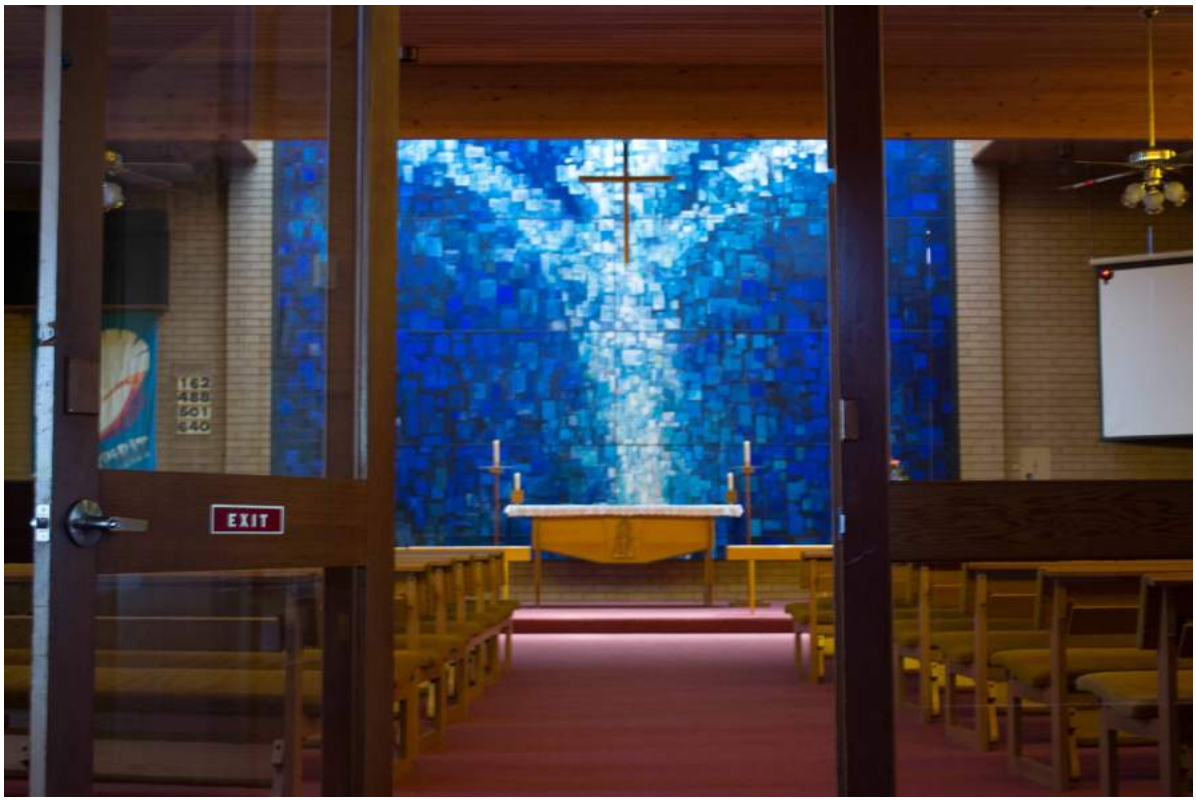
A Technical Investigation of *The Ascending Christ* (c.1960) by Arthur Boyd



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ABSTRACT

Despite guidelines available for communities to care for works of art housed in museum environments or to address architectural conservation, there are few guiding principles aimed at the non expert heritage professional for wall painting conservation in situ (Rainer 2003, p. 8). There are several reasons for this: the technical aspects of murals are intertwined with inherent problems related to the structure of the building and environmental factors that affect the composite painting materials, and; conservation standards are highly dependant on institutional priorities, values and capabilities; for small communities research and maintenance can be costly and systems concerned with management are subject to change over time.

The Ascending Christ (c.1960), housed within St Mary's Anglican Church, Morwell, is a rare example of Arthur Boyd's experimentations with abstraction and resonates both social and historical significance for the Morwell Church community. Whilst the aesthetic and spiritual value of the mural is formally recognised by the Latrobe City Heritage Overlay, currently there are few conservation measures in place to protect the physical and chemical condition of the mural from a conservation perspective. The large size of the mural renders conservation a complex activity and furthermore, the need to integrate the physical and contextual situation of *The Ascending Christ* within a model for conservation management highlights the need for a localised approach to conservation research and analysis.

Limited documentation arising from a lack of understanding regarding the issues associated with murals was found to be one of the key conservation issues and so it was felt that more technical information was required to better understand the materiality of *The Ascending Christ* and its susceptibility to deterioration.

An analytical examination of the mural was conducted utilising preliminary physical and scientific instrumental analysis and a review of primary and secondary literature provided connoisseur knowledge to supplement identification of material risk factors. Given that mural paintings are inherently related to the building environment they inhabit, it was necessary to consider *The Ascending Christ* in relation to its current place of housing, St Mary's Anglican Church, Morwell. An extensive literature survey of the Diocese internal records as well as the scholarship of Arthur Boyd that encompassed his experience with the materials and techniques of mural painting was also deemed necessary to begin to address this knowledge gap.

As an outcome, this minor thesis seeks to address and eliminate some of the ambiguity surrounding *The Ascending Christ*. From this the aim is to develop a viable conservation approach that might be more readily implemented by the Diocese. Additionally, insights gained from this research and analysis assist in developing a knowledgebase relating to safe-housing murals outside institutional museum environments and provide greater foundation for the practice of conservation within a religious heritage context.

PREFACE

This research stems from a request from the Anglican Diocese of Gippsland to the Grimwade Centre for Cultural Materials Conservation, University of Melbourne (GCCMC) for advice relating to conservation of the mural painting *The Ascending Christ* (c.1960) by Arthur Boyd, housed within St Mary's Anglican Church, Morwell.

In August 2015, Diocese consultant Kerrie Schmidt contacted the GCCMC seeking advice regarding conservation of the mural following the outcomes of a cultural heritage significance assessment made for the *Latrobe City Heritage Study* in 2008. The results and observations made in this report have been integrated into this study. It hoped that the findings of this minor thesis research will contribute to the knowledgebase and ongoing conservation of *The Ascending Christ*.

The Anglican Diocese of Gippsland will be provided with a copy of this research, photographic documentation and analytical data collected during this study.

Declaration of Sole Authorship

The work in this project was undertaken to partially fulfill the requirements of the University of Melbourne for the degree of Master of Arts (Cultural Materials Conservation). The views expressed are those of the author and aim to reflect the views of the GCCMC with consideration to the Australian Institute for the Conservation of Cultural Materials (AICCM) Code of Ethics and Practice and current Victorian state heritage guidelines.

Acknowledgements

A warm thank you to Brian Norris and Kerrie Schmidt of The Anglican Diocese of Gippsland, The Reverend David Head and the St Mary's, Morwell Parish community for facilitating me to conduct research on *The Ascending Christ* both in-situ and from afar. At all levels, communication was pleasurable, insightful and highly endearing.

Greatest thanks to my family and friends whose persistent emotional support, enthusiasm for the project and sense of perspective I could not have completed this thesis without. Also,

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INTRODUCTION

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Concern regarding the conservation of 'properties of religious interest' is increasingly prominent within the museum and heritage sector however for the non-expert heritage professional, the implementation of conservation strategies can seem particularly challenging when the object in question is both a tangible and intangible expression of a place and its community (UNESCO 2010, p. 1; Alexopoulos 2013, p. 1; Stovel 2005, p. 2). *The Ascending Christ* (c.1960) by Arthur Boyd, is one such example. Housed within St Mary's Anglican Church, Morwell, the mural resonates social and historical significance for the local Church community and is a rare example of Arthur Boyd's experimentations with abstraction yet uncertainty exists about where to begin to conserve the mural and what direction the preservation strategy should take. Whilst guidelines exist to assist communities to care for works of art housed in museum environments and to address technical issues for architectural conservation, within the available conservation literature little emphasis is given to the hybrid form of wall paintings. Furthermore, the discourse often stresses the ethical obligation of a participatory action approach to conservation of which is generally not feasible within the capacity of frameworks of the Church nor practical to deal with the large scale nature of mural paintings (Stovel 2005, p. 2). Within this context, an obvious place to begin conservation of *The Ascending Christ* seems to be with an object-centred approach. As such, this minor thesis aims to be a preliminary step towards greater understanding of the conservation needs of *The Ascending Christ* and to the conditions necessary to invoke community engagement within the means the St Mary's Anglican Church.

