As both a safety initiative and a future-proofing mechanism, concrete backfill has been placed to high-voltage conduits where future road construction is planned.

An example of the complexity of undertaking electrical works within a large, busy site with multiple teams was the team that managed an excavation within 200mm of a 10m run of high voltage power in the Central Utilities Building (CUB) work area. This work was undertaken in close coordination with Jemena (power authority) and safety was ensured through the temporary closure of the vehicle thoroughfare. Staging, duration and timing of works was coordinated across the adjacent works areas to ensure site safety was maintained while ensuring no loss to the works program.

Design management & technical solutions

Through a comprehensive and detailed design management process including dedicated quarantine working groups, user consultation workshops, independent expert peer reviews, material sampling and facility prototyping, CPB Contractors developed a number of industry first and innovative technical solutions to best meet the projects functional requirements. A few of these are summarised below;

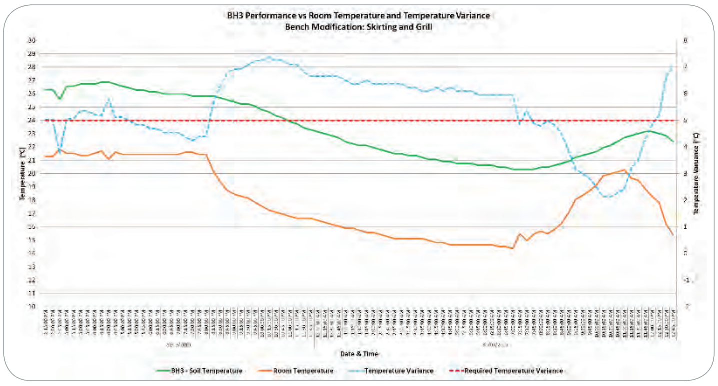
- In the Dog facility, the user brief was for a single-handed operation for the dog pen door so that the operators could open the door with a free hand to carry food bowl or blanket. Through a thorough investigation, it was discovered that there were currently no proprietary dog door handles or latches that facilitate a single-handed operation. Through a process of engaging with various industry experts and manufacturing companies, the project developed a series of samples and prototypes before landing on a preferred solution. The final outcome is a very robust, easy to clean, simple latch arrangement that has met and exceeded expectations

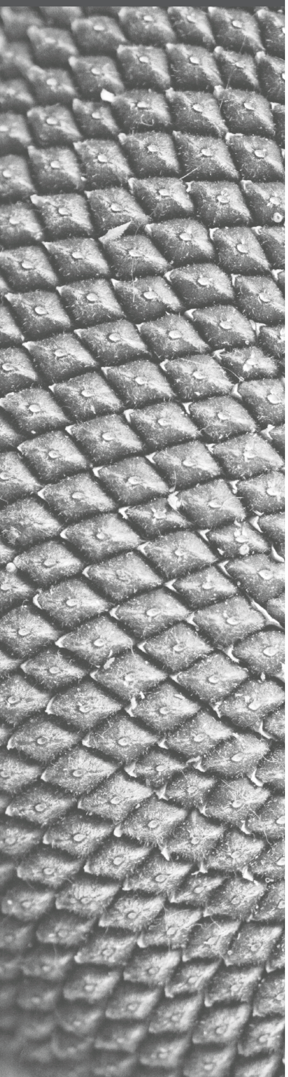
- In the Plant facility greenhouses, a number of plant benches needed to provide an additional heat source to warm the soil so that the delta between the room and soil temperature was greater than >5ºC. There are plenty of electronic heat mats on the markets, but very few that are suited to a QC2 quarantine environment where everything needs to be either disposable, capable of decontaminating through an autoclave or easy to manually clean. CPB Contractors proposed solution was to combine the Heating Hot Water Plant with a hydronic bench with a coil of pipe directly below the bench. The challenge was ensuring the system would provide sufficient heating capacity to reach the required temperature delta. CPB Contractors engaged with Powerplants Australia and developed a bench and coil design that was efficient to operate and easy to clean within the QC2 space. However, when tested through the operational commissioning period, it was found that soil temperatures were not reaching the required >5ºC variance. It was thought that the heating issue was due to air flow from the HVAC units displacing the heated air from the benches and rendering the hydronic heating ineffective. It was at this stage the CPB project team came up with some possible design solutions aimed at addressing the heating issue but maintaining the desired coil arrangement. These options were each tested under controlled conditions and the data analysed to identify the best solution – the team landed on a solution that met all key objectives and a permanent solution was fabricated and implemented for every hydronic bench.

Modification: *Skirting*

Modification: *Grill*

Example of the recorded trend data





- **In the cat facility**, the most efficient design to ensure thermal management, odour control and required air changes to the cat holding pens was to provide a fully conditioned service corridor, low air intake grill to the holding pen door and an exhaust fan in the cat pen to draw in the conditioned air. The challenge was finding a door grill that didn't have a myriad of crevices and cracks that are impossible to clean (not suitable in a quarantine environment), one that a cat couldn't harm themselves on or prematurely damage by clawing. Again, the CPB Contractor project team went about developing a customised solution that would meet every requirement – the solution was a perforated grill that was laser cut from a sheet of 316 stainless steel and then rebated into the door to provide an integrated kick plate and grill opening. The solution provided a seamless finish with no sharp edges that would harm a cat, no noticeable joins that could harbour dirt or grime (easy to clean) and the exact amount of open face area to provide the necessary volume of intake air.

