CONSERVATION ASSESSMENT OF KRAUSS DISPLAY OPTIONS

KRAUSS TRAM DISPLAY BUILDING BUDERIM QLD

CLIENT:
SUNSHINE COAST COUNCIL

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1. Introduction

Evaluating display options for the Krauss involves balancing future preservation requirements with present day public access. The tram has excellent interpretive potential, and the proposal to display the tram at the Lindsay Road site is very relevant to the history of the tram. The Krauss has been substantially but sympathetically reconstructed, and original fabric remains beneath the new paint coating. The display has support within the local community as a result of the very proactive efforts of the Buderim Palmwoods Heritage Tramway Inc. (BPHTI), who have built a walking track along the tramline, meticulously researched the tram's history, and carefully implemented a very well documented restoration of the Krauss.

How important is the tram? What resources and efforts have already been invested into its care? For how many years should it be preserved? Which fabric is significant and which fabric is replaceable? What standard of care is affordable and typical of similar large technology objects? What resources are available for its ongoing care? To what extent is access and preservation supported by the various building options?

Factors that will inform this decision include: significance, cost, lifespan (as determined by inherent vice and preventive factors), ongoing maintenance, safety, building size and design, Building Code of Australia (BCA) requirements, plus the size and viability of the proposed site.

2. Site and Building Size Requirements

Available Building Footprint Area
SCC advise that the surveyed area of the site is 10.8m deep from kerb to rear boundary x 14.5m wide from kerb to kerb.

Dimensions of the Amenity Component
SCC advise that the absolute minimum dimensions of the amenity component are 4.3 x 6.6m.

Dimensions of the Krauss Tram
BPHTI advise that the Krauss Tram dimensions are L 6.5786m, W 2m, H 3.2004m.

Wall display depth zone
SCC advise that 250mm allowance is required for all walls, including glass walls which still require a deep lintel and frame.

Crime Prevention Through Environmental Design (CPTED) requirements
The building must meet CPTED requirements such as ensuring clear visibility of toilet entrances.

Circulation zone within the display area
If visitors are entering the display space, 1.8m wide is the minimum circulation zone. This allows 2 wheelchairs to pass as per Australian Standards and BCA requirements. If visitors

are not entering the glazed display space, no extra circulation zone is required within the display area.

Footpath circulation zone surrounding building
SCC advise 1.8m is required as a minimum circulation.

Protection zone
A protection zone of 1m around the tram is recommended from a conservation point of view. This amount of room provides enough space for housekeeping, and allows for a ladder or scaffold to be used for maintenance etc. It ensures that injury doesn't occur when walking close to any sharp of protruding areas of the object, and dusts are minimised. Internal dimensions of the display would therefore need to be:

8.6 length x 4m wide x 3.7m high.

Building lifespan
SCC advise that the building lifespan is 25-50 years. The display and conservation requirement are that the Krauss is maintained in a stable condition and has an acceptable appearance for this amount of time.

3. Historical Significance and the Appropriate Level of Environmental Control

It is often not financially viable or practical to store large technology objects in usual museum conditions, particularly for smaller museums. With this in mind, The Museums and Galleries Commission (MAGC) in the UK have published Standards in the Museum Care of Larger and Working Objects. These standards acknowledge these constraints, and can be used as a guide for the care of the Krauss. The Commission recommends environmental control levels based on the significance of the object as follows:

"Category A: Tight Control
Objects which are internationally significant, or nationally very rare and vulnerable.

Category B: Moderate Control
Objects which are nationally significant or regionally rare or internationally important but robust.

Category C: Simple Control
Objects which are locally significant and/or central to the museum's collection or display and activities.

Category D: Basic Control
Objects which are useful for demonstration."
(Museum and Galleries Commission, 1994, p84).

A significance assessment has been conducted, and the Krauss has been assessed as Locally Significant (Mewes, D. 2016). This indicates that simple control is adequate. The Krauss is currently stored outdoors underneath a roof shelter with open sides and covered by a

tarpaulin. This provides some minimal protection from the elements. Rehousing the tram in any of the proposed structures in this report will provide a greater degree of protection than it currently has, although the degree of protection is variable.

Comparison can also be made to the standard of care of similarly significant large technology objects at other locations in Queensland. In many cases these objects are poorly stored and deteriorating at a faster rate than is desirable. The standard of storage of these objects is usually directly related to the availability of resources and finances, rather than the objects requirements. The standards of Simple Control as described by the MAGC are outlined below:

"Category C: Simple Control
Where simple control is appropriate the building forms the primary, and perhaps only, means of providing a stable environment. Where this level of control is appropriate maintenance of buildings must have a high priority and adequate funds should be included in the budget.

Condition of object/collection
A programme of annual object condition checks is in operation. This work should be undertaken by a conservator or other person experienced in caring for the object type.

Environmental monitoring
The environment of all display, storage and conservation areas is monitored. This may be done by using recording devices or by a regular programme of spot readings. A programme of analysis and interpretation of the collected data should be in place.

Environmental control:

Relative humidity
Relative humidity is maintained within a band of +/- 10% of the daily average for greater than 75% of the time. Good draught proofing, insulation, building maintenance and, where appropriate, local humidification or dehumidification should enable this to be achieved.
The *rate of change of relative humidity* should, as a general rule, not be greater than the equivalent of 10% in a 24 hour period. Repeated sharp fluctuations in relative humidity should not occur. As a rule, any event repeated with a frequency of greater than once in 24 hours should be investigated and steps immediately taken to identify the cause and to rectify the problem.

Temperature
In occupied buildings the temperature should be maintained between 16°C and 19°C to meet legal requirements. In unoccupied or infrequently used buildings the temperature can be allowed to fall to 7°C and be controlled by a humidistat rather than a thermostat.