A preliminary review of the records pertaining to *The Ascending Christ* revealed that although the social history of the mural is relatively well documented, there are no measures in place to protect the physical and chemical condition of the mural from deterioration and, details regarding the materials and techniques of the artwork is currently not known from a conservation perspective. Most records purport *The Ascending Christ* to be made with 'casein tempera on hardboard' however none of these records originate from the artist himself nor evocate the making of the mural and the mural has not undergone comprehensive physical examination previously. Whilst mural painting is synonymous with Christian artistic traditions, it was also noted that *The Ascending Christ* is not mentioned nor generally considered significant in Arthur Boyd's artistic oeuvre meaning that a study of Boyd's scholarship and painting practice prior to mural commission was an important task to undertake to better understand his material choices and technical competency for executing the artwork. Considering that limited documentation was found to be one of the key conservation issues, it was felt that more technical information was required in order for the Diocese to formulate a conservation planning strategy appropriate to the context of *The Ascending Christ* and the need to integrate the physical and contextual situation of *The Ascending Christ* within a model for conservation management highlighted the need for a holistic approach to conservation research and analysis. Furthermore, the importance of understanding murals both as a combined and separate entity to the building structure prior to developing a conservation planning strategy appears consistently in contemporary conservation literature and guidelines. Given the rapid response required of a minor thesis timeframe, the research focussed on two objectives: to contribute conservation expertise to characterise the materials and techniques of *The Ascending Christ*, and, to develop a set of documentation for the Diocese to begin to evaluate the condition of the mural and the conservation issues associated with housing the mural in situ.

For a site not previously studied in any detail, an approach that converges multiple inputs of contextual information was deemed useful to begin to build a broader insight into the material issues that impact the conservation of *The Ascending Christ*. A methodology that consisted of collating, organizing and cross-examining existing documentary sources with the results of scientific analysis is employed to extricate the material properties of *The Ascending Christ* and used to draw reasoned conclusions that aim to enable the Diocese to develop a conservation planning strategy.

To begin with, an extensive literature survey of the Diocese internal records was conducted as well as a study of scholarship of Arthur Boyd that encompassed his experience with the materials and techniques of mural painting. In the absence of primary records accounting for the materials and techniques of *The Ascending Christ*, a comprehensive survey of existing secondary literature provides the basis for characterizing the materials and techniques of the mural and to highlight considerations for appropriate conservation. The survey of documentary sources identifies a lack of evidence-based records pertaining to

The Ascending Christ and so physical and scientific data collected using both empirical and instrumental analytical techniques aims to supplement the identification of material risk factors. Considering the underlying goal of this minor thesis is to provide a preliminary understanding of the mural from a conservation perspective, the methodology to elucidate object-specific information adopts a positivist approach to provide a practicable basis for the Diocese to develop a conservation planning strategy. With this being the premise, the research findings are articulated in graphical manner so as to clearly demonstrate a pathway towards conservation that considers the ethics of museum standards within the wider context of non-professional heritage environments.

It is proposed that insights gained from this research and analysis will assist in developing a knowledgebase relating to safe-housing murals outside institutional museums venues and provide greater foundation for the practice of conservation within religious heritage environments. Additionally, this minor thesis establishes an 'as-found record' of *The Ascending Christ*, contributing a significant new dossier to Arthur Boyd's artistic legacy and to the Diocese archives.

Thesis Structure

In order to provide advice to the Anglican Diocese of Gippsland, this minor thesis will employ the method of data triangulation to identify the conservation needs of *The Ascending Christ*. The details of this research approach will be outlined in more depth in Chapter two.

Chapter one will begin by introducing the background and context for conservation surrounding the mural followed by the explanation of the research methodology in Chapter two. Chapter three will summarise the findings of documentary source research relating to the mural's materiality and mural painting traditions and Chapter four will explain the object-based analysis. Documentary sources will be reviewed to assess the susceptibility of *The Ascending Christ* to the common factors of deterioration associated with mural painting and object-based examination will be used to characterise the material and techniques of *The Ascending Christ*. finally, the applied research will be interpreted and contextualised in Chapter five, cross-referencing the findings of both methods of investigation.

A rigorous assessment of the data collected will be used to conclude the strongest case for the conservation measures required of the materials identified and at the same time function to provide a comprehensive record of the data collected for ongoing monitoring and evaluation.

Chapter 1: Context for Research

In the field of conservation, it is commonly regarded that the most important factors for the conservation of religious heritage objects are the determinant social contexts for whom the object exists to function (Stovel 2005, p. 1; Muir 2009, p. 2). There are multiple contexts for which a mural is a 'dynamic, vital artistic record' (Shank & Drescher 2007, p. 299) including the local community; daily audience of the mural, the artist, the patrons, the owners of the wall underlying the artwork, the conservation/ policy community; local, state, national and international heritage councils and initiatives, and, the future community of the mural of which can not be fully known. For conservators, there is a clear imperative to recognize the social value of a mural at all levels. Jones and Holden provide a useful reflection on the role of the conservator in this context explaining that 'how things are kept and cared for demonstrates their significance not just as objects, buildings or landscapes but in terms of how much value we place on them. What we conserve is a statement of what we respect, who we are and who we wish to be' (2008, p. 15).

It is therefore important to consider all whose interests and opinions may influence the development of a conservation strategy for *The Ascending Christ* to ensure that subsequent detailed investigations aim to contribute optimal value to those concerned. This chapter outlines the various contexts for which *The Ascending Christ* holds value and therefore for whose interests this minor thesis research aims fundamentally to serve.

Local community

St Mary's Parish

The mural is located in St Mary's Anglican Church, Morwell. The church is used on a weekly basis and on the occasion of funeral, baptism and wedding services. Regular church use is as follows:

Wednesday service at 10am at which around 10 to 15 people attend
Sunday service at 8am at which around 10 to 13 people attend
Sunday service at 10am at which around 35 to 50 people attend
Sudanese Nuer language worship on Sunday at 4pm at which around 20 to 30 people attend
Attendance at a funeral or baptism service varies but around 250 people may attend.

In addition, there are regular groups that use the hall who can see the mural but not use the church. These are: the Morwell Slimmers group, the local Alcoholics Anonymous group and at present a work training group for 3 days a week for several months (Head 2016, pers. comm., 12 April). What is consistent is that the church space containing the mural is routinely frequented by people meaning the mural is frequently observed and the building environment unofficially monitored.

Ownership and patronage

The Ascending Christ was originally commissioned for St John's Anglican Church, Yallourn with funds raised by the St John's Ladies Guild. It was installed and dedicated in May 1960 however when the Yallourn town site was set for demolition c.1976, it was bequeathed to The Anglican Diocese of Gippsland (Hugeunin 1996, pp. 47-48). The mural was re-located to St Mary's Anglican Church, Morwell who were subsequently planning the addition of a new church building to their Parish hall premises and the new church was opened in 1980 at the 6 Latrobe Road address in Morwell (Context 2010, p. 370). Many Yallournites had re-settled in Morwell and as such many of the former St John's parishioners took up worship with the St Mary's parish (Fletcher 2002, p. 202). The mural remains the ownership of The Diocese of Gippsland but the history of its origins in Yallourn form a significant link with the cultural significance of its present location in Morwell. The timeframe that the mural was commissioned coincides with the widening appreciation of art within the Australian community cited by Bernard Smith's seminal historical account *Australian Painting: 1788- 2000* (Smith et al. 2001, p. 342).