3.1 Bee flight room design solution

In an effort to further inform the final design development and ensure fitness of purpose, CPB Contractors coordinated an inspection of the Eastern Creek Post Entry Quarantine Bee Compound on Wednesday 23 July 2014 and invited local Apiarist, Daniel Simmons, to talk through essential operational requirements as well as typical bee behaviour. The Eastern Creek site inspection highlighted the critical importance of providing an environment that supported the health and wellbeing of future bee consignments at the new PEQ facility.

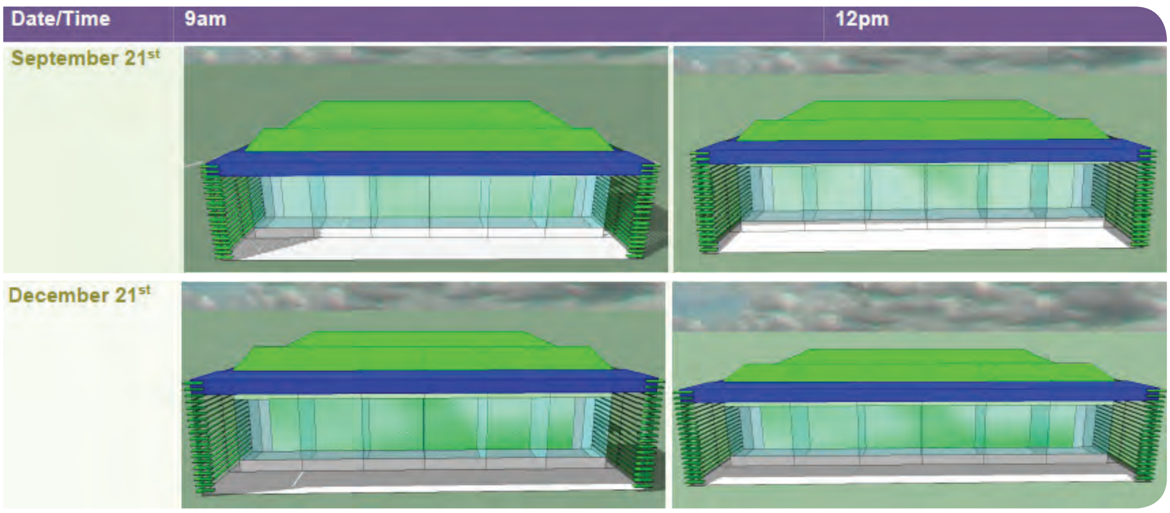
Key requirements for ensuring the quarantine stock's health and wellbeing included shelter from wind and rain, plenty of natural light and heat management. For users, the key requirements included ease of daily cleaning during the quarantine period. At this point, CPB Contractors noted some key concerns with certain elements of the current design that may not be conducive to meeting all these requirements.

The design for the bee compound included a solid canopy that extended over the northern face of the six flight rooms. This was the result of a Bee Compound Sun Shading Analysis previously prepared by Jacobs in July 2013, and was intended to provide complete shade to the flight rooms during the warmest part of the year, September to March, while allowing some direct sunlight into the flight rooms for the rest of the year. The primary intent being to moderate the thermal conditions in the naturally ventilated flight rooms.

From the discussions with Agriculture Apiarist, Daniel Simmons, and subsequent discussions with the Agriculture team more broadly, it was noted that permitting more sunlight into the flight rooms would be critically important to ensure the bee's wellbeing. Bees are attracted to light and primarily congregate in these areas. Appropriately designed, the flight rooms would permit far greater light at the northern wall allowing staff to enter the flight room from the door at the southern end away from where the bees would congregate.

Figure 2.

Example of solar study for the shoulder period (September) and Summer (December).



From the original design intent and the solar study previously prepared by Jacobs, it was evident that very little direct light would be achieved in the fight rooms during the warmer months when the quarantine period is typically conducted. Therefore, CPB Contractors decided to address this concern proposing two key design changes in an effort to introduce more light between September to March.

The recommended design changes included:

1. **Installing a low-light glazing panel to the bee flight room** – A glazed section on the lower section of the northern facade would permit light into flight room during the shoulder periods (September/October and March/April)

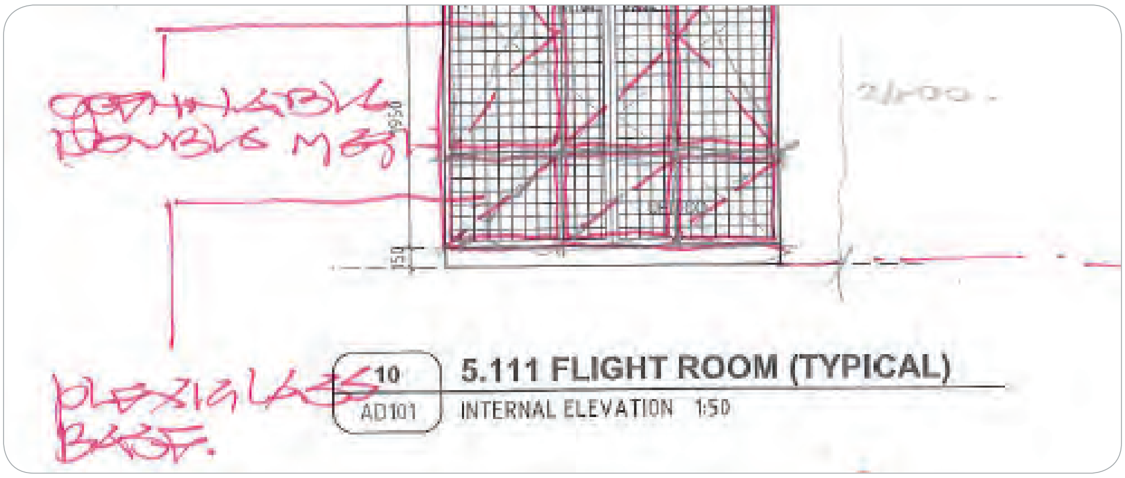


Figure 3. *Low-light glazing panel*

2. **Install a 1200 x 500mm skylight in the roof canopy** – The skylight would be strategically located to permit additional light into the northern end of the flight room during the summer period (November to February). By introducing a translucent plastic diffuser panel at the soffit level, we could also reduce heat transfer and help manage the flight room's thermal environment.

