RE IMAGINING LIBRARIES

NATIONAL AND STATE LIBRARIES AUSTRALASIA

Trends in environmental management for collection storage

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Prepared by Storage Management Working Group

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- Heating Ventilation and Air-Conditioning (HVAC) systems have been the principal means of maintaining these environmental conditions in standard buildings
- Rising energy costs and an increasing awareness of sustainability have resulted in renewed discussion about acceptable environmental parameters for collection storage

Recent discussion

- Current discussion about environmental standards and guidelines largely emanates from conservators and the Museum sector since 2008
- In April 2014, the AICCM issued Interim temperature and relative humidity guidelines for acceptable storage and display conditions of general collection material. These guidelines endorse broader parameters for general collection material but acknowledge that some material may require tighter controls which may be managed through microclimates
- In September 2014, at the IIC congress in Hong Kong and the ICOM-CC Melbourne workshop, delegates discussed and agreed on new environmental guidelines, including those of AICCM.

Sustainability

- There are a range of activities occurring internationally to reduce energy usage.
- In Australia, the Universities Research Repository (URRSA) joint library store in Adelaide is an early example of attempts to incorporate energy efficient design features into storage facilities

Current situation in NSLA Libraries

- The majority of NSLA libraries rely on continuous operation of HVAC systems to control temperature and humidity within most storage areas.

- Two offsite facilities operated by NSLA members operate HVAC systems with temperature and humidity control on a continuous basis and two facilities operate HVAC systems with temperature control on a continuous basis.
- Two offsite facilities operated by NSLA members are currently holding environmental conditions without reliance on HVAC systems
- Two shared sites operate HVAC systems with temperature and humidity control on a continuous basis

- The majority of respondents have policies which include reference to environmental management practices. Frequently policies cover related topics such as preservation.
- Only three respondents reported policies which are specifically dedicated to environmental management
- All policies are either scheduled for review in 2014 or to be reviewed annually.

- NSLA libraries rely on international standards, trends and research in setting environmental parameters for collection storage
- There have not been any significant changes to parameters across NSLA sites over the past three years
- Four NSLA libraries intend to review current environmental parameters over the next year.
- The existing environmental standards adopted by one NSLA library are consistent with the AICCM Interim Temperature and Relative Humidity Guidelines

- Preservation staff are primarily responsible for monitoring and analysis of environmental conditions
- The majority of libraries operate Building Management Systems (BMS) to monitor environmental conditions

- The design of HVAC systems and older air-conditioning units which require upgrade currently present challenges in environmental management
- The location and design of storage areas was identified as a challenge by some libraries
- Heritage buildings were not perceived as a significant challenge, which may reflect the benefits of refurbishment work at a number of sites, or the inherent thermal mass of older buildings which helps maintain stable conditions.
- The arrangement of collections was not considered to be a significant challenge, reflecting the progress made by NSLA libraries in achieving more logical storage arrangements

Research by NSLA Libraries

- Five libraries have undertaken testing of environmental conditions within storage equipment and four libraries have tested conditions within storage enclosures.
- Testing at NSLA sites reveals that environmental conditions within storage equipment and enclosures are more stable than open storage areas.

- Five libraries have conducted research into the stability of environmental conditions within storage areas when HVAC systems are switched off.
- Three libraries reported that environmental conditions remained stable for long periods when HVAC systems were switched off.
- Two respondents reported that stable environmental conditions could not be maintained without the intervention of HVAC.

- Lack of resources and expertise were generally cited as the principal factors preventing local research and testing

Energy usage

- There is a high level of awareness amongst storage managers about the correlation between storage planning and energy use
- Libraries are taking advantage of collection storage activities such as collection relocations to co-locate collections with similar environmental requirements when possible.
- A number of respondents are installing more energy efficient equipment e.g. lighting

• Approximately half of respondents are reviewing environmental parameters and set points on environmental management systems. • There is less progress in reducing energy usage through passive controls such as shutting doors, installing air-locks and insulated window panels etc.
• Responses indicate a high level of awareness about sustainability • Many suggestions to reduce energy usage are consistent with initiatives internationally • Some suggestions highlight the interrelationship between digitisation and the longer term access, storage and environmental requirements of collections

Actions being undertaken by NSLA Libraries	**Number taking action**
• Installing more energy efficient lighting. One respondent also reported installing sensor lighting	7
• Developing/implementing storage plans which support efficient environmental management practices e.g. storing collections requiring similar environmental conditions together	6
• Reviewing environmental parameters	5
• Reviewing set points on environmental management system	4
• Shutting doors	4
• Undertaking local research to determine how long different storage areas can maintain environmental conditions without reliance on HVAC systems	3
• Upgrading BMS which monitor and adjust air-conditioning	3
• Installing more energy efficient HVAC equipment	2
• Installing solar panels	2
• Installing insulated window panels	2
• Installing air-locks to reduce influx of external air	1
• Installing more energy efficient storage and delivery equipment	1

• Installing CO2 sensors to limit the outside air-exchange for low staff use areas such as storage	1
• Display cases with good condition controls	1
• Restricting staff access to storage areas	1

2 Introduction

The preservation community has long recognised that stable environmental conditions play an important role in the long term preservation of objects and art works. Environmental parameters of 20°C and 50% RH have been widely accepted as optimum conditions for the storage and display of art works and objects in museums and galleries. Cultural institutions rely heavily on Heating Ventilation and Air-Conditioning (HVAC) systems to achieve these conditions within standard buildings. As a result of escalating energy costs and a greater awareness of climate change, there has been renewed discussion within the international community about safe parameters for collection storage. A significant milestone was reached in 2014 when peak bodies of the preservation and museum sector endorsed adopting broader environmental parameters for the storage of cultural collections with a greater emphasis on stability, sustainability and recognition of the need for tighter controls for some collection material.

Libraries commenced adopting parameters recommended for the storage and display of museum collections in the late 1990s. Since then, NSLA Libraries have progressively incorporated these parameters into relevant policies and worked towards maintaining these parameters for critical heritage collections. In recent years several NSLA libraries have been exploring more sustainable options for maintaining stable storage environments for their collections.