Attribution: Arthur Merric Bloomfield Boyd (24 July 1920 – 24 April 1999)

The Ascending Christ is signed, but undated. Although it is not considered to be of Boyd's artistic oeuvre; The Bundanon Trust who manage copyright of Arthur Boyd's works, were not aware of the mural until an illustration of *The Ascending Christ* was published in *Anglicanism in Australia: A history*, by Melbourne University Press (Holden 2002, personal comm. 18 June), sufficient evidence remains to support that he was the artist.

Figure 1. *The Ascending Christ* (c.1960), detail of third bottom panel from the left of the mural showing Arthur Boyd's signature, photo by Dominic King.

The first records of the mural found in the Diocese archives refer to the date that St John's Church Yallourn was dedicated, 8 May 1960, and considering Boyd's catalogued works (Philipp 1967) it is assumed *The Ascending Christ* was commissioned between 1955 and 1960.

Historical research regarding Boyd's artistic practice during the mural's purported execution period demonstrates that Boyd ceased dating his artworks during the mid 1940s for the reason that he is said to have become less interested in formulating his artistic identity based on a particular style and surface quality and instead was more interested in forming a continuum of iconography as an artistic legacy (Gunn 1985, p. 14). Furthermore, Boyd's humanistic beliefs of his role as an artist demonstrate a social consciousness aligned with *The Ascending Christ* commission (Gunn 1985, p. 14):

> The whole thing has to become a community thing. The individual will still be important, but it can't any longer be a signature thing. In a way I feel guilty when I sign my name… the only reason you do it is because you know you can get money for it and the reason you want money is to pay for possessions and apart from food it is not a terribly edifying concept… You must do something which is connected with the community… making use of an idea which really belongs to the community in the same way that art or convention does… and I stopped dating pictures.

The most confirmatory evidence to support the attribution of the artwork is a reference to the mural painting that features in Franz Philipp's monograph of Arthur Boyd (1967, p. 79), Chapter VIII, *Landscapes of the Late Fifties, 1956-9:*

> Late in 1955 there is a passing phase in which he experimented with an idiom of small cubes, similar in effect to mosaic tesserae…in an altar-painting for a church in Yallourn, Gippsland (cat. 9.33), the tesserae form a Y-shaped crucifix…

It is pertinent to note that in the appendix the artwork is referred to under the title *Crucifixion* and is stated to be made in oil on board which is contrary to all other records that list *The Ascending Christ* to be painted in casein tempera on hardboard.

APPENDIX

In the years in which Arthur Boyd was predominantly occupied with the work on the Olympic Pool monument he painted a few pictures catalogued below; some experiment with abstract and semi-abstract modes of expression.

32 NIGHT 1955–6. Oil on board, 36 × 48, signed b. r. Collection Messrs. Desmond Digby and James Allison, Sydney. Exhibited: 1956 S.S. *Orcades*, no. 6. 1958 Australian Galleries, no. 70 (Title: *Night City*).
See p. 79.

33 CRUCIFIXION 1955–6. Oil on board, 16 × 24 feet. St John's Church of England, Yallourn, Victoria. Note: The painting covers the whole altar wall of the church.
See p. 79.

Figure 2. Appendix listing, cat. 9.33, from Franz Philipp's monograph, *Arthur Boyd* (1967, p. 260)

Philipp identifies only one other painting, *Night* c.1955 (available for sale through Cook Hill Galleries, NSW) to be painted in the same stylistic manner as *The Ascending Christ* (1967 pp. 79; 260) and even so, it is painted in oil, is considerably smaller in size (90 x 121cm) and completely non-figurative.

Figure 3. *Night*, Arthur Boyd, c.1955, oil on board, image: Cook Hill Galleries 2016

Philipp's monograph was written in correspondence with Boyd however both men have now passed away (Franz Phillip (2 June 1972) and Arthur Boyd (24 April 1999). Boyd's wife, Yvonne Boyd has also since passed (12 November 2003) leaving little primary contacts for information pertaining to the artist's construction of the mural.

Policy Context

Latrobe City Heritage Study 2010

The Ascending Christ was independently assessed by Context Heritage Consultants for the Latrobe City Council in 2008 and under the study's adopted RNE assessment criteria (Register of the National Estate; since superseded), the mural was listed at the level of 'Local Significance' in a published report in 2010. The primary reason given that the mural is included in the Latrobe City Heritage Overlay is the fact that Arthur Boyd was the artist. The official statement of significance merits:

> *The Ascending Christ* is of historic significance as a rare example of a mural commission by Arthur Boyd, one of Australia's foremost painters, in a public building and the only known example of his work in Gippsland. The mural illustrates Boyd's exploration of spiritual themes during the late 1950s and early 1960s (RNE criteria A.4, B.2, D.2 and H.1)

The Study highlighted that prior to future changes to the mural or church property 'a more detailed technical assessment…should be carried out by Council's Heritage Advisor or an appropriately qualified professional' (Context 2010, p. 372).

Heritage Victoria

At the state level, Heritage Victoria provides guidelines for change and development of heritage places of worship in the form of a technical guide (titled *Guidelines for Change and Development of Heritage Places of Worship*) that is recognised under the Victoria Heritage Act (1995). The purpose of this document is 'to assist owners, managers, congregations, planners and decision makers with day to day thinking and planning for change' based on *The Burra Charter (1999)*, the adopted Australia *International Council on Monuments and Sites (ICOMOS) Charter for Places of Cultural Significance.* It provides general advice on the following maintenance and preservation issues:

Managing change for ongoing liturgical use,
managing the setting,
relocation and demolition,
building services and utilities,
accessibility and inclusion, and
environmental sustainability

There is no advice provided regarding maintenance and preservation related to artworks within heritage places of worship.

Heritage Collections Council Guidelines

The Australian Institute for Conservation of Materials Conservation (AICCM) provides publicly accessible guidelines to assist cultural institutions to develop appropriate strategies for optimum display environments for the long term preservation of cultural materials. The *Guidelines for Environmental Control in Cultural Institutions* are published by the Commonwealth of Australia on behalf of the Heritage Collections Council (2002) and foreground the notion of 'passive climate control' strategies and considerations prior to implementing a new conservation strategy.

International Principles and Guidelines

A number of doctrinal texts and forum activities are established internationally to provide guidelines and principles for ethical practice regarding heritage of monuments and sites with in situ value. Particularly in dealing with living religious heritage sites 'ethics is useful because it maps a principled pathway to help the museum to navigate through contested moral territory' (Alexopoulos 2013, p. 1).

Among the most frequently cited codes of ethics applicable to approaching conservation of *The Ascending Christ* are those advocated by the International Council on Monuments and Sites (ICOMOS), the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) and the initiatives of the World Heritage Centre for the United Nations educational, scientific and cultural organisations (UNESCO) that provide general guidance regarding management of cultural heritage places of interest.

Particular charters and doctrinal texts that constitute issues to do with wall paintings include the: *ICOMOS Principles for the Preservation and Conservation-Restoration of Wall Paintings (2003)*, *The Venice Charter* (1964); general principles for the conservation-restoration of cultural heritage, *The Amsterdam Declaration* (1975); the concept of integrated conservation and the *Nara Document on Authenticity* (1994); dealing with cultural diversity. The UNESCO Initiative on *Heritage of Religious Interest* further summarises three broad phases from these systems of principles suggesting a number of core activities be undertaken during implementing a conservation strategy for heritage of religious interest. These include preparatory activities that develop a research methodology, research activities that involve data collection, survey and analysis activities and the production of thematic papers that collate and analyse testing results and incorporate them into general guidance (UNESCO 2010, p. 4).