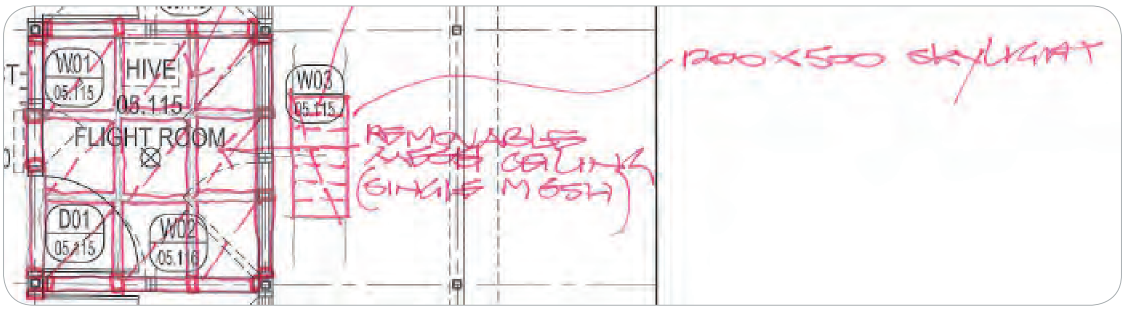


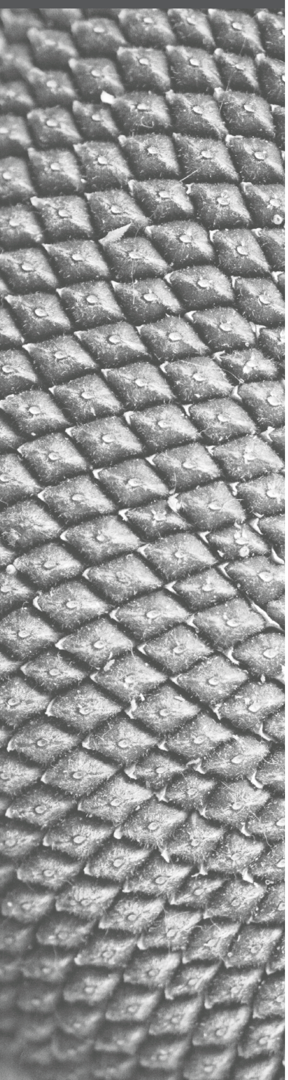
Figure 4. *Skylight in the roof canopy*

The original design specified a stainless steel woven mesh with an aperture (wire opening) of no more than 1000μm or 1mm. Following initial sampling and prototyping, the fine grade mesh proved flimsy and difficult to produce a taut/rigid finish. CPB Contractors also learned that fine grade woven mesh, including stainless steel, presented rust spots over time due to impurities picked up in the fabrication process.

The availability and cost of pickling and passivation proved prohibitive so alternate solutions were investigated.

CPB Contractors questioned the mandated aperture of 1000µm and soon learned this was not a requirement under the relevant Quarantine Approved Premises (QAP) Guidelines. Instead the team tested and trialled a number of mesh options, framing systems and installation details. A recommendation was made to adopt a powder coated Amplimesh product that had an aperture of 1500µm, allowing for a heavier gauge wire strand and improved mesh rigidity.

The research and testing undertaken by CPB Contractors, in its role as Managing Contractor, resulted in a number of key design changes to ensure the bee flight rooms not only facilitated safe and efficient operation but also supported the health and wellbeing of each bee quarantine consignment.



3.2 Avian QC3 Design Solution

One of the most challenging aspects of the PEQ facility, was the design and construction of the Avian QC3 containment suites and specifically the live bird rooms. Construction of level 3 bio-containment facilities (BSL3) is usually undertaken in a specialised panelling system such as the Dagard bio-containment panel system. However, in the case of the live bird rooms, this just wasn't going to be robust enough to withstand the conditions the finished product would need to handle, particularly the harsh environment caused by certain species reared on the floor, and not cages, and a cleaning regime that included square mouth shovels and harsh chemicals such as Virkon. To ensure the rooms achieved the required air tightness and robust finish that would not break down prematurely, CPB Contractors undertook an extensive investigation into all available materials including a complete whole-of-life assessment on what would present the best value for money. The result of this investigation proved that a concrete structure would provide the most durable and cost-effective solution, although achieving a lasting air tight seal with a material that is naturally porous and prone to cracking through building movement and thermal changes would be no easy feat. CPB Contractors went about developing a design and proving it through sample mock-ups and a complete scale prototype before works began on the main structure.

Through an extensive and rigorous design period, the team workshopped a number of solutions including:

1. A precast solution combined with in-situ columns that would be poured to form a stitch joint and a rigid concrete structure – the concern with this design was the risk of cracking at the connection that would compromise the critical air tightness requirement. (Monolithic Joint)

2. Poured columns and placement of precast panels with a compressible gasket that would provide an air tight seal but accommodate building movement – this solution was considered the most appropriate but required extremely tight tolerances that would be difficult for even the most capable and experienced contractor to achieve. (Gasket joint)

To further test the solution and develop the design, CPB Contractors proposed and managed a design and constructability review of the preferred concept through an Early Contractor Involvement (ECI) process with pre-qualified contractors shortlisted to tender the Avian Concrete & Precast and Avian Bio-Containment trade packages. The ECI process not only included the prospective trade package contractors but also the Design Services Consultant (Jacobs), subject matter experts (Scolexia), Quarantine Approved Premises Third Party Assessor (TPA) (AMEC Foster Wheeler) and Commonwealth stakeholders including independent bio-containment consultant, Neil Walls.