3 Background and methodology

There was a discussion about changing views on environmental parameters for collection storage at the July 2014 meeting of NSLA. As a result of the discussion, the Storage Management Working Group was requested to develop a discussion paper for the November NSLA meeting.

An environmental scan was conducted to obtain information about international trends in environmental management. For comparative purposes a survey was conducted to gather information about local environmental management practices across NSLA sites. The *Survey on Environmental Management Practices for Collection Storage* was issued to eight libraries on 2 September 2014. Seven responses were received.

This paper provides a summary of findings.

4 Environmental scan

- Current parameters of 20°C and 50% for the storage and display of art works and objects reflect environmental conditions of underground storage where cultural collections were stored during World War II without any noticeable deterioration. Libraries commenced adopting these parameters in the 1990s.
- Heating Ventilation and Air-Conditioning (HVAC) systems have been the principal means of maintaining these environmental conditions in standard buildings
- Rising energy costs and an increasing awareness of sustainability have resulted in renewed discussion about acceptable environmental parameters for collection storage

The effect of environmental conditions on the long term preservation of cultural collections was first recognised after World War II when it was observed that collections which had been stored underground at 20°C and 50% RH did not display any noticeable signs of deterioration. These environmental conditions were subsequently adopted as the preferred standard for the storage and display of art works and objects in museums and galleries. Libraries began adopting these parameters in the 1990s.

Heating Ventilation and Air-Conditioning (HVAC) systems have been the principal means of maintaining these environmental conditions in standard buildings; however, rising energy costs and an increasing awareness of sustainability has resulted in renewed discussion about acceptable environmental parameters. Current discussion on standards and guidelines for best practice largely emanates from conservators and the museum sector.

This section provides an overview of key areas of discussion within the international community. A full environmental scan containing more detailed information is provided in **Appendix 1**.

4.1 Recent discussion

- Current discussion about environmental standards and guidelines largely emanates from conservators and the museum sector since 2008
- In April 2014, the AICCM issued *Interim temperature and relative humidity guidelines* for acceptable storage and display conditions of general collection material. These guidelines endorse broader parameters for the storage of general collection material but acknowledge that some material may require tighter controls which may be managed through micro-climates

- In September 2014, at the IIC congress in Hong Kong and the ICOM-CC workshop in Melbourne, delegates discussed and agreed on a new position for environmental guidelines, including those of AICCM.

In 2008, the International Institute for Conservation of Historic and Artistic Works (IIC) hosted a roundtable entitled "Climate Change and Museum Collections" where alternate views about environmental parameters were expressed. At the same time, the International Group of Organizers of Large Scale Exhibitions (Bizot Group) was developing principles supporting the reduction of carbon footprints. The following year, AICCM (Australian Institute for the Conservation of Cultural Material) established an Environmental Guidelines Task Force to provide Australian conservators with a position on the global debate on safe environmental parameters for the display and storage of objects and collections. Over the following years there has been a polarised discussion within the international preservation community about safe environmental standards, particularly in relation to the loan of collection material.

The International Institute for Conservation of Historic and Artistic Works (IIC) in collaboration with the American Institute for Conservation (AIC) and its annual meeting hosted a roundtable in 2010 entitled: "***The Plus/Minus Dilemma: the way forward in environmental guidelines*** **"** which brought together over 600 conservators, scientists and collection care professionals at Milwaukee Wisconsin, USA to discuss environmental guidelines, advances in environmental research and solutions for a way forward to achieve responsible environmental control.

In 2012, the Munich Climate Change Conference was hosted to coincide with the 75th anniversary of the Doerner Institut. Thirty five papers were presented at the conference and the following year ***Climate for Collections: Standards and uncertainties*** was published, funded through the EU project Climate for Culture and the Doerner Institut.

In April 2014, the AICCM issued *Interim temperature and relative humidity guidelines* for acceptable storage and display conditions of general collection material. The 2014 interim guidelines recommended temperature and RH as follows:

- Temperature: between 15–25°C with allowable fluctuations of +/-4°C per 24 hr
- Relative Humidity: between 45-55% with an allowable fluctuation of +/- 5% per 24 hr.
- Where storage and display environments experience seasonal drift, RH change to be managed gradually across a wider range limited to 40% – 60%.

The Task Force also noted that:

- specific requirements for sensitive or fragile collections, and for collections on loan, should be determined in consultation with a professional conservator
- some material will require different or tighter conditions which may be managed through, for example, the use of micro–climates.
- additional specific environmental requirements, such as light levels, air-flow, and other conditions, should be determined based upon professional conservation advice.

The AICCM position reflects the AIC opinion that single standards for temperature and relative humidity are not suitable or necessary for all collection objects. The AIC advises that if standards are broadened, the needs of individual objects, groups of objects, and sensitive materials must be recognised and addressed by the use of micro-climates or other mitigation measures. The AIC also noted that any alteration of standards will require:

- a greater understanding of case design and the use of micro-climates to create appropriate environments for sensitive objects
- proper evaluation of the moisture content and sensitivities of objects in order to design safe and sustainable environments.

In September, 2014 at the IIC congress in Hong Kong and the ICOM-CC conference in Melbourne delegates discussed and agreed on a new position for Environmental Guidelines. The position includes support to convert existing interim guidelines to guidelines, including those by AICCM. The collaborative outcome is a significant achievement for the conservation profession. A copy of the declaration is located at **Appendix 2.**

4.2 Sustainability

- There are a range of activities occurring internationally to reduce energy usage.
- In Australia, the Universities Research Repository (URRSA) joint store in Adelaide is an early example of attempts to incorporate energy efficient design features into storage facilities

Trends internationally range from installing combined heat and power plants to make cost effective seasonal adjustments to environmental conditions, use of independent monitoring systems to maximise the efficiency of HVAC systems (Netherlands), sustainable building design, further research into the degradation of cultural collections and selecting environmental controls which reflect the preservation priority of the collection.

In Australia, the Universities Research Repository (URRSA) joint store in Adelaide is an early example of attempts to incorporate energy efficient design features into storage facilities.