With regard to the conservation of wall paintings, project-specific investigations are highlighted as particularly necessary reflecting that because of the diverse nature of wall paintings, The ICOMOS principles 'does not take into account the particular problems of regions or countries, which can be supplemented at regional and national level'(ICOMOS 2003, p. 1).

Evidently, the international guidelines cited above can be useful to refer to as a set of principles to guide the conservation of *The Ascending Christ* but will also require supplementary investigations to support implementation.

Museums Australia (Victoria)

Museums Australia (Victoria) has a variety of resources available to assist both small and large museums with practice in regional Victoria. A comprehensive compilation of publications, templates and information sheets are available to download online at http://www.mavic.asn.au/resources. Documents addressing materials care include:

Conservation and Lighting in Museums
Museum Temperature and Humidity
Air Pollution in Museums
Environmental Monitoring in Museums
Starting or Improving a Museum

All documents, although useful for understanding some of the factors that cause damage to artworks, notably are aimed to address the care of objects in 'Museum' environments, however can be useful to consider comparatively to evaluate the facility of St Mary's Church to house the mural.

Current context for conservation

The Anglican Diocese of Gippsland

Concerns for safe-housing *The Ascending Christ* appears consistently throughout the Diocese records and within the culture of the community. This was identified through ethnographic research during a fieldtrips to St Mary's Church during September 2015 and January 2016 (a voluntary questionnaire, group discussion and personal communication) and this data was further enhanced and enriched by analysis of written sources maintained in the Diocese archives. Of significance, numerous discussions between The Anglican Diocese of Gippsland, St Mary's Parish Council and external bodies have arisen regarding relocating the mural to a more art specific venue. Reasons for this have been cited for a monitored display environment (Holden 2002, pers. comm., 18 June), exposure to a wider viewing audience and to provide a

clearer narrative context for the theme of the mural amongst other religious artworks (Norris 2009, pers. comm., 11 August; Kennedy 2003, pers. comm., 19 December). Direct letters to the Diocese Bishop from external persons namely, Donald Webb, advising architect for the original St Mary's Church building (1999) and the Reverend Dr Colin Holden, co-editor of historical publications for the Fine Arts Department of the University of Melbourne (2002) as well as a brief condition report by paintings conservator Judy Dunlop *(MA Fine Art, Dip. Cons.)* (2002) also express concern the mural's safe-keeping at St Mary's.

In all cases it appears action has not gone ahead due to external party costs in the relocation activity; re-fitting a new site to fit the large size of the mural is logistically complex and labour intensive, and replicas proposed to replace the mural have been deemed insufficient (Pickard 2015, pers. comm., 23 April; Guy 2003, pers. comm., 9 June; Holden 2002, pers. comm. 18 June). Also, the conservation assessment carried out by Dunlop is a written report based on empirical observations and no materials testing is recorded.

Given that the Diocese have shown interest in potentially implementing conservation activities, a better understanding of the physical components of the mural and its materiality would be beneficial and analysis from a scientific perspective will eventually be necessary should the mural require interventive treatment in the future.

Rationale

The fact that the existing information available pertaining to *The Ascending Christ* encompasses multiple historical, aesthetic and technical dimensions emphasises the need for more substantial and localised investigation of the mural to inform the development of an appropriate conservation strategy. In light of the distinctive social characteristics of murals housed in religious heritage environments outlined above, the methods of material analysis and diagnosis of condition employed in this minor thesis are inflected to consider the specific context that surrounds the *The Ascending Christ.*

Chapter 2: Research Methodology

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A 'bricoleur' approach

Like all conservation projects, the conservation of a mural painting 'should begin with substantial scholarly investigations' (ICOMOS 2003, p. 2; Clark 2007, p. 3; Letellier et al. 2007, p. xvii; Twinn 1999, p. 20; Pye & Sully 2007, p. 30). Unlike portable works of art, the conservation of murals belonging to living religious environments are governed not only by the materials and techniques arising from their special and spiritual character as an artwork but also by others that are imposed by the surrounding architecture and the building environment in general (Alexopoulos 2013, pp.1-13; Mayer 1991, p. 360). Given their site-specific nature, the elicitation of the technical aspects of mural paintings requires a broadened scope than that the traditional study of easel paintings predicates, by integrating the ideas and methodologies of different expert skill sets to provide the most pragmatic results (UNESCO 2010, p. 3; Mason 2012, p. 16; Scott 2008, p. 123; Ribeiro et al. 2012, p.15).

Considering this, it is most sensible to employ an interdisciplinary research approach that uses analytical tools in complementary ways with the aim to generate data that will be meaningful for a range of different professionals, accepting 'wide participation as an inherent aspect of conservation' (Mason 2012, p. 16; Letellier et al. 2007, pp. 31-32; Pye & Sully 2007, p. 29). Outlined by Mason, this type of analysis, known as the method of 'triangulation' in evaluation and monitoring fields, is particularly well suited to conservation studies in situations where there are several sources of heritage value that require consideration by stakeholders and when the knowledge generated by research is required to address members outside of the conservation field such as community-based organisations or other professional disciplines (2012, pp.16-17). The underlying notion of such an approach is that the culmination of different and complementary sources of information will be able to produce a comprehensive, robust and practicable set of data to inform decision making than would the pursuit of simply one disciplinary system of enquiry (Mason 2012, p. 16; Scott 2008, p. 123).

Such an approach exemplifies the interdisciplinary mindset expected of contemporary conservators whose holistic understanding of heritage conservation (ICOMOS 2003, p. 4; Rainer 2003, pp. 7-8; Pye & Sully 2007, pp. 29-30) can be used most effectively to offer 'some appraisal of the value of the object or phenomenon according to a scale of values internal to the profession'(Mason 2012, p. 19). In the wider social and policy contexts that surround a mural, expert analyses are 'de facto valuable' and so studies conducted in this way are able to generate practical data that is useful and readily able to be implemented by various disciplined professional and participants (Mason 2012, p. 20). Further to this explanation, Mason's description of the contemporary conservation researcher as 'a bricoleur: one who patches together different methods to glean different sorts of knowledge, iteratively, opportunistically, to build the best composite answer to the question at hand' (2012, p. 16), could in this sense be adopted to understand the role of the conservator in a mural conservation project.

Using a variety of data sources to strengthen conclusions about empirical findings also functions to reduce the risk of false interpretations that often arises when a range of sources are brought to the table for analysis and for this reason has been widely employed in other professional fields to conduct monitoring and evaluation of a particular phenomenon with the aim of providing key decision makers with new insights and relevant reference data to compare trends of condition overtime (UNAIDS 2010, p. 33).

Noting that in its current state the mural exhibits a generally sound appearance (the impetus for conservation has arisen from the community's mindfulness of the mural's value rather than obvious material degradation), the analytical pathway (figure 4) used in this minor thesis foregrounds the need to provide greater evidentiary basis to understand the materiality of *The Ascending Christ*.

It entails a three part method; first, employing secondary research techniques using existing and archival data (both internal Diocese records and general technical art history); second, conducting primary research using basic conservation examination techniques and base recording techniques as well as instrumental scientific analysis; and third, using graphical presentation modes to corroborate the material and technical findings and extricate sufficient information from which a well-informed conservation planning strategy can ensue.

Figure 4. Proposed analytical pathway outlining triangulation of data

It is proposed that from utilising such a methodology, a delineation between conservation priorities for the mural should become identifiable and should reach some form of assessment that will be familiar to other disciplined professionals who will require conservation knowledge to progress future work (Mason 2012, p. 19; Dallas 2007, p. 5). Further explanation of the investigatory tools employed in this minor thesis are detailed below.