Through this process some improvements to the existing design, and an alternate and very credible design opportunity, was identified which CPB Contractors then tested through theoretical modelling. The monolithic and now equally preferred design option was an in-situ and precast joint that was bonded with an epoxy bonding agent and included an injection hose system. Once proven through theoretical modelling, The project team took the two preferred design solutions to the next stage of testing by way of two small sample chambers in an effort to drill down on a preferred design approach.

The sample test chambers were constructed to inform the most appropriate construction methodology based on the verification of the concrete performance, the ability to achieve the necessary construction tolerances and a final air leakage test to ensure the primary containment envelope would achieve the critical requirements of a level 3 bio-containment facility.

The design and construction methodology used in the sample test chambers demonstrated the two different structural joint options and is outlined below. Two separate test chambers were constructed using form-ply and Sikaflex, incorporating the structural joint prototypes in order to conduct leakage tests and subsequently rate the performance of each structural joint.

Sample 1: Gasket joint

The first concrete structural joint design involved precast panels and in-situ concrete compressing a memory foam gasket with ferrules. Refer to figures 5, 6 and 7.

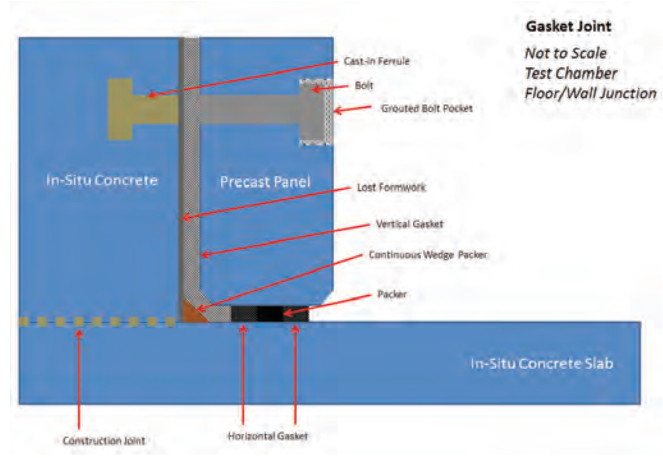


Figure 5. *Gasket joint – floor/wall junction*

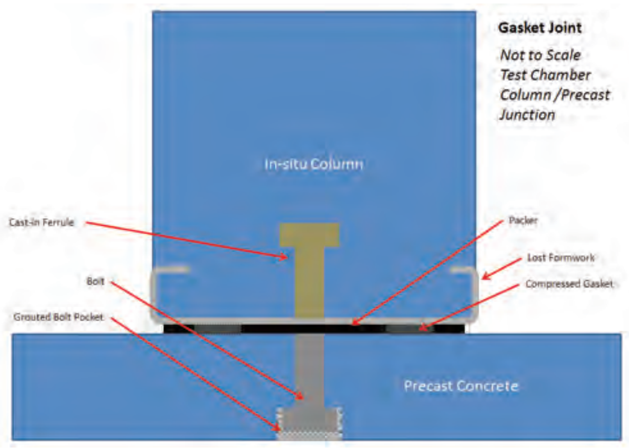


Figure 6. *Gasket joint – column/precast junction*

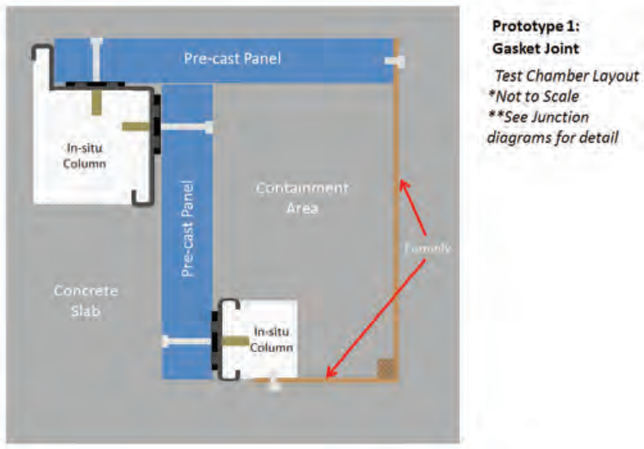


Figure 7. *Sample 1 – Gasket joint – test chamber layout*

Sample 2: Monolithic joint

The second concrete structural joint design (using standard construction methodology) involves the creation of a monolithic concrete joint between precast panels and in-situ concrete using an epoxy bonding agent with a secondary measure of an injectable hose (Sikafuko VT1) with integral valves for further sealing should it be deemed necessary during construction and/or throughout the lifetime of the structure. Refer to figures 8, 9 and 10.

A number of observations were made through these mock-up samples and qualitative risk assessment completed for each. The key observations for each sample are summarised below.

Sample 1: Gasket joint

- Gaskets were more durable than originally perceived, relatively easy to handle and place without causing damage during placement of pre-cast panels
- Gasket movement was identified following concrete placement
- The briefing required for the workforce was significant due to the complexity of the task and the non-standard construction methodology
- Considerable time was required to complete test chamber construction due to the complexity of joint detail. Gasket joint detail took approximately five times longer than the monolithic joint detail
- Misalignment of bolt holes and ferrules prior to compression of gasket meant it was very difficult to place the joint without considerable physical manipulation of pre-cast panels and formwork.