First constructed in 1984, the store relies on thick insulation in walls and ceiling to maintain environmental conditions within acceptable tolerances. Only staff and reading areas are air-conditioned.

5 Current situation in NSLA Libraries

5.1 Control of environmental conditions onsite

- The majority of NSLA libraries rely on continuous operation of HVAC systems to control temperature and humidity within most storage areas.

The majority of respondents rely on continuous operation of HVAC systems (24/7) to maintain environmental conditions in most storage areas. Three libraries do not operate HVAC systems 24/7 for overseas collections. Two libraries do not operate HVAC systems 24/7 in storage areas housing Australiana/Stateiana collections. These libraries also reported that they do not currently operate HVAC systems to control humidity in these collections. Neither library reported difficulties with maintaining environmental conditions within specified parameters and both libraries have been proactive in testing the stability of environmental conditions when HVAC systems are switched off for periods of time. This may suggest opportunities to reduce reliance on continuous operation of HVAC systems to maintain conditions. Apart from these instances, there is little evidence of more flexible approaches to the operation of HVAC systems onsite. This may be partially due to building design, design limitations of existing HVAC systems and/or stack areas which accommodate a range of different collection materials within the one space.

Passive controls reported by respondents include insulated window panels (2) and closing doors to some storage areas (5).

5.2 Control of environmental conditions offsite

- Two offsite facilities operated by NSLA members operate HVAC systems with continuous temperature and humidity control and two facilities operate HVAC systems with continuous temperature control.
- Two offsite facilities operated by NSLA members are currently holding environmental conditions without reliance on HVAC systems
- Two shared sites operate HVAC systems with continuous temperature and humidity control.

Six libraries store collections offsite. NSLA libraries currently operate six offsite storage facilities and share space with other agencies at another three sites. The percentage of the collections stored offsite ranges from 7% to 50.5%. The type of material stored offsite also varies. Facilities range from 7 years to 40 years of age with two of those sites owned by NSLA members. Two facilities operate HVAC systems with temperature and humidity controls 24/7 and two facilities operate HVAC systems with continuous temperature controls. Two facilities operated by NSLA members are passively maintaining conditions following a successful trial monitoring conditions when HVAC systems have been switched off. It should be noted that it is largely paper-based collections stored in these two facilities. Of sites shared with other agencies, two sites operate HVAC systems with continuous temperature and humidity control and the third site operates HVAC systems with continuous temperature controls during summer months.

5.3 Policies and guidelines

- The majority of respondents have policies which include reference to environmental management practices. Frequently policies cover related topics such as preservation.
- Only three respondents reported policies which are specifically dedicated to environmental management
- All policies are either scheduled for review in 2014 or are reviewed annually

The majority of respondents (5) have policies which include reference to environmental management and related topics such as preservation. Only three respondents reported policies which are specifically dedicated to environmental management. Of the nine policies reported, five are due for revision this year and a further three are reviewed annually. This provides an opportunity to achieve greater consistency in policy statements across NSLA Libraries.

Appendix 3 provides a summary of policies relating to environmental management reported by NSLA Libraries

5.4 Current environmental parameters

- NSLA libraries rely on international standards, trends and research in setting environmental parameters for collection storage
- There have not been any significant changes to parameters across NSLA sites over the past three years
- Four NSLA libraries intend to review current environmental parameters over the next year.
- The existing environmental standards adopted by one NSLA library are consistent with the *AICCM Interim Temperature and Relative Humidity Guidelines*

The majority of respondents (6) rely on international standards, trends and research in setting environmental parameters. These standards have also been adopted by other libraries and institutions internationally. Recommended parameters from international professional associations were also considered. Several respondents (4) have taken local testing into consideration and made adjustments for local conditions.

No respondents reported any significant changes to environmental parameters over the past three years; however, four intend to revise/review current environmental parameters over the next year. At least two respondents anticipate there will be ongoing application of zoned collection storage and broadening of parameters where feasible with their HVAC system. These libraries also anticipate a more tiered approach with tighter parameters for some formats e.g. microforms. Two respondents are not intending to review current environmental parameters. One of those respondents reported parameters which are consistent with the *AICCM Interim Temperature and Relative Humidity Guidelines* while the other has examined and assessed seasonal variations to temperature and humidity and is not intending to implement changes, as the assessment does not indicate any large energy/cost savings would be achieved. Based on the survey information, it appears as though any revision to parameters will be consistent with the new AICCM interim guidelines.

Generally, preservation staff in NSLA libraries are responsible for establishing and reviewing environmental parameters with input from facilities, collection and storage managers. Two libraries have established collection storage committees which also consider recommendations for environmental parameters. A summary of environmental parameters reported in the NSLA *Storage Management Survey* in 2012 and any changes that have occurred within the past three years are provided at **Appendix 4.**

5.5 Environmental monitoring

- Preservation staff are primarily responsible for monitoring and analysis of environmental conditions
- The majority of libraries operate Building Management Systems (BMS) to monitor environmental conditions

Five respondents operate a Building Management Systems (BMS) to monitor environmental conditions. These respondents also use data loggers for environmental monitoring. Two also use portable handheld monitoring devices such as Vaisalas and one relies solely on thermo hygrographs.

Six respondents reported that preservation staff are primarily responsible for monitoring and analysis of environmental conditions within storage areas. Four reported that building/facilities management staff also have a responsibility for environmental monitoring. Storage management staff are involved in environmental monitoring at two libraries and one respondent reported that environmental monitoring is the responsibility of collection management staff.