Light
Daylight is not allowed to fall directly on objects. Blinds and filters are fitted to the

windows of all rooms where objects are stored or displayed. All light is excluded except for periods of display or inspection. The elements of objects which are most vulnerable to damage by light should receive special protection. Light is excluded when the building is closed and/or not in public use.
Objects should be exposed to no greater than l0µWatts per lumen of UV radiation from all sources of daylight and electric light combined. The performance of UV filters fitted to lamps, windows, skylights etc. should be checked every 6 months during the first five years of use and monthly afterwards.

Pest control
An integrated pest management programme is in place. This involves good building maintenance, a thorough cleaning programme, exclusion of sources of risk, e.g. food and drink, and monitoring and trapping of pests.

Air quality
The building can act as an effective buffer to protect from external air pollutants if air infiltration has been reduced. A "building within a building" and display cases having reduced air exchange, can provide a higher degree of protection.

Maintenance plan
A planned preventive maintenance programme is in place for all buildings and equipment. A programme of servicing and calibration of monitoring equipment is in place. Frequency of servicing and calibration will vary according to the type of equipment used but in general thermohygrographs should be cleaned and calibrated every two months and/or whenever moved.

Documentation
All procedures are logged and data is available in a readily accessible form.

Quality control
A programme of continuous monitoring and assessment of performance of all the above is in place together with a scheme to evaluate and revise all operational procedures."
(Museum and Galleries Commission, 1994, pp 88-89).

4. Description of Building Options

This assessment of building options is based on the assumption that conservation recommendations are followed, as outlined in Conservation Specification, Krauss Tram Display Building Buderim Qld; in particular the Conservation recommendations for appropriate building fabric and construction materials as outlined in Section 9 (Fihelly, M, 2017, pp. 20-26). All costings are estimates only as there are many determining factors that could contribute to these figures.

4.1 Concept Design – Buderim Design Studio (2015)

Description
Floor to ceiling glazing that encloses all of the main Krauss display area

- North glazed surface is buffered from the environment and protected from light by the adjoining toilet block structure.
- South East and West glazed surfaces receive direct sunlight.
- Unsealed with ventilated opening at the ceiling to allow airflow.
- Display is part of the same structure as the toilet block.
- Uninsulated ceiling cavity.
- Sliding doors extending down each side of the tram.

Conservation Assessment of Building Envelope:

Temperature:
Unable to maintain temperature within the required range.

RH:
Unable to maintain RH within the required range.

Light:
Unable to maintain light levels within the required range.

Pest:
Unable able to protect from pests and vermin.

Air Quality:
Unable to protect from dusts and external pollutants.

Potential to include associated collection materials:
Insufficient space and not recommended due to environmental conditions.

Floorplan and Block size:
Fits on the proposed building site. This building measures 8410l x 2608w x 2962h inside the display space. Extra space is required within the display case. The proposed 30cm gap between the tram and the glazing is insufficient. There is insufficient space within this display area for safe access and maintenance.

Safety:
SCC advise that orientation should be changed to an East West axis for CPTED safety reasons.

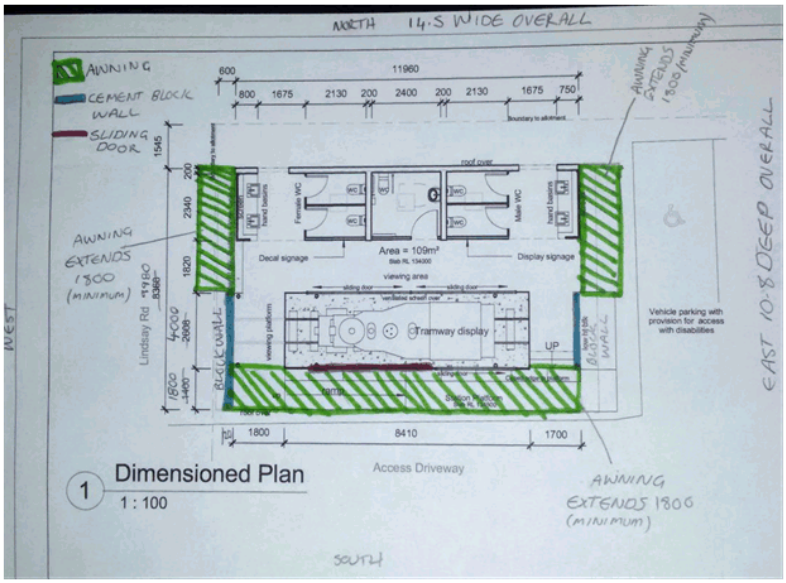
Preservation Maintenance and Housekeeping Actions:
Please see the table in Section 5 for details.
A very high level of routine maintenance and preservation housekeeping will be required. The paint coating is expected to fail in these conditions, leading to accelerated corrosion. A large scale restoration of the paint coating will likely need to be undertaken every 15 years if a high quality paint is used; and every 10 years if low quality paint is used.

Ongoing Preservation Maintenance and Housekeeping Cost:
First year: $1989
Ensuing years: $180 p/a
Cost after 40 years: $9175.80

Environmental Control Equipment and Cost:
Equipment cost = $0
Major restoration cost x 2 = $60,000

Estimated time before major restoration/conservation treatment is required:
15 years.
The Krauss can't be maintained in a stable condition for the lifespan of the display building if kept in this environment. If the Krauss had been assessed as having a lower level of historical significance; then poorer storage, poorer physical condition, and its use as a demonstration object with a shorter lifespan could be justified. However these factros could make it unsuitable for selection in a display building with a 25-50 year lifespan.