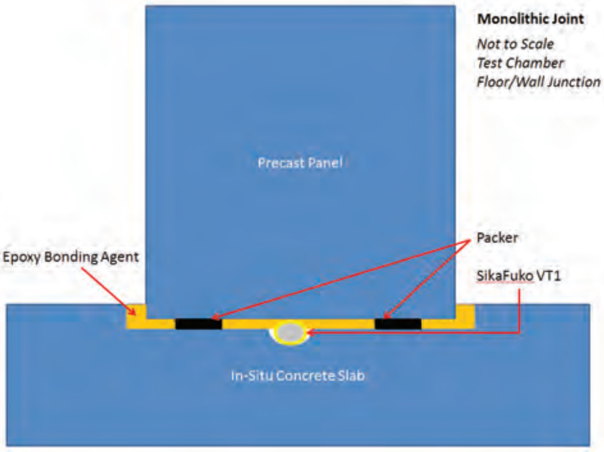


Figure 8. *Prototype 2 – Monolithic joint floor/wall junction*

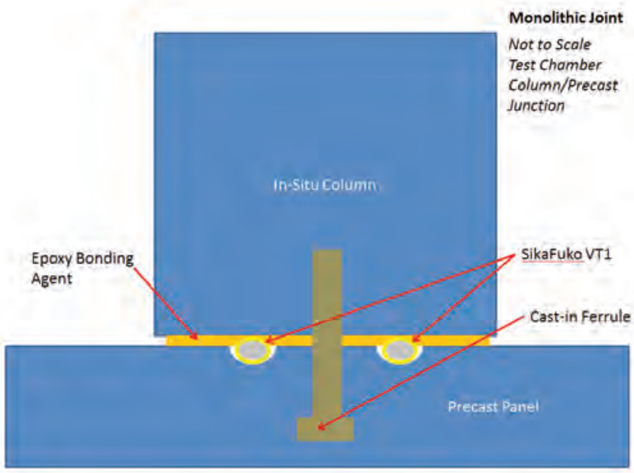


Figure 9. *Prototype 2 – Monolithic joint column/precast junction*

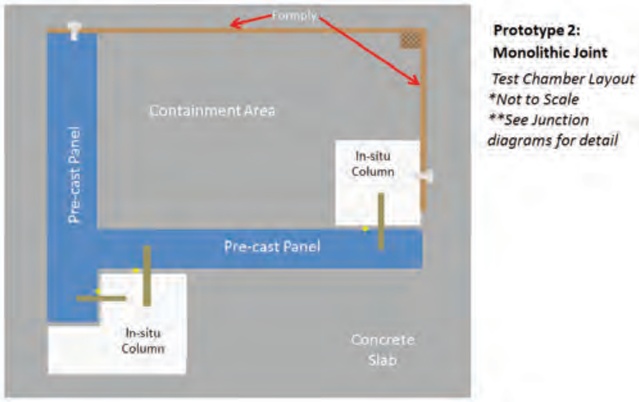


Figure 10. *Prototype 2 – Monolithic joint – test chamber layout*

Sample 2: Monolithic joint

- The detail followed traditional construction methods, making this solution quick and easy to construct. It also aligned with the existing skillset of workforce (placement of Sikafuko VT1, construction tolerances etc.)
- The tolerances required for this detail were significantly less than the gasket detail. Remediation work was required on rebate in bottom of slab although this was easily completed on site and didn't compromise the quality of detail or impact construction time.
- Placement of panels was a messy process with the epoxy bonding agent significantly displaced, leading to considerable clean-up.
- The limited working time of the epoxy once placed allowed for sufficient time to place reinforcement, form up and pour the in-situ column.

Figure 11. *Gasket joint – column/precast junction*

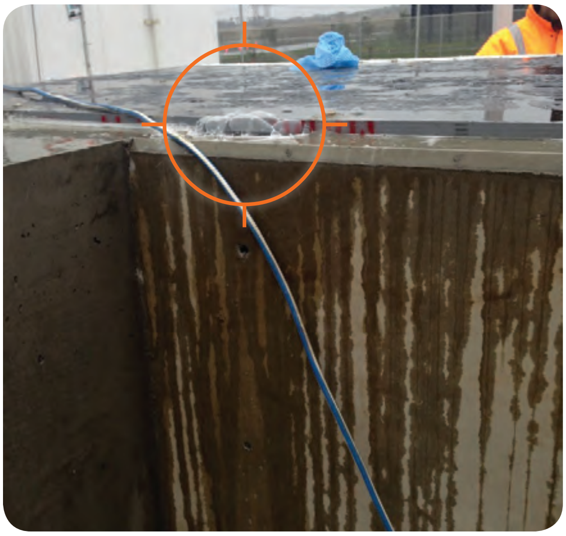


Figure 12. *Monolithic joint – column/precast junction*

Sample test chamber performance

The test chambers were constructed with form-ply sealed to the structure with silicone, leaving construction joints unsealed. The chambers were pressurized and any leaks identified in the form-ply structure were further sealed before recording the leakage results. Leakage tests were conducted at approx. 200-500Pa. The performance is shown in the table below.

	Prototype 1 (Gasket Joint)	Prototype 2 (Monolithic Joint)
Leakage (L/min)	15-20L/min	~<10L/min *unable to accurately measure
Identified Leakage Points	Significant leaks identified in construction joint in corner detail and vertical gaskets. No leaks identified in form-ply structure.	No leaks identified in construction joint. Small leaks identified in form-ply structure.