Documentary Source Investigations

Historical and Documentary Research

Due to the limited object-specific information available to account for the material components of *The Ascending Christ,* the research methodology first concentrated on a general historical survey which consisted of identifying and collating primary and secondary sources relative to the description of the materials and techniques of the mural previously recorded but that have not been scientifically evidenced. Within the survey emphasis was placed on sourcing knowledge of materials and techniques likely to have been available to Boyd around the period of the mural's creation. Considering the mural is not generally recognized within studies of Boyd's oeuvre, the investigations focused on a rigorous study of the Diocese archival records, secular historical accounts of Arthur Boyd's artistic practice and a review of previous conservation studies investigating characteristics of Boyd's material choices and techniques. This includes artist's technical manuals in addition to the physical materials for support construction and painting.

Throughout the collection and survey phase, the aim is to build a knowledgebase to positively identify the materials of *The Ascending Christ* whilst simultaneously enrich an understanding of the mural painting tradition and best practice techniques.

The idea of collating the available documentary sources in this manner is to allow for consistencies across the data to be identified which can then be used to inform the diagnosis of conservation problems following the object-based investigations (Ribeiro 2012, p. 17; UNAIDS 2010, p. 38).

Object-based investigation methods

Basic Physical & Site Examination

An initial physical examination and standard form condition report is a priori to embarking on more sophisticated methods of materials analysis (Stuart 2007, p. 43) and even more so is necessitated before decisions about detailed analyses of large-scale, site-specific cultural heritage can be taken (Dallas 2007, p. 3).

Traditional conservation techniques using different types of lighting and optical microscopy (Stuart 2007, p. 72-102; Macbeth 2012, p. 291; Eastaugh & Walsh 2012, p. 306-317) are often less feasible for the examination of mural paintings (Fidler 2007, p. 1; Shank & Drescher 2007, p. 299) however, such hand-held devices as a magnifying glass, torch light and measuring tape; simple survey systems routinely employed by architects and surveyors, provide the ability to perform rapid, in situ analysis and require only few tools that are easily accessible to a conservator in the field (Dallas 2007, p. 5; Stuart 2007, p. 43). Lo-tech digital systems, such as a digital microscopes used in conjunction with a portable computer have also been readily adopted by conservators for in situ analysis of objects and during examination of *The Ascending Christ* a USB digital microscope was employed to assist in the selection of sampling sites excised for laboratory examination.

Apart from identifying important signifiers of decay and deterioration, examination by reflected light at both the micro and macro level can provide information regarding the nuances of colour and surface finish, and suggest the techniques of production method and aesthetics that assist architects and conservators to make informed decisions regarding changes and developments in heritage places of worship (Dallas 2007, p. 5; Macbeth 2012, p. 291; Stuart 2007, p. 1). A consideration of the regular viewing distance of the audience as well as the surface lighting dictated by the architectural design of the mural can also assist to determine sample sites that characterise the paint medium (Santacesaria, A 2006, p. 124).

Photography with visible light was used extensively to evaluate the homogeneity mural and its surrounding architecture when not present at the actual site. Although the use of photography and diagrams is already used as a basic methodology to record the physical condition of an object in the conservation field, the analytical potential offered by a wide range of image-based documentation used for 'base recording' in other related disciplinary fields have increasingly been recognised as useful to inform conservation decision-making for site-specific heritage objects (Mason 2012, pp. 18-21; Dallas 2007, p. 5). One such surveying technique, involving comparing multiple photographs of the same scene and commonly used in building surveys (Dallas, p. 7), was deemed useful to discover overall optical phenomena displayed across

the surface of the mural that was otherwise difficult to observe from standard eye height and for this reason a comprehensive photographic record was logged.

Instrumental Analysis

Instrumental analysis of the composite materials of paintings is generally the second step of object-based analysis. The analytical techniques used in laboratories are able to provide information regarding the chemical composition of materials at a molecular level that are otherwise not obvious to the naked eye (Stuart 2007, p. 1). An array of materials are employed in paintings. The support and main structural layers may be identified simply during the physical examination, however as a painting generally consists of multiple layers on top of the support (Stuart 2007, p. 29) more in-depth examination of excised samples is often required to be able to characterise the component materials of the paint layer. More detailed explanation of the instrumental analysis undertaken on samples excised from *The Ascending Christ* is provided in Chapter 4.

Chapter 3: Documentary Source Investigations

This chapter collates the findings of a review of existing primary and secondary documentary sources about *The Ascending Christ* based on the supposition that it is rightfully made with 'casein tempera on hardboard'.

The importance of understanding murals both as a combined and separate entity to the building structure appears consistently in contemporary conservation literature and guidelines and so a thorough cross-examination of technical art history, Diocese records and heritage guidelines was deemed a useful method to prepare a system of appraisal for the condition of the mural which will be further developed by the results of the object-based investigations and scientific analysis in Chapter 5.

Historical Research

A brief history of mural painting

The term *mural* derives from the Latin word *murus*, meaning wall and generally refers to a work of art that is applied to a permanent surface that occupies an architectural space (Oxford Dictionary 2003; Rainer 2003, p.1). Murals have been used extensively to signify religious establishments within the built environment and to communicate liturgical narratives and since the legalization of Christianity in 313, the commissioning of murals has done much to encourage the refinement in materials and techniques for executing art of architectural scale (Grabar et al. 1967, p. 13; Wadum & Streeton 2012, p. 73). Intermediary to the materials and techniques of a mural painting is the location and condition of the building environment in which it is housed (Doerner 1962, p. 264). The evidence provided by bygone eras of the deterioration of murals has simultaneously impacted the history of architecture in the church. Since the practice of mural painting in the church is so long standing, it is difficult for a brief overview such as this to do it justice. However, certain basic characteristics of the mural painting tradition are pertinent to consider as murals of the 20th century grow out of this tradition.

Grounds

Firstly, most wall paintings require application to a prepared wall surface in order to render the painting permanent. The earliest murals made in the catacombs in Rome were executed on layered renderings made of plaster applied to the wall in several coats until a smooth layer for painting was achieved. Paint was then applied either *a fresco;* pigment directly applied to a wet ground, or *a secco*; applied to dry plaster in a binding medium (Ward 2002, p. 735).

Tempera painting

A further feature that characterizes the technique of mural painting, is the medium in which the pigments are applied (Ward 2002, p. 735; Doerner 1962, p. 265). Tempera painting, the technique that involves applying pigment and adhesive emulsions diluted with water was historically the preferred method for mural painting as it provided the ability to apply and work large designs by way of using water to spread the medium and build fast-drying, in-soluble layers. Proteinaceous binders were discovered to be particularly well suited to architectural scale works of art situated in interiors for they are inherently stable to oxidation under normal conditions of humidity and temperature and if well placed, could be significantly protected from the effects of ultraviolet light (Mills & White 1987, p. 78). Casein, the principle protein found in milk, historically found applications in tempera mediums for wall painting for its propensity to form and maintain a strong glue (Mills & White 1987, p. 76). Additionally, casein provided an economical material for use in murals as it could be used both in the sizing medium, in pure form, and thereafter applied diluted in an emulsion (Ward 2002, p. 590; Doerner 1962, p. 25).

Support Construction

The inherent constraints of time, labour and resources required to work with the quick-curing mediums in situ soon led to the adoption of wood supports that could be executed on panels in an artist's studio and later assembled at a chosen site (Ward 2002, p. 264; Wadum & Streeton 2012, p. 73). Effectively, paint can be worked on wood supports in much the same way as it is on walls, requiring the wood first to be coated with a waterproofing layer to support the paint and applying pigment in some way with a binding medium (Ward 2002, p. 264; Doerner 1962, p. 265). The hard setting properties of the tempera mediums

used earlier in the tradition continued to suit the durability necessary of artworks housed in large architectural environments. The longevity of murals painted on panels however is also determinant on the stability of the wood and to counter the tendencies of wood to shrink and expand by moisture or chemical action from within the wall, innovations in fixing panels to load bearing walls resulted in the development cradling and mounting systems that eliminate direct contact with the wall by way of crossbars bracing the panels at the rear (Ward 2002, p. 742; Mayer 1991, p. 304).