4.2 Concept Sketch by Melanie Fihelly:



Description

- Floor to ceiling glazing that encloses all of the main Krauss display area
- North glazed surface is buffered from the environment and protected from light by the adjoining toilet block structure.
- Display is part of the same structure as the toilet block.
- Cement block on the West and East side of tram display to block light
- Enclosure of the South, West, and East walls would be ideal, but partial enclosure of just the East and West walls would be approaching an adequate scenario from a conservation point of view, and would significantly improve the display potential.
- Awning extending 1800cm out from building perimeter at south, partial awning at west and east sides.
- Extra sliding door to extend access to all of the south side of the display case.
- Seal display area so that it is unventilated at the roof.
- Install Dehumidifier
- Insulate roof
- Extra space of 1m is required as a protection zone around the object.

Conservation Assessment of Building Envelope:

Temperature:
Able to maintain temperature approaching the required range, and better than other large technology objects in Queensland.

RH:
Able to maintain RH within the required range.

Light:
Unable to maintain light levels within the required range, however light ingress will be significantly reduced by the window film, walls, and awning, so that levels are less than similar large technology objects in Queensland. The extent of glazing is increased as a result of the building re-orientation, and this will increase light ingress and heat load. A rib wall that extends a minimum of 1m along the south side from the west wall is recommended to reduce the amount of strong afternoon light from the West. The South side will be more damaged by light than other sides. The most light affected fabric will be the replaceable restoration paint film and not original fabric. All original light affected fabric such as the rubber hose should either be removed, or covered during display. One option would be to wrap the hose in an inert, colour matched, cotton sleeve. In these circumstances, this light level could be considered adequate.

Pest:
Able to protect from pests and vermin.

Air Quality:
Able to protect from dusts and external pollutants.

Potential to include some associated collection materials:
This is possible from a preventive conservation point of view, but unfortunately the available space is insufficient.

Floorplan and Block Size:
The dimensions are 13.90m x 15.51m. From a Conservation point of view, a 1m protection zone is recommended around the tram for cleaning, access, and future maintenance work to occur to the tram. Unfortunately there is insufficient room on the site for a building footprint of this size.

It would be possible to minimise this protection zone around the object so that it could fit on the block if the sliding doors were opened at all times when routine preservation housekeeping, maintenance and repairs were occurring. This would allow the building to fit on the proposed block. However, this could prevent access to part of the toilet block every time the tram was cleaned, which may create access issues for toilet patrons, and security issues for the tram and volunteers. Further thought could be given to potential ways of managing this scenario.

Each time the doors are opened, external climate will enter the space, creating a high environmental fluctuation event at non ambient times of the year. As a result, the dehumidifier will switch on for a long period of time to bring the display space back to equilibrium after every access event. Pests, outside pollutants, dust, dirt, and debris will also enter the space at this time, particularly on windy days. This would not be ideal, but could be managed by an intensive cleaning regime. From a Conservation point of view, it

may be worth reducing the protection zone if it means that all other aspects of storage can be upgraded from the trams current outdoor site.

Safety:
Not Safe in terms of CPTED – toilet access is at the rear of the block where entrances have poor visibility.

Preservation Maintenance and Housekeeping Actions:
See table in Section 5 for details. A standard level of routine maintenance and preservation housekeeping will be required. The paint coating will eventually fail in these conditions, and a large scale restoration of the paint coating will need to be undertaken every 30-40 years (if high quality paint is used). Once the paint coating fails, corrosion will be slowed if humidity is able to be maintained within the desired range and the paint coating is made sound again.

Ongoing Preservation Maintenance and Housekeeping cost:
First year: $1989
Ensuing years: $180 p/a
Cost after 40 years: $9175.80

Environmental Control Equipment and cost estimate:
Dehumidifier purchase cost = $5350 + $120 + GST = $6017
Annual dehumidifier running cost = $400 - $600 p/a
Dehumidifier running cost over 40 years = $16000 – $24,000
Total Dehumidifier cost over 40 years = $22,017 - $30,017

Dehumidifier:
Information, pricing and approximate running costs for the MC 150XD industrial grade dehumidifier. Based on an expected average room condition of 26degC/45%RH.

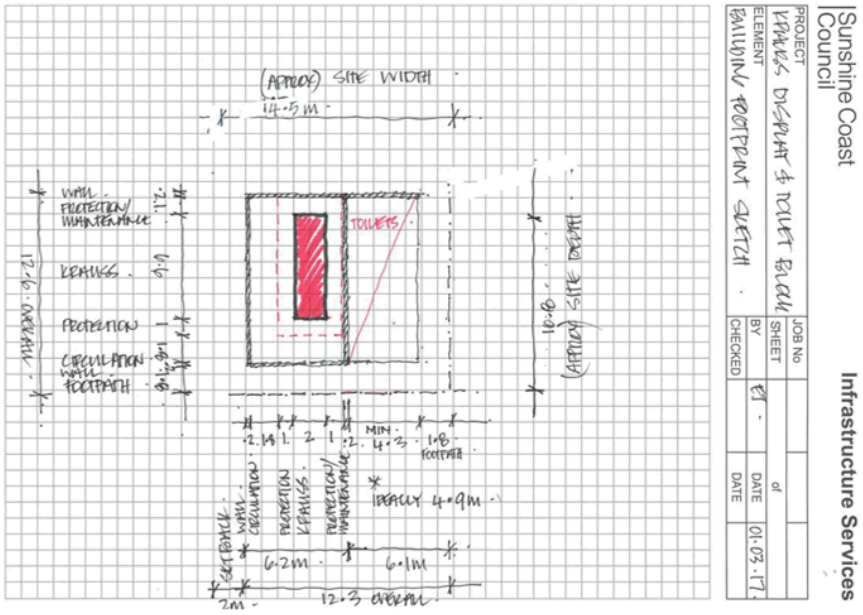
MODEL: MC150XD
PRICE : $5,350.00 + GST
AVAILABILITY : Ex-stock Sydney
FREIGHT : $120.00 + GST

Installation would be as simple as plugging it in (240VAC) and running an 80mm diameter flexible duct/hose to another room or preferably outdoors (somewhere where high humidity is not an issue).
Estimated running costs (power) would be around $400 to $600 per year.
This is an estimation only as there are many determining factors that could contribute to the latent load in the room.
The inbuilt humidistat will control the unit so that it only turns on as required to maintain whatever set point is chosen.