The results of these sample test chambers strongly supported the alternate monolithic construction detail although not without one significant query, *"What potential for cracking would the change to a solid connection create based on the anticipated concrete shrinkage and building movement?"*

There was also a concern that the strength of the epoxy bonding agent could result in structural cracking in the precast and in-situ elements and the injection system would become redundant. To address this issue, the monolithic solution was modified to a grouted connection that would allow small movement at the connection and enable the injection system to do its job and form an air tight seal at the connection. It was at this time that a flexible rubber membrane was workshopped to provide an additional seal and further certainty in achieving the necessary long term durable solution. A Sika product by the name of Sikadur Combiflex was investigated and deemed an appropriate material to provide a flexible, seamless and impervious membrane over every joint. This solution was worked into the design and a complete scaled down prototype of one entire containment suite was constructed as a final measure to prove the effectiveness, refine the construction methodology, set a quality bench mark for future reference and educate the construction team on the construction detailing. Figure 13 shows the model representation of the prototype that was constructed.

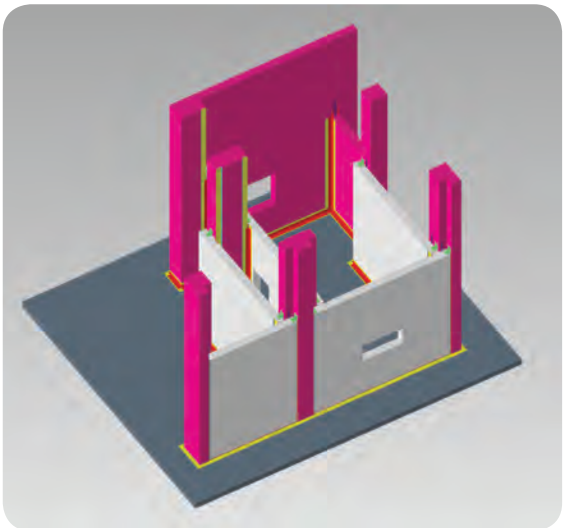


Figure 13. *Avian Prototype 3D Model*

Figure 15. *Leakage Testing*

Figure 14. *Constructed Avian Prototype*

Figure 16. *Completed Avian Bird Rearing Room*

3.3 Wastewater Decontamination Plant

The Avian QC3 / BSL3 Facility contains a specialised Wastewater Decontamination Plant (WDP) system which is located in the lower basement to collect and treat all waste from the five bird rooms located on the ground floor above. The WDP thermally decontaminates the QC3 liquid waste water, rendering the organisms present in the waste non-viable in accordance with the requirements of QAP 5.3 and AS/NZS 2243.3 Physical Containment Level 3 (PC3).

The WDP is a batch type system consisting of a:

1. Collection vessel (12,500L);
2. Heat treatment vessel (1650L) and;
3. Chemical treatment skid;

These are a particularly complex piece of plant and the proposed system for the PEQ facility underwent an extensive design and review process involving many different consultants, the department approved Third Party Assessor (TPA) and various Commonwealth stakeholders.

The project team identified early that the design and performance of this piece of equipment presented a significant risk to the project and invited a number of different suppliers to submit technical and commercial offers very early in the procurement process.

These offers were then assessed for technical compliance, value for money and ongoing whole-of-life considerations where local support and response times for maintenance call outs would prove to be essential to mitigate the risk of disruption due to plant downtime. Based in the UK, the successful supplier, Suncombe, was engaged under hydraulics subcontractor Geschke. The vessels were manufactured in Australia to conform to the relevant local standards for pressure vessels including the requirements for registration. However the engineering and controls components were manufactured overseas and assembled in the UK. To mitigate the risk of the equipment being delivered to site and not meeting the relevant performance requirements, CPB Contractors arranged for a complete Factory Acceptance Test (FAT) to be conducted at Suncombe's manufacturing facility in the UK. We than arranged for key members of the project team to attend including those from the Department of Agriculture and Third

Party Assessor. To ensure the final performance requirements were correctly validated, Suncombe's FAT protocol was developed to align with the testing that formed part of the final installation verification (IV) and operational verification (OV) process.

These tests generally consisted of the following:

- Verfication of installation and assembly in accordance with design specifications, AS Builts and Process & Instrumentation Diagrams (P&IDs)
- Thermal mapping to ensure correct temperature distribution within the tank during a steam cycle
- Manual operation of system
- Automatic operation of system
- Chemical decontamination process
- Failure scenarios – failed thermal cycle, loss of steam, power failure, high pressure, instrument failure.

The testing was conducted over a period of five days and helped to identify and resolve a number of technical issues prior to shipping the equipment. To the immense satisfaction of the client, this resulted in trouble-free commissioning and seamless consultant witness testing and verification process, one of the project's main technical challenges and a key risk to the successful completion.

Figure 17. *Wastewater decontamination plant system*

Figure 18. *Wastewater decontamination plant system*

Pioneer greenfield development

Some of the key challenges faced by the project team in delivering the earlier stages of the project included not having access to key utility Infrastructure, as summarised below.