5.6 Challenges in maintaining environmental conditions

- The design of HVAC systems and older air-conditioning units which require upgrade currently present challenges in environmental management
- The location and design of storage areas was identified as a challenge by some libraries
- Heritage buildings were not perceived as a significant challenge which may reflect the benefits of refurbishment work at a number of sites, or the inherent thermal mass of older buildings which helps maintain stable conditions
- The arrangement of collections was not considered to be a significant challenge, reflecting the progress made by NSLA libraries in achieving more logical storage arrangements

Respondents were given a list of challenges in maintaining stable environmental conditions and asked to rate each on a scale of 1 – 5. Based on the survey, the design of HVAC equipment *and* older air-conditioning units which require upgrade present the greatest challenges. Energy costs were given a moderate rating by all except one respondent. Only one respondent perceived heritage buildings as a significant challenge which may reflect the refurbishment work that has taken place at a number of sites over the past ten years, or the inherent thermal mass of these buildings which helps maintain stable conditions. The need for staff to access and work in storage areas was considered to be a moderate to high challenge by three respondents. The location of storage areas was identified as a high to significant challenge by three respondents while the design and layout of storage areas was also reported to be a significant challenge by four respondents. The arrangement of collections was only considered to be a low to moderate challenge by respondents reflecting the progress made by NSLA members in achieving more rational storage arrangements. Material stored on open access was identified as a moderate challenge by two respondents and climate was only identified as a significant challenge by two respondents. One respondent reported not owning the building as a significant challenge.

6 Research conducted by NSLA Libraries

6.1 Environmental conditions within storage enclosures and equipment

- Five libraries have undertaken testing of environmental conditions within storage equipment and four libraries have tested conditions within storage enclosures.
- Testing at NSLA sites reveals that environmental conditions within storage equipment and enclosures are more stable than open storage areas.

Four respondents have conducted research into the stability of environmental conditions within storage enclosures such as manuscript cartons and polypropylene boxes. One library has also tested the stability of environmental conditions within minigrip bags and conditions within hollowed out books. All respondents that had undertaken testing reported conditions within enclosures were more stable than open storage areas and one respondent noted the buffer effect of cellulose archival boxing. One respondent also reported testing conditions within display cases without full HVAC controls and reported the conditions were very stable. Similarly, five respondents had undertaken testing of environmental conditions within storage equipment such as storage cabinets, plan file cabinets and compactus and reported that the conditions within the storage equipment were more stable than open storage areas.

Further research and discussion may determine whether conditions should be monitored within storage enclosures, storage equipment or the open storage environment. Additional research may also be required to assess the buffering effect of compacted collections.

6.2 Environmental conditions within storage areas when HVAC systems are switched off for specific periods of time

- Five libraries have conducted research into the stability of environmental conditions within storage areas when HVAC systems are switched off.
- Three libraries reported that environmental conditions remained stable for long periods when HVAC systems were switched off.
- Two respondents reported that stable environmental conditions could not be maintained without the intervention of HVAC.

Five respondents have conducted research into stability of environmental conditions when HVAC systems are switched off for periods of time. Findings varied. Two respondents found that conditions could not be maintained for very long without HVAC equipment. This could be due to location, climate, design and age of storage areas and the season when testing was conducted. One library reported switching off air-conditioning at night resulted in unstable environmental conditions whilst three respondents reported that environmental conditions remained stable for long periods. One library reported that dead zones and upper and lower controls were introduced based upon test findings and the HVAC system in use. The State Library of Queensland reported that during the 2011 floods when the building was without power for up to four days, there was only a minor escalation in temperature and relative humidity and that the stability of conditions was due to the high level of insulation in perimeter walls and keeping anterooms closed.

These findings suggest that building design, geographic location, season and frequency of access impact on the stability of environmental conditions when HVAC systems are switched off.

6.3 Reasons preventing respondents from undertaking research

- Lack of resources and expertise were generally cited as the principal factors preventing local research and testing

Respondents cited lack of resources and expertise as principal factors preventing local research. Concern that switching off HVAC systems may re-introduce problems with stabilising storage environments and the potential damage to collections also discouraged respondents from undertaking research.

One respondent who had undertaken research reported that implementation of findings was slow, due to a lack of time across Divisions to dedicate to the project.

7 Energy usage

7.1 Actions to reduce energy usage for collection storage

- There is a high level of awareness amongst storage managers about the correlation between storage planning and energy use
- Libraries are taking advantage of collection storage activities such as collection relocations to co-locate collections with similar environmental requirements when possible.
- A number of respondents are installing more energy efficient equipment e.g. lighting
- Approximately half of respondents are reviewing environmental parameters and set points on environmental management systems.
- There is less progress in reducing energy usage through more passive controls such as shutting doors, installing air-locks and insulated window panels etc.

Member libraries were asked to report activities relating to collection storage which are being undertaken to reduce energy usage. The survey reveals a high level of awareness amongst storage managers about the correlation between storage planning and energy usage. The majority of respondents are taking advantage of the opportunities presented through collection moves and implementation of storage strategies to co-locate collections with similar

environmental requirements and install more energy efficient equipment such as lighting. Five respondents are reviewing environmental parameters and four respondents are reviewing set points on environmental management systems. Based on survey results, there appears to be less progress in reducing energy usage through passive measures such as shutting doors or installing air-locks, insulated window panels or CO2 sensors to limit outside air-exchange.

A summary of actions undertaken by NSLA Libraries to reduce energy usage for storage is provided below:

Action	**Number of respondents undertaking actions**
Installing more energy efficient lighting. One respondent also reported installing sensor lighting	7
Developing/implementing storage plans which support efficient environmental management practices e.g. storing collections requiring similar environmental conditions together	6
Reviewing environmental parameters	5
Reviewing set points on environmental management system	4
Shutting doors	4
Undertaking local research to determine how long different storage areas can maintain environmental conditions without reliance on HVAC systems	3
Upgrading Building Management Systems which monitor and adjust air-conditioning	3
Installing more energy efficient HVAC equipment	2
Installing solar panels	2
Installing insulated window panels	2
Installing air-locks to reduce influx of external air	1
Installing more energy efficient storage and delivery equipment	1

Action	Number of respondents undertaking actions
Installing CO2 sensors to limit the outside air-exchange for low staff use areas such as storage	1
Display cases with good condition controls	1
Restricting staff access to storage areas	1

7.2 Other suggestions to reduce energy usage for collection storage

- Responses indicate a high level of awareness about sustainability
- Many suggestions to reduce energy usage are consistent with initiatives internationally
- Some suggestions highlight the interrelationship between digitisation and the longer term access, storage and environmental requirements of collections

Respondents were invited to provide details of other initiatives which could be considered to reduce energy usage for collection storage.