Estimated time before major restoration/conservation treatment is required:
30 – 40 years.
It is adequate (but not ideal) to have the South face glazed and visible if there were large awnings and a screen extending down from the roof to reduce light.

This would be an improvement on the Krauss current storage situation, and better that the storage of similar large technology objects in Qld. This display would be acceptable if the restored paint was regarded as sacrificial, and sensitive associated collection items were displayed elsewhere, as it is the non original fabric that is most at risk. However it does mean maintenance will be required down the track, or else that deterioration of non-original paint must be accepted as a part of the Krauss' future appearance.

4.3 Concept Design SCC (2017)



Description

- Reorientation of the building to an East West axis.
- Walls can be cement block on the North and East side, and one of either the South or West sides.
- Enclosure of the North, West and East walls would be ideal, but enclosure of just the North and West walls would be adequate from a conservation point of view, and would significantly improve the display potential.
- Awning extends 1.8m out from the roof on the south side.
- Seal display area so that it is unventilated at the roof.
- Install Dehumidifier
- Insulate roof and walls.
- Sliding glass door on each side for access and to ensure there is 1m space available around for access and any future maintenance works to occur to the tram.

Conservation Assessment of Building Envelope:

Temperature:
Able to maintain temperature approaching the required range and better than many other large technology objects on Queensland.

RH:
Able to maintain RH within the required range.

Light:
Unable to maintain light levels within the required range, however light ingress will be significantly reduced by the window film, walls, and awning; so that levels are less that similar large technology objects in Queensland. The South side will be more damaged by light than other sides. The most light affected fabric will be the replaceable restoration paint film and not original fabric. All original light affected fabric such as the rubber hose should either be removed, or covered during display. One option would be to wrap the hose in an inert, colour matched, cotton sleeve. In these circumstances, this light level could be considered adequate.

Pest:
Able to protect from pests and vermin.

Air Quality:
Able to protect from dusts and external pollutants.

Potential to include associated collection materials:
This is possible from a preventive conservation point of view, and also possible if the space is extended in the East West direction.

Floorplan and block size:
12.3 x 12.6m. The building does not fit on the block unless the conservation protection zone around the tram is reduced. It is not ideal to eliminate the protection zones, but this can be done if a large door extends across the entire South side for maintenance access, and visitor's behaviour within the space is carefully managed and supervised. The rear of the tram will be extremely cramped, with only a 20cm gap between it and the north wall. Not all of the tram will be safely accessible for maintenance, and lack of housekeeping will increase pests and dusts affecting this part of the object. However, from a Conservation point of view, it may be worth reducing the protection zone if it means all other aspects of storage can be upgraded from the trams current outdoor site.

With only a 20cm gap between the tram and the wall, it will be very difficult to install the tram into this space, without crashing into the wall on the north side. If the wall is built around the tram once it is in situ, it might not be possible to build without damage to the tram, or injury to construction workers. A Builder could advise on this.

SCC advise that there is not enough room for an assembly point for tour groups on this block of land. As the building has minimal setback from the street, and no room for an assembly area at the South Side, there is a safety issue at the road edge.

Safety:
Safe in terms of CPTED - orientation changed to an East West axis so that toilet entrances are visible.

Preservation Maintenance and Housekeeping Actions:
See table in Section 5 for details. A standard level of routine maintenance and preservation housekeeping will be required. The paint coating is expected to fail in these conditions, and a large scale restoration of the paint coating will need to be undertaken every 30-40 years (if high quality paint is used). Once the paint coating fails, corrosion will be slowed if humidity is able to be maintained within the desired range and the paint coating is made sound again.

Ongoing Preservation Maintenance and Housekeeping cost:
First year: $1989
Ensuing years: $180 p/a
Cost after 40 years: $9175.80

Environmental Control Equipment and cost:
Dehumidifier purchase cost = $5350 + $120 + GST = $6017
Annual dehumidifier running cost = $400 - $600 p/a
Dehumidifier running cost over 40 years = $16000 – $24,000
Total Dehumidifier cost over 40 years = $22,017 - $30,017

Dehumidifier:
Information, pricing and approximate running costs for the MC 150XD industrial grade dehumidifier. Based on an expected average room condition of 26degC/45%RH.

MODEL: MC150XD
PRICE : $5,350.00 + GST
AVAILABILITY : Ex-stock Sydney
FREIGHT : $120.00 + GST

Installation would be as simple as plugging it in (240VAC) and running an 80mm diameter flexible duct/hose to another room or preferably outdoors (somewhere where high humidity is not an issue).
Estimated running costs (power) would be around $400 to $600 per year.
This is an estimation only as there are many determining factors that could contribute to the latent load in the room.
The inbuilt humidistat will control the unit so that it only turns on as required to maintain whatever set point is chosen.

Estimated time before major restoration/conservation treatment is required:
30-40 years

4.4 Fully enclosed cement block building (on a new site, or a small room within a museum)

Description

- Building can be constructed on either axis.
- Cement block walls on all sides.
- Fully enclosed and well-sealed.
- Install Dehumidifier.
- Install Air-conditioning.
- Insulate roof and walls.