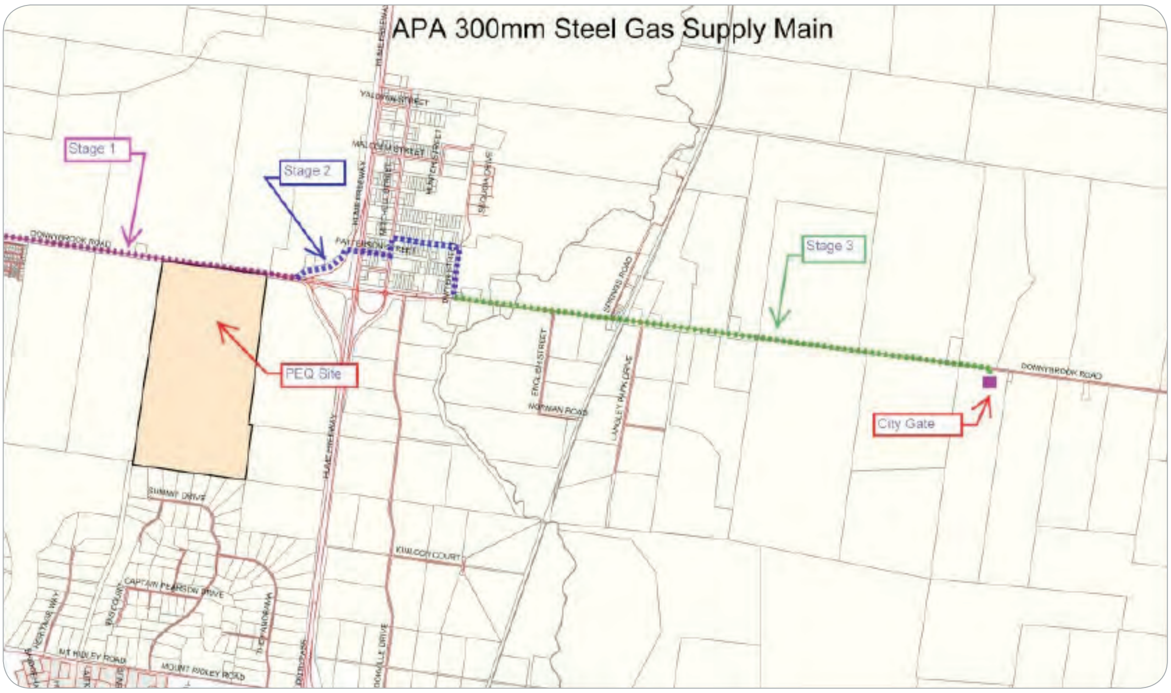


Figure 19. *Permanent gas infrastructure*

4.1 Mains gas connection

The permanent gas main to the PEQ site was served by a 300mm diameter gas supply main, which ran from the new City Gate substation located approximately 6km from the site and along Donnybrook Road, as depicted in Figure 19 above.

The gas main was initially scheduled for completion by January 2015, however it was not completed until February 2016. Gas was a critical utility required for the proper operation of the facility and served key mechanical and hydraulic infrastructure and equipment including:

1. Heating hot water boilers located in the central utility building
2. Domestic hot water units located in various buildings
3. Heating cooling and ventilation units (HCV) serving the greenhouses
4. Underfloor heating and dryers within the cats and dogs facilities
5. Steam plant located within the plants facilities

The project contained a number of key contractual milestones, which included seasonal testing of the greenhouses in peak summer and peak winter conditions. In order to satisfy the winter testing requirement, CPB Contractors had to investigate a number of alternative temporary gas solutions over several months including:

Option 1: Centralised bulk LPG storage (including equipment burner conversion)

Option 2: Distributed LPG bottles (including equipment burner conversion)

Option 3: CNG virtual natural gas main

Option 4: Distributed LPG storage (including equipment burner conversion)

Option 5: LNG virtual natural gas main.