Suggestions include considering reducing staff presence in storage areas by supporting access and delivery needs through digital surrogates or Automated Storage and Retrieval Systems; a tiered approach to environmental management based on collection lifespan and vulnerability of collection format; the use of more passive systems to reduce energy usage such as the use of insulation to provide “esky style” storage environment, placing greater emphasis on the stability of environmental conditions whilst widening environmental parameters; engaging experts to assess what energy reduction measures can be achieved at different NSLA sites; making greater use of CO2 monitors to reduce outside air-intake, allowing drift between set temperature and RH bands so HVAC system only operates when conditions are outside the set parameters and upgrading central HVAC systems to achieve maximum efficiency.

8 Conclusion

Existing environmental parameters for collection storage were established over sixty years ago and largely reflect environmental conditions of underground storage during World War II. These parameters have been widely adopted internationally as best practice for the storage of cultural institutions. Libraries moved towards adopting these parameters in the 1990s.

As a result of rising energy costs and greater emphasis on sustainability, there has been renewed interest in environmental parameters within the international preservation and cultural institution sector. Over the past five years there has been a polarised debate about safe environmental parameters for the display and storage of cultural collections. In September 2014, a significant milestone was reached, when the IIC congress and the ICOM-CC issued a joint declaration on environmental guidelines recognising that collecting institutions have a responsibility to mitigate climate change by reducing energy use and placing less reliance on HVAC systems for care of collections. The declaration places greater emphasis on stability of environmental conditions and recognises that some cultural materials require tighter environmental parameters for their long term preservation. The declaration also supports converting existing interim guidelines which contain broader environmental standards into guidelines. Interim Temperature and relative Humidity Guidelines adopted by AICCM reflect the international position.

The *Survey on Environmental Management Practices for Collection Storage* reflects a high level of awareness about changing trends in environmental management within NSLA Libraries. While there is still heavy reliance on the continuous operation of HVAC systems to maintain environmental conditions for collection storage across NSLA sites, several NSLA libraries have undertaken local research to test the stability of environmental conditions with less reliance on HVAC systems and are moving towards more sustainable means of maintaining stable environmental conditions. With the international acceptance of broader environmental parameters for the storage of general collection materials, there are new opportunities to review current environmental standards and practices.

Areas which could be considered for further investigation include:

- Local research to determine whether it is necessary to operate HVAC systems across all storage areas on a continuous basis taking into consideration specific requirements of different collection formats.
- Consider whether local conditions/equipment support a move to periodic operation of HVAC equipment during particular times of the year, i.e. allowing seasonal variation.
- Whether revision of existing policies relating to environmental management practices should incorporate a consistent statement about environmental management priorities and aspirations.

- Whether current environmental parameters adopted by NSLA libraries require revision to reflect more closely the 2014 AICCM *Interim Temperature and Humidity Guidelines.*
- Investigate whether adopting the 2014 AICCM *Interim Temperature and Humidity Guidelines* for specified collections would mitigate some challenges to maintaining environmental conditions reported in the survey.
- Carry out further research to more fully understand the correlation between environmental conditions within storage enclosures, storage equipment and open storage areas.
- Seek specialist advice about design features which should be incorporated in HVAC systems to promote maximum efficiency and guide procurement decisions and equipment upgrades.
- Consider whether environmental readings should be taken from the open storage environment and/or within storage equipment and enclosures.
- Investigate more fully options for reducing energy usage through greater use of more passive controls.
- Consider a more tiered approach to environmental management reflecting environmental requirements of different collections.
- Consider whether increasing digital access to collections will provide new opportunities to transfer some physical collections into low access, environmentally sustainable storage, as access requirements decline.
- Consider incorporating passive energy efficient design features into new and refurbished storage facilities.

Appendix 1

Full environmental Scan

With energy costs rising, and an increased emphasis on sustainability, cultural collecting organisations are assessing the impact and costs of maintaining environmental conditions for collection storage. Current discussion on standards and guidelines for best practice in this area emanates from conservators and the Museum sector.

International standards/guidelines

International guidelines of note include:

Organisation		Guideline, Standard
AIC: American Institute for Conservation of Historic and Artistic Works	National US organisation dedicated to the preservation of cultural material	Discussion about environmental guidelines; last modified 24/07/14 (http://www.conservation-wiki.com/w/index.php?title=Environmental_Guideline)
American Society of Heating, Refrigerating, and Air-Conditioning Engineers	Founded in 1894, ASHRAE is a global society advancing human well-being through sustainable technology for the built environment	*2011 ASHRAE Handbook—HVAC Applications* Sect 23. Museums, Galleries, Archives and Libraries (under Industrial Applications) (https://www.ashrae.org/advertising/handbook-cd-commercial-resources/applications)
AICCM: Australian Institute for the Conservation of Cultural Material	Professional organisation for conservators in Australia	*AICCM Interim Temperature and Relative Humidity Guidelines for Acceptable Storage and Display Conditions*, March 2014 (http://www.aiccm.org.au/sites/default/files/docs/AICCM_MediaReleases/Environmental%20Guidelines%20Taskforce%20report.pdf)
Bizot Group (International	International group of Directors of the world's	*Bizot Interim Guidelines for Hygroscopic Materials*

Organisation		Guideline, Standard
Group of Organisers of Large Scale Exhibitions)	leading museums and galleries	
British Standards Institute	UK's national Standards agency	PAS 198:2012: *Specification for managing environmental conditions for cultural collections* *Published* : March 2012 (http://shop.bsigroup.com/en/ProductDetail/?pid=000000000030219669)
Canadian Conservation Institute	*Guidelines based on the ASHRAE Handbook*	*Environmental guidelines for museums*; last modified 08/10/13 (http://www.cci-icc.gc.ca/resources-ressources/carepreventivecons-soinsconspreventive/enviro-eng.aspx)
Image Permanence Institute (IPI)	*World leader in the development and deployment of sustainable practices for the preservation of images and cultural property*	*IPI's Guide to Sustainable Preservation Practices for managing storage environments*, 2012 (https://www.imagepermanenceinstitute.org/store/publications/sustainable-preservation-practices-guidebook)
National Museum Directors' Council (NMDC)	*Represents the leaders* of the UK's national collections and major regional museums	*NMDC guiding principles for reducing museums' carbon footprint*, 2009 (http://www.nationalmuseums.org.uk/media/documents/what_we_do_documents/guiding_principles_reducing_carbon_footprint.pdf)