Conservation Assessment of Building Envelope:

Temperature:
Able to maintain temperature better than the required range. In this building envelope, air conditioning will not be necessary for much of the year.

RH:
Able to maintain RH better than the required range.

Light:
Able to maintain light levels either at or better than the required range.

Pest:
Able to protect from pests.

Air Quality:
Able to protect from dusts and external pollutants.

Potential to include associated collection materials:
Possible from a preventive conservation point of view, and sufficient space.

Floorplan and Block size:
Space within the display for access and maintenance.

Safety:
Safe - orientation changed to an East West axis so that toilet entrances are visible.

Preservation Maintenance and Housekeeping Actions:
See table in Section 5 for details.
A standard level of routine maintenance and preservation housekeeping will be required. The paint coating is expected to be maintained for 50 -60 years in these conditions, and a large scale restoration of the paint coating will need to be undertaken after this time (if high quality paint is used; Once the paint coating fails, corrosion will be slowed as humidity is maintained within the desired range and the paint coating is made sound again.

Preservation Maintenance and Housekeeping cost:
First year: $1989
Ensuing years: $180 p/a

Cost after 40 years: $9175.80

Environmental control and equipment costs:
Dehumidifier purchase cost = $5350 + $120 + GST = $6017
Annual dehumidifier running cost = $400 - $600 p/a
Dehumidifier running cost over 40 years = $16000 – $24,000
Total Dehumidifier cost over 40 years = $22,017 - $30,017

Air conditioner purchase cost = $2323
Annual air conditioner running cost in a well-insulated room = $400 - $500p/a
Air conditioner running cost over 40 years = $16,000 - $20,000
Air filters cost = $50 p/a;
Total Dehumidifier and air-conditioner combined running cost per year = $850 - $1150
Total Dehumidifier and air-conditioner combined cost over 40 years = $42,340 - $54,340

Dehumidifier:
Information, pricing and approximate running costs for the MC 150XD industrial grade dehumidifiers. Based on a desired room condition of 26degC/45%RH.

MODEL: MC150XD
PRICE : $5,350.00 + GST
AVAILABILITY : Ex-stock Sydney
FREIGHT : $120.00 + GST

Installation would be as simple as plugging it in (240VAC) and running an 80mm diameter flexible duct/hose to another room or preferably outdoors (somewhere where high humidity is not an issue). Estimated running costs (power) would be around $400 to $600 per year (less for this well insulated room). This is an estimation only as there are many determining factors that could contribute to the latent load in the room. The inbuilt humidistat will control the unit so that it only turns on as required to maintain whatever set point is chosen.

Air-conditioning unit:
Daiken Inverter R32 Split system with 5.0 kW capacity.
Supply and Install is approximately $2323
Running Cost is $400 - $500 p/a for a well-insulated room.

Estimated time before major restoration/conservation treatment is required:
50-60 years

4.5 Carcoon Interim storage

A Carcoon is a large plastic bubble that can be used to protect objects from external environmental conditions. If long term off site storage is likely before the Krauss is put on display inside a building, I would recommend the use of a custom made Carcoon as an interim storage or display solution. A Carcoon consists of a base mat and a separate top cover. The top cover attaches with a zip once the vehicle has been placed on top of the

base mat. The enclosure creates continuous stabilised air circulation, and would prevent light damage, reduce temperature, prevent dust and external pollutants, plus remove moisture from the storage environment. This would prolong the lifespan of the Krauss and prevent mould and corrosion, plus prevent the splitting of timbers and desiccation due to low and extremely fluctuating RH.

To reduce humidity to more stable levels, a small dehumidifier should also be used in conjunction with the Carcoon when storing the Krauss. A Carcoon with a dehumidifier could be expected to reduce RH by 17-19%RH.

Carcoon options

The outdoor double skin Carcoon or the outdoor workstation Carcoon are the best options if the Krauss continues to be stored outdoors. The clear indoor inflatable single skin Carcoon is particularly good from a display point of view, and is a good option if the Carcoon current storage can be enclosed by tarps, or enclosed storage can be found. Based on a Carcoon measuring 7.3m long x 3.0m Wide x 3.5m high, options are:

Indoor inflatable Carcoon $2790.00 *including delivery & GST running costs for this size approx. 30c per day plus dehumidifier cost*

Outdoor Single Skin Carcoon $2790.00 *including delivery & GST*
Single Skin units are intended for use in semi-sheltered situations, like carports. They provide additional protection from UV light.

Outdoor Double Skin Carcoon $3390.00 *including delivery & GST*
This is effectively 'a bubble within a bubble'; this model is designed to help protect vehicles in an outdoor environment. The outdoor Carcoon uses two layers of a special alloy coated material with an insulating air gap between each skin, this configuration along with a thick insulated base mat increase protection from the cold and damp, and also from high light levels.

Outdoor workstation Carcoon:

This structure can be custom made, and would allow the Krauss to be worked on and the structure entered without dismantling the top half of the Carcoon.
Cost estimate – $13,980.00

Conservation Assessment:

Temperature:
Unable to maintain temperature within the desired range, but better than other large technology objects in Queensland

RH:
Able to maintain RH within the required range.

Light:
Able to maintain light levels within the required range.

Pest:
Able to protect from pests and vermin.

Air Quality:
Able to protect from dusts and external pollutants.

Potential to include associated collection materials:
Possible from a preventive conservation point of view, and sufficient space.

Floorplan and Block Size:
This structure would be sited away from Lindsay road Buderim, and likely remain in its current location at Wises Farm Maroochydore. There is sufficient space within the display for access and maintenance if the Carcoon workstation model is purchased, or if a supporting internal structure is constructed within the Carcoon.