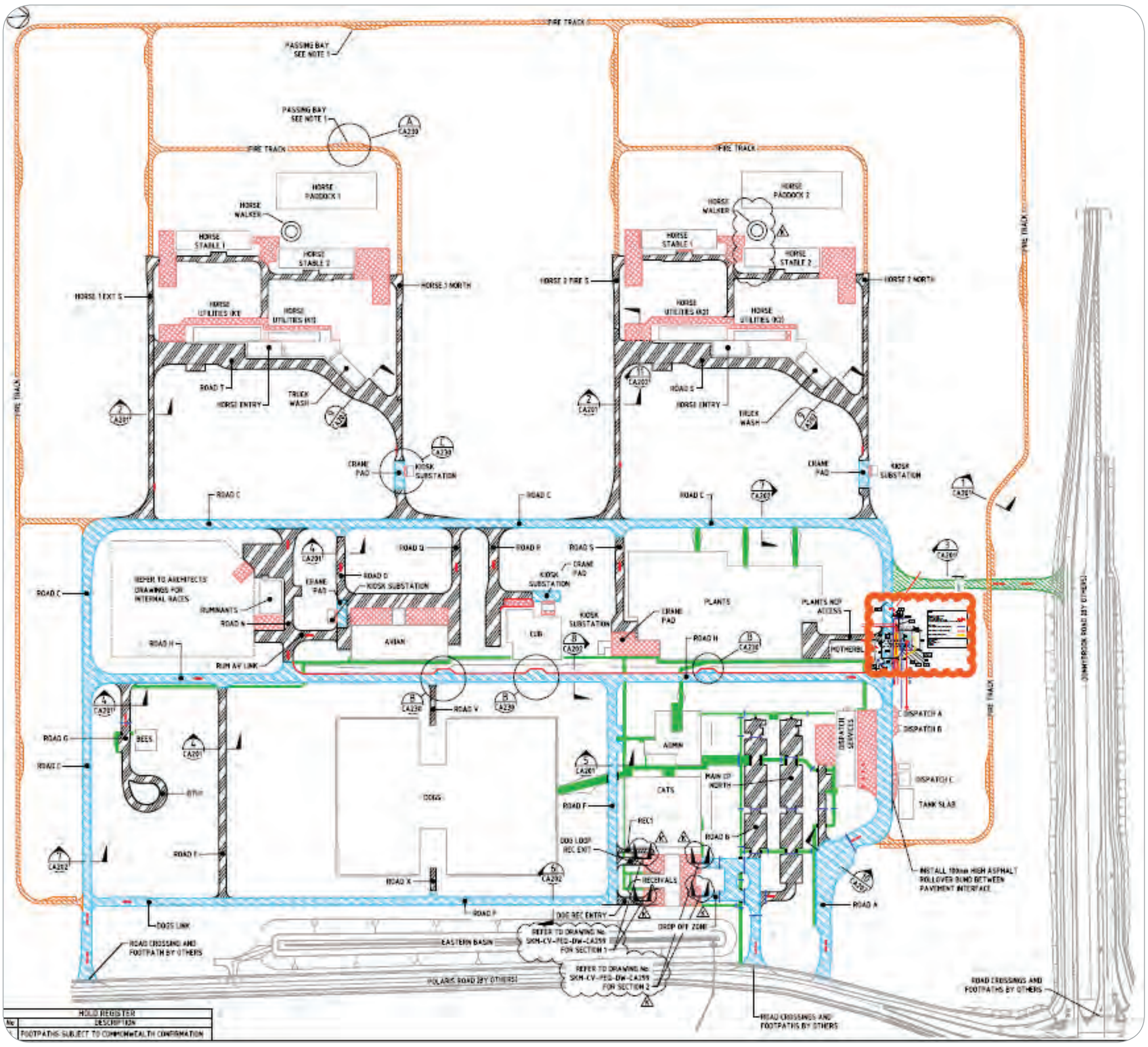


Figure 20. *Permanent gas infrastructure*

CPB Contractors recommended Option 5 – LNG virtual gas main, due to the benefits of timing, avoiding the need to convert any equipment and seamless transition to the permanent supply once it became available without impacting on Commonwealth operations. The process also required the engagement of a Specialist Dangerous Goods Consultant (AMOG) to analyse all relevant OH&S risks and ensure the delivery of the temporary infrastructure was in accordance with relevant Safety legislation and Comcare's requirements. The system was finally commissioned in August 2015, which allowed the seasonal testing to proceed and the facility to operate for several months before the permanent gas main became available in February 2016.

Figure 21. *PEQ temporary LNG plant*

Figure 22. *PEQ temporary LNG plant*

4.2 Water and sewer infrastructure

Permanent water infrastructure for the PEQ facility was reliant on the completion of relevant Authority Works which were also contingent on the resolution of a number of factors outside of the project's control, including the Execution of a Development Deeds and completion of various land divestment processes between the Commonwealth, relevant authorities and other stakeholders. This required CPB Contractors to implement a range of mitigation strategies to ensure summer seasonal testing could occur in the Greenhouses. As such a number of temporary service connections had to be implemented, including;

1. Temporary water storage and early energisation of site wide booster system
2. Back feeding the recycled water network with temporary water supply, including appropriate backflow prevention devices
3. Temporary sewerage tanks and ongoing pump outs.

4.3 ICT integration

The original project scope only allowed for passive ICT infrastructure including a site-wide fibre optic back bone (dual redundancy), fibre optic break-out tray (FOBOT), and racks and cabling infrastructure within each building. However it did not include any active equipment such as switches, servers, etc. to support the facilities' site-wide building systems.

This scope gap was identified as a risk as part of the initial trade package procurement process and led CPB Contractors to deploy a temporary local area network (LAN) to facilitate the commissioning of the relevant building systems in time for each handover and DAWR's subsequent operational commissioning activities.

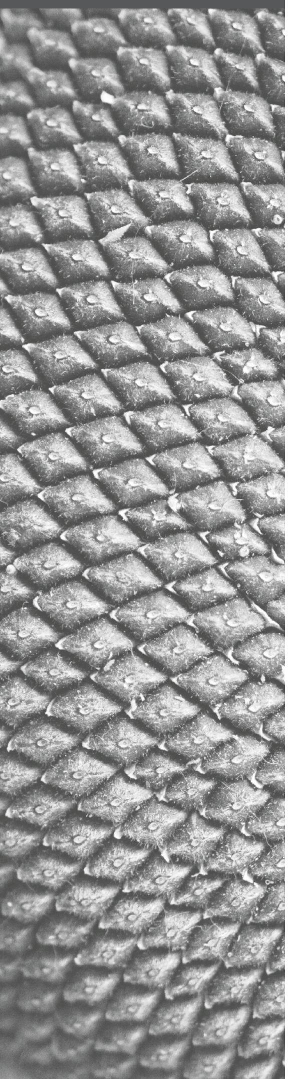
CPB Contractors were also later engaged by the Commonwealth to investigate a number of alternative strategies as part of the development and implementation of the permanent LAN, which resulted in the delivery of a fully integrated converged network solution to support the site's BMS, security, energy metering, lighting control, emergency lighting and master clock, with voice/data and wireless services supported off a separate network deployed by DAWR.

Conclusion

This technical paper provides an insight into some of the key challenges CPB Contractors faced on the PEQF project and the highly innovative technical solutions developed for the design and construction of such a large, complex facility.

CPB Contractors' solution for the PEQF project demonstrates that outstanding results can be achieved with the right people, an approach focused on transferring lessons learnt, a commitment to challenging design assumptions, thoroughly researched alternate approaches and developing a truly collaborative partnership with project stakeholders.

CPB Contractors is particularly proud of our achievements in delivering the PEQF and we believe this project has set new standards for similar facilities in Australia and around the world.



CPB CONTRACTORS

Contact for submission
Sebastian Ward | Project Manager
Sebastian.Ward@cpbcon.com.au
0400 906 699

Post Entry Quarantine Facility

Australian Construction Achievement Award
STAGE TWO SUBMISSION

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