International discussion

In 2009, AICCM (Australian Institute for the Conservation of Cultural Material) established an Environmental Guidelines Task Force to provide Australian conservators and museums with a position on the global debate on safe environmental parameters for the display and storage of objects and collections. The AICCM's 2014 interim guidelines recommended temperature and RH as follows:

- Temperature: between 15–25°C with allowable fluctuations of +/-4°C per 24 hr
- Relative Humidity: between 45-55% with an allowable fluctuation of +/- 5% per 24 hr.
- Where storage and display environments experience seasonal drift, RH change to be managed gradually across a wider range limited to 40% – 60%.

The Task Force also noted that:

- specific requirements for sensitive or fragile collections, and for collections on loan, should be determined in consultation with a professional conservator
- some material will require different or tighter conditions which may be managed through, for example, the use of micro–climates.
- additional specific environmental requirements, such as light levels, air-flow, and other conditions, should be determined based upon professional conservation advice.

The AICCM position reflects the AIC (American Institute for Conservation of Historic and Artistic Works) opinion that single standards for temperature and relative humidity are not suitable or necessary for all collection objects. The AIC advises that if standards are broadened, the needs of individual objects, groups of objects, and sensitive materials must be recognized and addressed by the use of micro-climates or other mitigation measures. The AIC also noted that any alteration of standards will require:

- a greater understanding of case design and the use of micro-climates to create appropriate environments for sensitive objects
- proper evaluation of the moisture content and sensitivities of objects in order to design safe and sustainable environments.

In September, 2014 at the IIC (International Institute for Conservation of Historic and Artistic Works) congress in Hong Kong and the ICOM-CC (International Council of Museums Committee for Conservation) conference in Melbourne delegates discussed and agreed on a new position for Environmental Guidelines. The position includes support to convert existing interim guidelines to guidelines, including those by AICCM. For details, see **Appendix 2.** The collaborative outcome is a significant achievement for the conservation profession.

Sustainability of environmental conditions: activities, issues, examples

National Library of Scotland

The National Library of Scotland has increased the environmental range in collection storage areas and makes cost effective seasonal adjustments. This has been achieved by expenditure on a combined heat and power plant (CHP).

HVAC systems: Dutch experience

Complex HVAC systems are used to optimise the indoor climate for preservation and visitor comfort. The article's author considers that these systems regularly do not function according to their design specifications. Malfunctioning or faultily designed systems can disrupt climate conditions near

collections and may decrease the lifetime for exposed or stored objects. Constant checking of indoor climate conditions and the use of independent monitoring systems is recommended, thus increasing the cost of environmental control.

A museum storage facility controlled by solar energy

A new Danish museum storage facility provides an excellent example of a sustainable building:

- climate is controlled by solar heating
- temperature is moderated by heat storage below the ground floor
- insulated superstructure and good airtightness shield against weather variations
- relative humidity is kept moderate by solar heating of attic space through a roof window
- heat is slowly released through the ceiling to the storage space below, giving a temperature which cycles annually between 10 °C and 25 °C
- fine humidity control is achieved by use of moisture reactive wall surfaces, such as clay in the form of unfired brick.

Passively conditioned zero-energy storage for cultural properties and archival material

The Fraunhofer-Institute for Building Physics (IBP) has developed an economical and sustainable solution for a zero-energy building which meets conservation requirements, neutral energy balance and modular design. Modelling and building simulations have aided the design of different module types for storage buildings, such as a painting module, a furniture module, a paper archive module for paper, etc. The concept uses construction material and processes that minimise retention of moisture.

Managing Collection Environment Initiatives

In April, 2014 the Getty Conservation Institute identified a number of initiatives in relation to collection environments:

- carry out research that will address critical questions pertaining to the behaviour of materials under a range of environmental conditions
- propose viable decision making and practical strategies for collection environments, based on an understanding of risk and incorporating recent advances in active and passive environmental control

- encourage critical dialogue among other colleagues working in this area through collaboration, workshops, and expert meetings
- disseminate results through educational activities, publications, and professional meetings.

Alternate considerations

No energy driven conditions

Not all literature focuses on using technology for provide acceptable environmental conditions. *How the usual museum climate recommendations endanger our cultural heritage* argues that the standard temperature/RH ignores recent scientific research in areas such as the influence of temperature on the

speed of degradation. The German castle Moritzburg houses the world's largest collection of baroque gilt leather wall hangings. Its exhibition rooms are traditionally unheated and room climates fluctuate over the year with annual averages of 11 °C and 65 % RH. It is one of many examples where groups of materials have minimal or no damage as a result of an environment which is contrary to existing 'rules for museums'.

'Expected collection lifetime'

Recent guidance for British cultural collecting organisations recommends that environmental controls should be determined within the context of the 'expected collection lifetime'. *Collections demography: stakeholders' views on the lifetime of collections* describes a public engagement project which asked stakeholders about the value and lifetime of collections. The results, along with significance, use and material type, could inform the use of specific damage thresholds and, therefore, different environmental controls, depending on an item's expected collection lifetime.

An active application of this concept is the West storage facility. Collections are stored in long-term storage facilities or full-service libraries. Long-term storage meets standards for environmental control, while full-service libraries rarely meet the. Material is assessed according to 'archive type' and stored accordingly.

These models move away from the 'one size fits all' concept where most items/material types are stored collectively. Being selective about which items receive the highest level of environmental protection could support the segmentation of storages spaces, and the associated levels of environmental control, as per the IBP model above.

Key documents

Two recent publications document current environmental issues for collection storage.