Safety:
This depends on the location. There is a risk of puncture from vandalism, but able to be repaired. No CPTED safety issues apply as this is not in a public location.

Preservation Maintenance and Housekeeping Actions:
See table in Section 5 for details. A standard level of routine maintenance and preservation housekeeping will be required. The paint coating will eventually fail in these conditions, and a large scale restoration of the paint coating will need to be undertaken every 40-50 years (if high grade paint is used)

Once the protective paint coating fails, corrosion will not accelerate significantly, as humidity can be kept within an acceptable range.

Preservation Maintenance and Housekeeping cost:
First year: $1989
Ensuing years: $180 p/a
Cost after 40 years: $9175.80

Environmental control and Equipment Cost:
Dehumidifier purchase cost $4790 +$120 + GST = $5401,
Air filters $25.22 per year
Annual dehumidifier running cost = $400 - $600
Dehumidifier running cost over 40 years = $16,000 - $20,000
Total Dehumidifier cost over 40 years = $21,401 – $25,401

Dehumidifier:
Munters MX150YD
This is the same physical size as the MC150XD proposed for the display building, however it has a slightly lower performance but still enough capacity.

MODEL: Munters MC150YD
PRICE: $4,790.00 + GST
AVAILABILITY: Ex-stock Sydney (subject to prior sale)
FREIGHT: $120.00 + GST

Carcoon ventilator running cost: The Carcoon uses two 12-volt 0.23amp brushless ventilators to provide its active airflow. In normal operation they don't work under much load and draw under half an amp. Running costs are 40 few cents per day.

Estimated time before major restoration/conservation treatment is required:
40-50 years

5. Preservation Maintenance and Housekeeping Actions

5.1 Maintenance and Preservation Schedule for Krauss Tram

These tasks should be undertaken by someone trained in Preservation Housekeeping using appropriate cleaning products, materials and techniques. Staff and visitors should wear socks when entering the display space. All costs are an estimation only as there are many determining factors that could contribute.

Maintenance Task	Concept Design – Buderim Design Studio (2015)	Concept Design – SCC (2017) and Melanie Fihelly concept sketch	Fully enclosed cement block building	Carcoon
Monitoring: • Inspect Krauss and display area for any incidents, damage, rubbish, hazards etc. • Check dehumidifier and lighting for any faults. • Monitor temperature, RH, and light conditions. • Check any known building incidents. • Monitor sticky traps and display for pests and record activity in housekeeping log. Any insect carcasses found on window sills or other areas must be removed as they provide food for mice and other predators. • Fill out housekeeping log to confirm task has been completed and add notes on any incidents noticed. • Note any emergencies and report to a Conservator/ Facilities staff at Sunshine Coast Council.	Monthly	Monthly	Monthly	Monthly
Vacuum floors of display; then wash floors with slightly damp microfibre mop and water (if dirt can't be removed with water, a non-ionic detergent can be added).	Fortnightly	Monthly	Six Monthly if in a display case within the building, otherwise monthly if	Six Monthly

			on open display.	
Clean any marks to glazing surface inside of display area.	Monthly	Monthly	Monthly	-
Housekeeping equipment care – wash after use.	Fortnightly	Monthly	Six - Monthly	Six monthly
• Dust/Vacuum all tram surfaces • Thoroughly clean any heavy dirt and dust accumulation under and behind tram, and difficult to reach areas. • Damp clean non-moisture susceptible surfaces. • Clean moisture susceptible surfaces with a dry microfibre cloth. • Remove textile hose cover, inspect beneath for insects, dust/vacuum hose surface and replace cover. • Remove any cobwebs. •	Quarterly	Six Monthly	Six Monthly	Six Monthly
Undertake tram condition check using a torch.	Six monthly	Annually	Annually	Annually
Ceilings - dust and clean with long handled microbfibre attachment.	Six monthly	Annually	Annually	-
Clean out of reach areas using a safety step ladder. An assistant will be required to steady the ladder.	Six monthly	Annually	Annually	Annually
Clean light fixtures (ensure electricity is turned off).	Six monthly	Annually	Annually	-
Cyclical deep cleaning of tram and interiors, including cleaning in hard to reach areas.	Six monthly	Annually	Annually	Annually
Seal up any dust and dirt ingress points such as bottoms of doors, gaps in windows, gaps in roof and skylights etc.	-	Annually	Annually	-

Restock supplies for cleaning kit.	Annually	Annually	Annually	Annually
Review of preservation housekeeping plan.	Annually	Annually	Annually	Annually
Service dehumidifier	-	Annually	Annually	Annually
Service Air conditioner	-	-	Annually	-
Service Environmental monitoring equipment	Five – Yearly	Five - Yearly	Five - Yearly	Five - Yearly
Replace Air Filters	-	-	Two - Yearly	Two - Yearly
Replace any Vapour Phase Inhibitors located in enclosed areas of the tram.	Two-Yearly	Two-Yearly	Two-Yearly	Two-Yearly
Maintenance of any mechanical moving parts. Drain and replace any oil/inhibitor.	Five-Yearly	Five-Yearly	Five-Yearly	Five-Yearly
Major Repaint tram /treatment of corrosion	15 Years	30-40 Years	40-50 years	50-60 years
Deep clean of display space if any major construction, maintenance, or earthworks occur nearby.	Incidental	Incidental	Incidental	Incidental
Replace any broken or malfunctioning lighting or equipment	Incidental	Incidental	Incidental	Incidental
Repairs to building fabric	Incidental	Incidental	Incidental	Incidental
Disaster Response	Incidental	Incidental	Incidental	Incidental
Respond to any vandalism	Incidental	Incidental	Incidental	Incidental

5.2 Preservation Housekeeping Training and Housekeeping Manual

Volunteers and Cleaning staff should be trained by a Conservator, and a detailed Housekeeping Manual should be provided to guide the cleaning practises of volunteers and cleaning staff. It will outline the products, supplies, and procedures for cleaning the different types of tram materials, and display room interior surfaces. Incidental Conservation advice and research (approx. cost estimate $10,000) will also be required over the lifespan of the display.