Hardboard supports

The adoption of compact board products for use as painting supports during the early 20th century represents a further technical advancement in the search for a durable material on which to execute a long lasting mural (Austec 2000). Hardboard is a thin, homogenous fibreboard made from steamed wood chips that have been stretched into fine fibres and pressed together with heat to form a solid board. The most common commercially available board of this type is Masonite®, a product developed in the USA in the late 1920s and patented by the manufacturer of the construction method, William H. Mason, (Austec 2000) and was first manufactured in Australian in 1938 by the Masonite Corporation (Australia) Ltd. (later becoming Hardboards Australia Ltd.)(Austec 2000). By way of the 'mason method', the fibres within the wood interlock and form a mass bound by natural lignins as well as a very small amount of sizing compound made from paraffin (Mayer 1991, p. 303). The addition of paraffin imparts a waterproof quality to the fibres meaning the finished boards resist moisture to a high degree and are less prone to warping and dimensional changes than the wooden panels of the past (shrinkage or expansion) (Mayer 1991, p. 303).

Documentary Research

A brief history of Arthur Boyd and mural painting

Recognition of *The Ascending Christ* rarely features in narrative discussions of Boyd's artistic development however, what recurs most consistently in historical accounts is the impact on Boyd's materials choices from his associations with peers and family (Theobald Clark 2013; Kowalski & Tse 2014; Smith et al. 2001, p. 283).

It is well-documented that during the late 1940s Albert Tucker is to have introduced Boyd to Max Doerner's *Materials of the Artist and Their Use in Painting* (first edition published in 1921) (Gunn 1985, p. 76; Theobald Clark 2013, p. 8) and the studies conducted by Theobald Clark in 2013, elucidated many painting techniques recorded in a recipe book belonging to Boyd were transcribed from a revised edition of Max Doerner's technical manual, *Materials of the artist and their use in painting: with notes on the techniques of the old masters* (1962). Although the revised publication postdates the execution of *The Ascending Christ*, it could be reasonably assumed that Boyd had been exposed to the text prior to recording them in his own recipe book considering that Theobald Clark reports that:

> 'his wife Yvonne possibly typed up the 'recipes', as she took care of much of his paperwork after their marriage (Thompson 2013, pers. comm., 6 August)….Many of the recipes and lists of pigments are not dated, and could easily have been typed up after their time of use (Theobald Clark 2013, p. 19)

Of additional relevance, is that Boyd had already experimented with mural painting in 1948 at *The Grange*, the house in Harkaway where his uncle, Martin Boyd, lived and Boyd is quoted to describe to 'the murals [at The Grange] were painted "with casein tempera mixed with powder colour, which is an old Doerner recipe" (Philipp 1967, p. 72). Furthermore, a review of Doerner's technical manual reveals an entire chapter dedicated to the materials and techniques of mural painting (Chapter VIII: 'Mural Painting') and therefore provides a significant source of reference to produce a better understanding of the materials and techniques exhibited by *The Ascending Christ*.

Mural painting: according to the manual

Tabulated below is a collation of references relating to the use of casein tempera and hardboard supports for mural painting according to Max Doerner's *Materials of the artist and their use in painting: with notes on the techniques of the old masters* (1962), the technical manual reportedly referenced by Boyd (Gunn 1985, p. 76; Theobald Clark 2013, p. 8; Philipp 1967, p. 72). After which, notes have been made against each that may assist to elucidate the technical construction of *The Ascending Christ.*

Table 1. Collation of references from Max Doerner's *Materials of the artist and their use in painting: with notes on the techniques of the old masters* (1962) relating to the use of casein tempera and hardboard supports for mural painting.

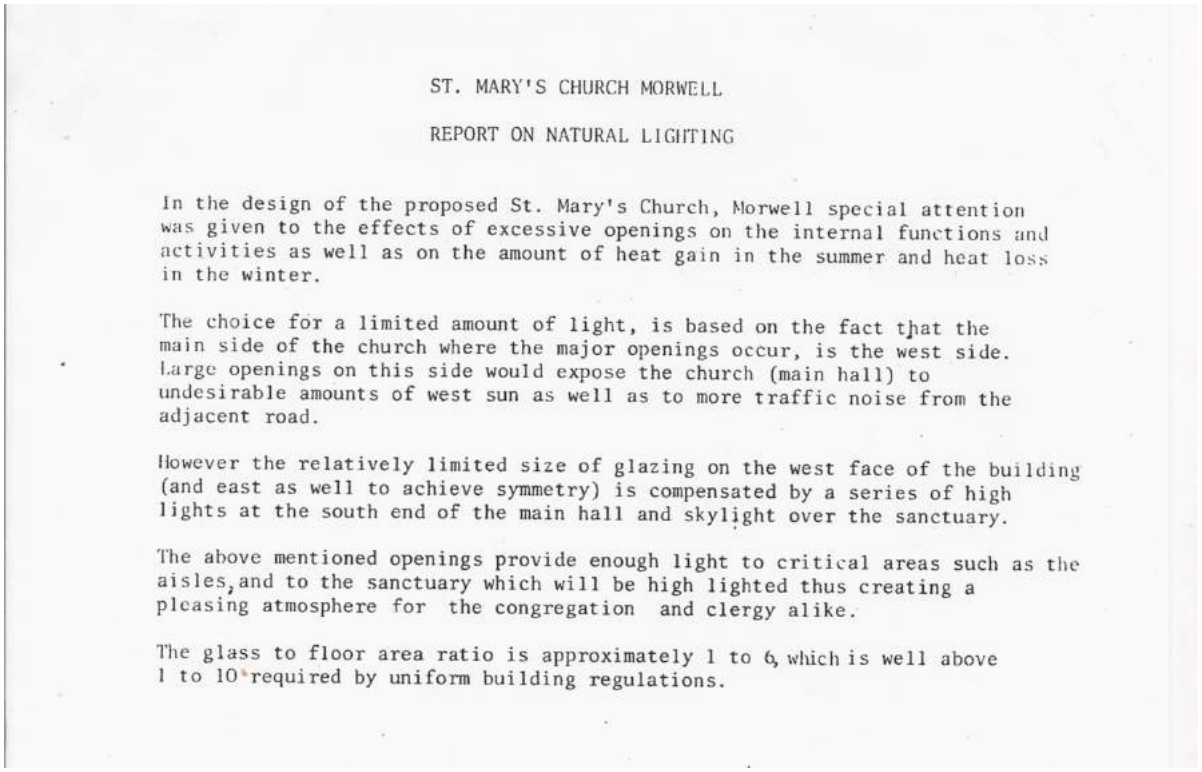
Component	**Reference**	**Inferences for identification**
Support construction	'Often air wells will have to be constructed inside and back of walls' (p. 306)	Adequate ventilation required between wall and the mural
Support construction	Casein emulsion might be used on solid supports like wood…' (p. 218)	Infers casein painting is well suited to wood supports
Ground/ wood support	'Casein grounds become exceptionally hard; they are therefore best used on strong, tight materials such as wood… (pp. 25-26)	Infers casein is suitable for use in grounds; infers casein grounds perform best when employed on wooden supports
Size/ ground	'By itself casein acts like glue. In grounds on a solid support it is practical…' (p. 220) 'technically pure casein is insoluble in water and well adapted for use in grounds. Casein is used in the same manner as glue' (pp. 25-26) 'On the wall it is best to use pure but thinned casein without the addition of oils and resins.' (p. 218)	infers may be used in pure form as a size layer or mixed with other materials to form a ground; infers best used pure with additions
Size/ ground	'Casein white is very brilliant and naturally adheres well…' (p. 220)	Infers if used in pure form it can be identified by very white appearance
ground	'Casein grounds containing oil yellow and are therefore usually coloured in order to conceal this, but are otherwise practical' (p. 26)	If ground appears yellow it may contain oils (in addition to casein); if it is coloured it may also contain oils
Ground/ paint layer	'tempera emulsions can be used with chalk and zinc white or white lead, etc., as grounds, but they absorb much moisture. They are… best of all as thin coats over the ground when mixed with zinc white…' (p. 25)	infers casein may be used mixed with other materials to form a ground or applied diluted on top of the ground
Paint layer	'Casein sets quickly and well and becomes exceedingly hard and luminous.' (p. 218)	Paint surface should be well fixed and film might appear luminous
Paint layer	'The painting may in parts be pulled together with a sponge, and a soft, harmonious effect may be achieved by means of powerful outlines and light and dark accents set in while the surface is still wet' (p. 298)	If appearance of sponge-like surface texture, outlines and contrasting light and dark tones it may be painted with casein tempera
Paint layer	'the colour layers appeared as if they had expanded and contracted like an accordion. This is the typical result where hygroscopic media are used' (p. 299)	If 'accordion'-like appearance in paint layer it may be painted with casein tempera