The Plus/Minus Dilemma: the way forward in environmental guidelines

Provides transcript and comments from a roundtable of over 600 conservators, scientists and collection care professionals, held on 13 May, 2010 Milwaukee Wisconsin, USA, by the International Institute for Conservation of Historic and Artistic Works (ICC) in collaboration with the American Institute for Conservation and its annual meeting.

Overview:
Environmental guidelines for museums and archives have been defined within narrow parameters. The apparently unassailable standard of 20° C +/- and 50% RH +/- came when energy was relatively cheap, global climate discussions were not yet mainstream and HVAC systems focused on control rather than efficiency. The energy crisis, the global economic downturn and the rising awareness of *green* technology have made responsible and efficient environmental control essential.

Climate for Collections: Standards and uncertainties

First published in 2013 by Archetype Publications Ltd in association with Doerner Institut, Munich, this document:

- comprises 35 papers from the Munich Climate Conference, 7 to 9 November 2012
- has a particular focus is on Museums, but content is generally applicable to the library environment.

Appendix 2

IIC announces declaration on Environmental Guidelines

Submitted by Athanasios Velios on 26 Sep 2014

Friday, 26 September, 2014

Place: Hong Kong

The IIC 2014 Congress has wrapped up in Hong Kong with the announcement in the closing ceremony of the joint IIC and ICOM-CC declaration on environmental guidelines. Developed in conjunction with ICOM-CC through a joint working group, the declaration was drafted at the ICOM-CC conference in Melbourne last week, and finalised in a plenary session in Hong Kong.

The full text follows:

Environmental Guidelines – IIC and ICOM-CC Declaration

At the IIC congress in Hong Kong and the ICOM-CC conference in Melbourne in September 2014 the delegates discussed and agreed the following declaration:

The conservation profession has come together and agreed a position on environmental guidelines as follows:

Sustainability and management

- The issue of museum sustainability is much broader than the discussion on environmental standards, and needs to be a key underlying criterion of future principles.
- Museums and collecting institutions should seek to reduce their carbon footprint and environmental impact to mitigate climate change, by reducing their energy use and examining alternative renewable energy sources.
- Care of collections should be achieved in a way that does not assume air conditioning (HVAC). Passive methods, simple technology that is easy to maintain, air circulation and lower energy solutions should be considered.
- Risk management should be embedded in museum management processes.

Museum environment

- It is acknowledged that the issue of collection and material environmental requirements is complex, and conservators/conservation scientists should actively seek to explain and unpack these complexities.
- Guidelines for environmental conditions for permanent display and storage should be achievable for the local climate.

Loans

- There needs to be transparency about actual environmental conditions achieved in museums to ensure that realistic requirements are made for loan conditions.
- Noting that most museums in the world have no climate control systems in their exhibition and storage spaces, we acknowledge the need for a document that will influence decision makers that the environmental conditions for international loans may not be appropriate for the permanent display and storage of collections in all museums.
- There needs to be flexibility in the provision of environmental conditions for loans from museums which have climatic conditions different from the set points in the guidelines. This may be achieved with alternative strategies such as microclimates.

Existing guidelines

- The existing interim guidelines agreed by AIC, AICCM, the Bizot group etc (see Appendix) should be guidelines not interim guidelines. It is noted that these guidelines are intended for international loan exhibitions.

APPENDIX

Bizot Interim Guidelines for Hygroscopic Materials

For many classes of object[s] containing hygroscopic material (such as canvas paintings, textiles, ethnographic objects or animal glue) a stable relative humidity (RH) is required in the range of 40–60% and a stable temperature in the range 16–25°C with fluctuations of no more than ±10% RH per 24 hours within this range.
More sensitive objects will require specific and tighter RH control, depending on the materials, condition, and history of the work of art. A conservator's evaluation is essential in establishing the appropriate environmental conditions for works of art requested for loan.

The AICCM recommended Interim Temperature and Relative Humidity Guidelines for acceptable storage and display conditions of general collection material are:

Temperature – between 15–25°C with allowable fluctuations of +/-4°C per 24 hr
Relative Humidity – between 45-55% with an allowable fluctuation of +/- 5% per 24 hr
Where storage and display environments experience seasonal drift, RH change to
be managed gradually across a wider range limited to 40% – 60%
Temperature and Relative Humidity parameters for preservation of cultural materials will differ according to their material, construction and condition, but stable conditions maintained within the parameters above are generally acceptable for most objects.

AIC Interim Guidelines endorsed by the Association of Art Museum Directors:

For the majority of cultural materials, a set point in the range of 45-55% relative humidity with an allowable drift of +/-5%, yielding a total annual range of 40% minimum to 60% maximum and a temperature range of 59-77ºF (15-25ºC), is acceptable.

- Fluctuations must be minimized.
    - Some cultural materials require different environmental conditions for their preservation.
    - Loan requirements for all objects should be determined in consultation with conservation professionals.

Appendix 3

Summary of policies relating to environmental management reported by NSLA Libraries

Library	Title of policy/guideline	Year developed	Organisational unit responsible	When scheduled for review	Comment
Libraries ACT					No policies or guidelines
NLA	Environmental Management Plan	2002	Preservation Services	2014	
NLA	Preservation Policy	Reviewed 2009	Preservation Services	2014/15	Does not refer to specific parameters
SLNSW	Preservation Policy	2012	Collection Care	2014	Does not mention specific parameters
SLNSW	Outward Loan Agreement	2012	Collection Care	2014	
SLQ	Specification for Lighting Control	2004	Collection Preservation	Reviewed on annual basis	
SLQ	Specification for Climate Control	2004	Preservation Services	Reviewed on annual basis	
SLQ	Integrated Pest Management	2006	Preservation Services	Reviewed on annual basis	
SLSA	Standards for Environmental Control in Collection Stores	2004	Preservation Services		