5.3 Cleaning Equipment and Supplies List

The following supplies are recommended in order to carry out Preventive Conservation programs:

Long Term Items

- HEPA Filter vacuum cleaner with variable speed - see the following website for a comparison list of brands and prices available in Australia http://www.comparison.com.au/vacuum-cleaners/features%3AHEPA-Filter
- Spare vacuum bags for vacuum cleaner.
- Set of micro brush attachments for the vacuum cleaner.
- Flashlight to use when inspecting.
- Data Logger.
- Folders for recording incidents in Housekeeping Log.
- Short handled duster.
- Long broom handles - attach microfibre cloths to these when dusting ceiling and walls (Alternately, a commercially available long handled microfibre duster with replaceable microfibre heads would be suitable for this dusting).
- Mop for damp mopping of indoor floors.
- Dustpan and brush.
- Plastic bucket.
- Caddy to carry basic cleaning supplies.
- Magnifying glass for insect pest identification.
- Step platform ladder (according to OH&S standards).
- Door mats.
- Discrete cover to place over cleaning products and equipment.

Replenishable Items

- Disposable dust masks.
- A large quantity of microfibre cloths Chux Wipes for mop.
- Zip lock bags (for insect collection).
- Powder free Nitrile gloves.
- Plastic drop sheet.
- Air filters

- De-ionised water.
- Non-ionic detergent.
- Groom Stick.
- Sticky glue board pest traps.
- Vapour Phase Inhibitors for any enclosed tram spaces.
- Flea collar to place in vacuum cleaner bag (to kill any insects vacuumed up).

5.4 Preservation Maintenance and Housekeeping cost

These costings relate to Conservation and Preservation activities specific to the display area. It is not possible to predict all future occurrences that could impact on these costs, and these costings are an estimate.

Restoration activities undertaken by BPTI prior installation will not be funded by the SCC and are not included in this costing. Costs associated with the moving and installing of the Krauss from Wises Farm Maroochydore to within the display space are beyond the scope of this report. SCC Facilities Staff will be able to advise on any other facilities maintenance activities such as the ongoing painting and repair of building fabric and HVAC equipment typical for a building of this size and type.

It has been proposed that equipment running costs for the Dehumidifier, Air-conditioner and other electrical components could be offset by the use of solar power as an energy source. An Electrical Engineer could be engaged to design a suitable system and give an estimate on the cost and feasibility of this option.

Calculation of Cost Estimates:
Cleaning /maintenance work and monitoring to be carried out by trained volunteers: $0
Incidental use of step platform/ladder – loan from SCC: $0
Initial Purchase of equipment and supplies (including vacuum cleaner): $1500
Purchase of Data logger environmental monitoring equipment, software and cable: $339
5 yearly service and calibration of data loggers: $150 ($30 per year)
Annual cost to replenish cleaning and equipment supplies: $150
2 yearly cost to replace Carcoon air filters: $50.45 ($25.22 per year)
Minor conservation/restoration treatment: $5,000 - $10,000
Major conservation/restoration treatment to repaint tram and treat corrosion: $30,000
Incidental Conservation advice and research: $10,000

Preservation Maintenance and Housekeeping cost:
First year: $1989
Ensuing years: $180 p/a
Cost after 40 years: $9175.80

HVAC Equipment costs:

Concept Design – Buderim Design Studio (2015):

Equipment cost = $0
Major restoration cost x 2 = $60,000

Concept Design – SCC (2017) and Melanie Fihelly concept sketch:
Dehumidifier purchase cost = $5350 + $120 + GST = $6017
Annual dehumidifier running cost = $400 - $600 p/a
Dehumidifier running cost over 40 years = $16000 – $24,000
Total Dehumidifier cost over 40 years = $22,017 - $30,017

Fully Enclosed Cement Block Building:
Dehumidifier purchase cost = $5350 + $120 + GST = $6017
Annual dehumidifier running cost = $400 - $600 p/a
Dehumidifier running cost over 40 years = $16000 – $24,000
Total Dehumidifier cost over 40 years = $22,017 - $30,017

Air-conditioner purchase cost = $2323
Annual air conditioner running cost in a well-insulated room = $400 - $500p/a
Air conditioner running cost over 40 years = $16,000 - $20,000
Air filters cost = $50 p/a;
Total Dehumidifier and air-conditioner combined running cost per year = $850 - $1150
Total Dehumidifier and air-conditioner combined cost over 40 years = $42,340 - $54,340

Carcoon:
Dehumidifier purchase cost $4790 +$120 + GST = $5401,
Air filters $25.22 per year
Annual dehumidifier running cost = $400 - $600
Dehumidifier running cost over 40 years = $16,000 - $20,000
Total Dehumidifier cost over 40 years = $21,401 – $25,401

6. Estimated time before major restoration/conservation treatment is required

The lifespan of an object varies dependent on the conditions it is stored in. Many large technology objects end up being stored in outdoor conditions due to space, financial, and resource limitations. A large technology object has a maximum lifespan of 50 years if stored outside (even with the highest standard of care). After this point it will have corroded and deteriorated past a redeemable state.

Accelerated aging tests have been conducted with paint films to determine their longevity. One recent study found that a painted iron surface using a high quality alkyd paint with graphite in the topcoat will last 10 years outdoors (Shashoua, Matthiesen, 2010).