Diocese Archives

A review of the Diocese archives highlighted it has often been assumed that an artificial environment is required to house the mural (Holden 2002, pers. comm., 18 June; Norris 2009, pers. comm., 11 August; Kennedy 2003, pers. comm., 19 December). Similarly, a review of the AICCM *Guidelines for Environmental Control of Cultural Institutions* (HCC 2002) recognise that because museum institutions

specify narrow ranges of conditions for optimal environments for the preservation of materials and artefacts, it is often assumed that buildings not intentionally designed with a museum climatology are inadequate to achieve appropriate environmental conditions for housing artworks (HCC 2002, pp. 6-7) .

Foremost, it is beneficial to recognise that St Mary's church was specifically designed to house *The Ascending Christ* and an un-dated *Report on Natural Lighting* found in Diocese records (referring to the 'proposed St Mary's Church') explicitly accounts for this; albeit the author of the document is not recorded.



ST. MARY'S CHURCH MORWELL

REPORT ON NATURAL LIGHTING

In the design of the proposed St. Mary's Church, Morwell special attention was given to the effects of excessive openings on the internal functions and activities as well as on the amount of heat gain in the summer and heat loss in the winter.

The choice for a limited amount of light, is based on the fact that the main side of the church where the major openings occur, is the west side. Large openings on this side would expose the church (main hall) to undesirable amounts of west sun as well as to more traffic noise from the adjacent road.

However the relatively limited size of glazing on the west face of the building (and east as well to achieve symmetry) is compensated by a series of high lights at the south end of the main hall and skylight over the sanctuary.

The above mentioned openings provide enough light to critical areas such as the aisles, and to the sanctuary which will be high lighted thus creating a pleasing atmosphere for the congregation and clergy alike.

The glass to floor area ratio is approximately 1 to 6, which is well above 1 to 10 required by uniform building regulations.

Figure 5. *Report on Natural Lighting,* n.d.*,* found in Diocese archives (author not recorded).

Previous conservation studies

A number of studies into the artistic practice of Arthur Boyd provide supplementary contextual and scientific sources to inform identification of the mural's painting materials. These include investigations that characterise some of the colourants used by Boyd in his post-war oil paintings by Theobald Clark (2013), an analysis of his material preferences during the 1940s by Kowalski & Tse (2014) and the most comprehensive monograph, even now, documenting the oeuvre of Arthur Boyd up to 1966 by Philipp (1967). The primary results of their studies are more greatly applicable to discuss in conjunction with the findings of the object-based analysis in Chapter 4.

Chapter 4: Object-Based Investigations

As outlined in the previous chapter, most records purport *The Ascending Christ* to be made with 'casein tempera on hardboard' however none of these records are evidence-based. Therefore, this chapter outlines the object-based investigation methods employed, sampling details and procedure using basic physical examination techniques, X-ray Fluorescence (XRF) Spectroscopy and Fourier Transform Infrared Attenuated Total Reflectance (FTIR-ATR) employed to scientifically elucidate the component materials of the mural.

Preliminary Physical and Site Examination

The initial stage of analysis involved basic visual examination and recording techniques using reflected light and handheld survey tools including measuring tape, torch, magnifying glass. The procedures were all undertaken over the period of a two-day site visit to St Mary's Anglican Church, Morwell which houses *The Ascending Christ* mural. The mural was examined visually from ground level and then documented graphically, photographically and in written form. Due to the resources available and occupational, health and safety risks presented by working at heights, detailed observations and photographs were only made for the surface area that could be examined from standard eye height, which was generally within the two lowest rows of mural panels.

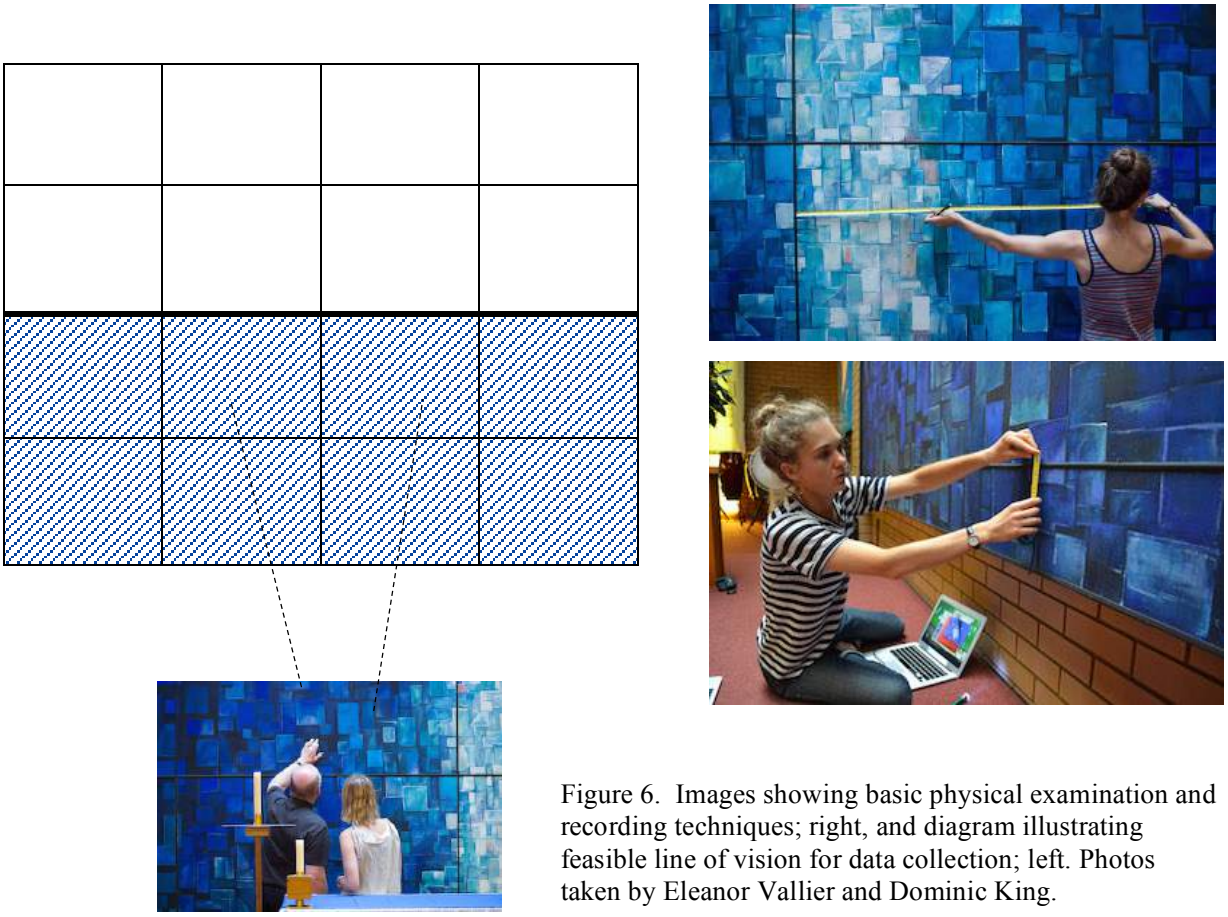


Figure 6. Images showing basic physical examination and recording techniques; right, and diagram illustrating feasible line of vision for data collection; left. Photos taken by Eleanor Vallier and Dominic King.