Library	Title of policy/guideline	Year developed	Organisational unit responsible	When scheduled for review	Comment
	v.2				
Library	**Title of policy/guideline**	**Year developed**	**Organisational unit responsible**	**When scheduled for review**	**Comment**
SLV			Conservation & Preservation Unit and People and Property Unit responsible for setting and maintaining agreed environmental parameters of collection storage		No policies or guidelines reported
SLWA	Preservation Policy	1991	Manager, Preservation and Maintenance	2014	

Appendix 4

Summary of environmental parameters across NSLA sites

AICCM Interim Temperature and relative Humidity Guidelines (2014):

- Temperature between 15 - 25°C with allowable fluctuations of +/- 4°C per 24 hours
- Relative humidity between 45 – 55% with an allowable fluctuation of +/- 5% per 24 hours
- Where storage and display environments experience seasonal drift, RH change to be managed gradually across a wider range limited to 40% - 60%

		Libraries ACT (2014)	LINC TAS (2012)	NTL (2012)	NLA (2012)	SLNSW (2012)	SLNSW (2014)	SLQ (2012)	SLSA (2012)	SLV (2012)	SLV* (2014)	SLWA (2012)	SLWA (2014)
Standard print collection	°C	21 ± 2	20 ± 2	24 ± 1	20 ± 2	23 ± 2	-	21 ± 1	20 ± 5	22 ± 4	21 ± 5	20 ± 2	20 ± 2
	RH	50 ± 5	50 ± 10	N/A	45 ± 5	50 ± 10	-	50 ± 5	50 ± 5	50 ± 10	50 ± 10	50 ± 5	50 ± 5
Australian/Stateiana print collections	°C	21 ± 2	20 ± 2	24 ± 1	20 ± 2	23 ± 2	-	21 ± 1	20 ± 5	-	22 ± 1	20 ± 2	20 ± 2
	RH	50 ± 5	50 ± 10	N/A	45 ± 5	50 ± 10	-	50 ± 5	50 ± 5	-	n/a	50 ± 5	50 ± 5
Rare print materials	°C	21 ± 2	20 ± 2	21 ± 2	18 ± 2	23 ± 2	-	21 ± 1	20 ± 5	-	21 ± 1	20 ± 2	20 ± 2
	RH	50 ± 5	50 ± 10	50 ± 5	40 ± 5	50 ± 10	-	50 ± 5	50 ± 5	-	52 ± 7	50 ± 5	50 ± 5
Pictures	°C	21 ± 2	20 ± 2	21 ± 2	20 ± 2	23 ± 2	-	21 ± 1	20 ± 5	-	21 ± 1	20 ± 2	20 ± 2
	RH	50 ± 5	50 ± 10	50 ± 5	45 ± 5	50 ± 10	-	50 ± 5	50 ± 5	-	52 ± 7	50 ± 5	50 ± 5
Manuscripts	°C	21 ± 2	20 ± 2	21 ± 2	20 ± 2	23 ± 2	-	21 ± 1	20 ± 5	-	21 ± 1	20 ± 2	20 ± 2
	RH	50 ± 5	50 ± 10	50 ± 5	45 ± 5	50 ± 10	-	50 ± 5	50 ± 5	-	52 ± 7	50 ± 5	50 ± 5

		Libraries ACT (2014)	LINC TAS (2012)	NTL (2012)	NLA (2012)	SLNSW (2012)	SLNSW (2014)	SLQ (2012)	SLSA (2012)	SLV (2012)	SLV* (2014)	SLWA (2012)	SLWA (2014)
Newspapers	°C	21 ± 2	20 ± 2	21 ± 2	20 ± 2	23 ± 2	-	21 ± 1	20 ± 5	-	21 ± 1	20 ± 2	20 ± 2
	RH	50 ± 5	50 ± 10	50 ± 5	45 ± 5	50 ± 10	-	50 ± 5	50 ± 5	-	52 ± 7	50 ± 5	50 ± 5
Microforms	°C	21 ± 2	19 ± 1	8 ±1	20 ± 2	18 ± 2	18 ± 2	23 ± 2	20 ± 5	-	21 ± 1	20 ± 2	20 ± 2
	RH	50 ± 5	45 ± 5	35 ±5	45 ± 5	50 ± 5	45 ± 5	60 ± 5	50 ± 5	-	52 ± 7	50 ± 5	50 ± 5
Audio	°C	21 ± 2	20 ± 2	24 ± 1	17 ± 1	18 ± 2	-	21 ± 1	20 ± 5	-	21 ± 1	20 ± 2	20 ± 2
	RH	50 ± 5	50 ± 10	N/A	30 ± 5	50 ± 5	-	50 ± 5	50 ± 5	-	n/a	50 ± 5	50 ± 5
Video	°C	21 ± 2	20 ± 2	24 ± 1	18 ± 2	18 ± 2	-	21 ± 1	20 ± 5	-	21 ± 1	20 ± 2	20 ± 2
	RH	50 ± 5	50 ± 10	N/A	40 ± 5	50 ± 5	-	50 ± 5	50 ± 5	-	n/a	50 ± 5	50 ± 5
Film	°C	21 ± 2	14 ± 2	21 ± 2	n/a	N/A	-	4 ± 1	20 ± 5	-	21 ± 1	10 ± 2	10 ± 2
		50 ± 5	45 ± 5	50 ± 5	n/a	40	-	35 ± 5	50 ± 5	-	n/a	35 ±5	35 ± 5
Colour negatives	°C	21 ± 2	20 ± 2	21 ± 2	8 ±1	N/A	-	4 ± 5	20 ± 5	-	21 ± 1	2 ± 2	2 ± 2
	RH	50 ± 5	50 ± 10	50 ± 5	35 ±5	40	-	35 ± 5	50 ± 5	-	n/a	35 ±5	35 ± 5
Nitrate	°C	± 2	n/a	n/a	n/a	n/a	-	4 ± 1	20 ± 5	9 ± 2	n/a	2 ± 2	2 ± 2
	RH	50 ± 5	n/a	n/a	n/a	40	-	35 ± 2	50 ± 5	35	n/a	35 ±5	35 ± 5

*Note: Based on active environmental controls rather than parameters

Source: Storage Survey 2012 and Environmental Management Practices for Collection Storage Survey 2014