Based on my personal observations of the lifespan of large technology objects in various environmental conditions, I expect that the Krauss will remain stable for the following number of years (before conservation/restoration treatment is required):

Current Architect design concept:
15 years.

Melanie Fihelly and Erin Johnston Concept drawings:
30 - 40 years.

Carcoon:
40-50 years.

Cement block building:
50-60 years.

In general, all outdoor painted objects, including artworks, ships, and bridges, need recoating every ten to fifteen years, as no paint system can withstand weather past this point. The paint can be considered a sacrificial coating on the Krauss, as no original paint remains. The key issue is to determine when the cleaning of a surface, followed by light sanding and an extra layer of paint, is sufficient; and when more interventive treatment is necessary, such as when the metal substrate has begun to corrode.

7.References

Fihelly, M., 2017, "Conservation Specification, Krauss Tram Display Building Buderim Qld.", Brisbane, pp. 20-26 (unpublished).

Mewes, D., 2016, "Buderim Krauss Locomotive Significance Assessment", Brisbane, p. 11 (unpublished).

Museums and Galleries Commission, 1994, "Standards in the Museum Care of Larger and Working Objects: Social and Industrial History Collections", Cassar, M., (ed.) Museums, Environment, Energy, London, pp. 84, 88-89).

Shashoua, Y., Matthiesen, H., 2010, "Protection of Iron and Steel in Large Outdoor Industrial Heritage Objects", *Corrosion Engineering, Science and Technology*, Vol. 45, Iss. 5.

Appendix 1. Krauss Conservation Options Comparison Table

This Table provides a comparison outline only of the estimated cost of Conservation aspects required of the three different Building Options. These are outlined in the Conservation Specification Report and should be read in conjunction with that Report.

The Categories of Control used are those referred to in the Museum and Galleries Commission ''Standards in the Museum Care of Larger and Working Objects'' outlined in Section 3.

Please Note:

Option 1 would provide Moderate Control
Option 2 would provide close to Simple Control
Option 3 would provide Basic control

Option1 is suitable but extra to requirements of the tram of Local Significance.
Option 2 is adequate for a tram of Local Significance with a non-original painted surface.
Option 3 is not adequate for a tram of local Significance.

Task	**Option 1** **Moderate Control**	**Option 2** **Simple Control**	**Option 3** **Basic control**
	Fully enclosed cement block building (on a new site, or a small room within a museum) mentioned in Section 4.4. When assessed by MAGC criteria this would be described as Moderate Control. This level of storage is great, but exceeds what is required by the Krauss, given its significance rating.	Concept Design - SCC (2017) *The Erin Johnston Concept Sketch mentioned in Section 4.3 is also viable from a Conservation point of view but is too large for this block. SCC and an architect can confirm viability in terms of all other factors.* When the Amended Architect Concept Sketch in Section 4.2 is assessed by MAGC criteria, it would be described as being close to Simple Control, although light level will be a bit too high, and heat will be a bit too high. However, this high light will primarily impact on non- original fabric, and so	Concept Design - Buderim Design Studio (2015) mentioned in Section 4.1. When assessed by MAGC criteria, this level of storage is described as Basic Control and is only suitable for

		is adequate for this object.	display and demonstration models)
Condition Checks			
Frequency	Annually	Annually	Annually
Cost	0 (done by volunteers)	0 (done by volunteers)	0 (done by volunteers)
Environmental monitoring			
Frequency	monthly	monthly	monthly
Cost	0 (done by volunteers, if in a large new museum, done by conservation staff)	0 (done by volunteers trained in how to respond to any incidents)	0 (done by volunteers trained to respond to any incidents)
Environmental control			
RH	Dehumidifier	Dehumidifier	0
Temperature	Air conditioner, Light minimising Building design, window films, Roof and wall insulation, light exterior and roof paint colour, sprinkling roof with water on hot days	Light minimising Building design, window films, Roof and wall insulation, light exterior and roof paint colour, sprinkling roof with water on hot days	Sprinkling roof with water on hot days. Light exterior and roof paint colour. Window films. Insulation in ceiling cavity
Light	Building design, window films, LED lights inside case.	Building design, window films, LED lights inside case.	Window films, LED lights inside case.
Pest control	Building design, good seals on building, sticky traps and visual inspection of volunteers, meticulous preservation housekeeping	Building design, good seals on building, sticky traps and visual inspection of volunteers, meticulous preservation housekeeping	Sticky traps to monitor and visual inspection of volunteers.
Air quality	Sealed building, replace filters at cost of $50p/a	$0 Sealed building	$0
Ongoing preservation and housekeeping maintenance (if the building is expected to have a longevity of 40 years then preservation housekeeping maintenance must continue for the entire life of the building).	First year: $1989 Ensuing years: $180 p/a Cost after 40 years: $9175.80	First year: $1989 Ensuing years: $180 p/a Cost after 40 years: $9175.80	First year: $1989 Ensuing years: $180 p/a Cost after 40 years: $9175.80

Environmental control equipment cost (does not include servicing cost- SCC facilities staff to advise on servicing cost)	$42,340 - $54,340 equipment cost SCC estimate a total of $70k with sprinklers, battens and insulation etc.	$22,017 - $30,017 equipment cost SCC estimate a total of $50k with sprinklers, battens and insulation etc.	$0 equipment cost SCC estimate a total of $20k with sprinklers, battens and insulation etc.
Major restoration/ conservation treatment (if expected building lifespan is 25 years)	No major treatment required. $7,000 approx. minor treatment cost	$20,000 approx.	$40,000 approx.
Incidental Conservation advice and research	$10,000	$10,000	$10,000