Following visual investigation at the object scale, an inspection was conducted of the site and observations were recorded from each cardinal direction of the building, documenting both internal and external facades. The main function of this activity was to identify and assess the design elements that contribute to the building environment.

Photo documentation

In order to ensure a comprehensive record of the mural was made, 111 individual photographic images were produced of the mural and St Mary's Church from to assist in understanding the physical characteristics/ layout that was documented in text.

In accordance with the current Victorian Government photographic recording conventions (available on the DTPLI website as a technical note titled *Photographic recording for heritage places and objects*), images were recorded face-on and centrally to the mural and building façade. The photographs were primarily recorded to document the condition of the mural and therefore the surface area in each photo varied, determined by the nature of the detail to be captured however several different shots were taken, including contextual images from different view points, to orient the mural within its natural surrounds. Equipment employed included a Panasonic DMC-TZ6 35mm optical zoom equivalent digital camera and a NIKON D3100 single-lens reflex digital camera. It was considered that photography with larger format capabilities would generally be required to obtain an image quality suitable for true-scale reproduction, however for the initial stages of analysis such equipment was cost prohibited and would require additional skills outside of the capabilities of the project team. With this in mind, the digital format was selected due to the relative ease of handling and operation as well as for the ability to readily view, store and manipulate images on a computer without requiring additional post-processing. Off-site data processing was undertaken involving transferring site-recorded annotations to computer photographic and drawing applications to map the mural dimensions and sampling locations in digital format. A comprehensive log of the photographs captured is contained in Appendix 2.

Condition Reporting

Congruent to the basic physical and site examination, a standard format condition report was compiled using general conservation terms to record condition types, colour and recognizable technical characteristics. Photographic documentation was taken to illustrate significant phenomena described. The full condition report is included as Appendix 1. From the report compiled, the materials of the auxiliary support and technical construction of the mounting system were evident as well as the basic building related factors that may cause deterioration however the need for additional paths of enquiry were established to more reliably account for the paint medium as casein tempera.

Sampling

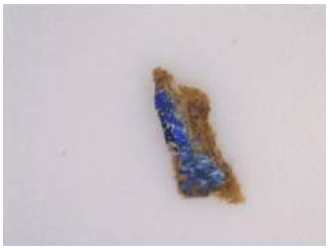
Seven sample sites were chosen from the bottom row of mural panels to undergo instrumental analysis. Sample locations were chosen based on their representation of the various colours that dominated the colour palette. The samples were taken following the inspection of potential sampling sites with a Dino-Lite® digital microscope and DinoXscope software. The portability of the Dino-Lite® handheld device enabled samples to be readily examined in situ to ensure that the cross-sections excised were suitable for laboratory testing.

The samples were excised in the form of 1-2mm² (LxW) flakes with consideration to the dual nature of the material size required for planned instrumental analysis (see table 2). A scalpel was used to excise seven flakes (S01-S07) to a make-shift paper collection plate and funneled into glass vials using the same collection plate as a 'boat'. Flakes SO1, SO2, SO4, SO5 and SO7 were made >2mm in depth to provide an adequate representation of the mural's layer structure ranging from the wooden support material to the surface paint layer. An impasto section of the painting was gently scraped using the blade of a scalpel to produce a sample that contained surface paint only (S03) and a section of the painting which exhibited loss of the main pigment layer was excised to produce a sample that was assumed representative of the ground layer (SO6). The amount of powder collected for SO6 was later deemed inadequate for the intended instrumental analysis systems. All samples removed from the site were labeled and retained for lab-based testing. See table 2 and Appendix 1, figure_, for specific location of sampling sites.

Microscopy and Microphotography

S01, SO2, SO3, SO4, SO5 and SO7 were further examined using a stereomicroscope with reflected light and the TLI® Handheld Digital Microscope in the GCCMC laboratory. Prior to instrumental analysis, photographs of the samples were captured with the TLI® digital microscope (20x -200x magnification) using in-built white-light LED illumination and Plugable Technologies Software.

Table 2. Sampling details including observations of the paint layer structure made during microscopy

Sample number	Photomicrograph	Panel:(x,y)/ within panel x, y (cm)	Type of sample	Microscopic observations	Analysis conducted
S01		Panel: 1, 1 (135, 77)cm	Black paint sample/ Cross section/ flake ~2mm²	Black paint appears to be second pigment layer over blue paint	Microscopy, FTIR-ATR, XRF
S02		Panel: 2,1 (137.5, 1)cm	Blue paint sample/ Cross section/ flake ~2mm²	Blue paint appears to be first pigment layer over ground	Microscopy, FTIR-ATR, XRF
S03		Panel: 3,1 (30.5, 40.5)cm	Upper layer / White / Single layer/ flake ~1mm²	Sample taken from top layer; suitable to differentiate paint from ground layer	Microscopy, FTIR-ATR, XRF
S04		Panel: 4,1 (135, 22)cm	Black paint sample/ degraded appearance/ Cross section/ flake ~2mm²	Black paint appears dull in comparison to S01, possible degradation product(?)	Microscopy, FTIR-ATR, XRF
S05		Panel: 1,1 (175, 26)cm	Green paint sample/ Cross section/ flake ~2mm²	green paint appears to be a pigment layer over blue paint; cross section	Microscopy, FTIR-ATR, XRF
S07		Panel: 3,1 (138, 74)cm	Blue paint sample/ Cross section/ flake ~2mm²	Blue paint appears to be a pigment layer over darker blue paint	Microscopy, FTIR-ATR, XRF
***S06**	*n/a*	*Panel: 2,1* *(95, 24)cm*	*Ground/ Single layer/ powder*	*Nil; quantity taken was not adequate for laboratory examination or instrumental analysis*	

Scientific Instrumental Analysis

The positive identification of casein tempera is somewhat difficult because there are no unique chemical components particular to the constituent materials of the painting medium whose presence serves to identify them (Mills & White 1987, p. 74). Casein itself is a protein defined only by a 'quantitative assay of the amino acids' present in the pure material (Mills & White 1987, p. 74) and in a mixed, multilayer media such as a painting, the component of free and unmodified amino acids available for analysis is so small that they are inadequate to provide a quantifiable measure (Mills & White 1987, p. 78). For the analysis of proteins in connection with their use in paint media, Mills and White (1987, p. 78) suggest that simply identifying the presence of proteins, without identifying it specifically is sometimes all that can be successfully achieved.

FTIR and XRF Spectroscopy are often used as complementary techniques to provide an initial indication about pigment type and binding medium (Derrick, Stulik, & Landry 1999, p. 18). In multiple-component samples, such as tempera-like compositions, knowledge of one material often simplifies the identification of other remaining components (Derrick, Stulik, & Landry 1999, p. 19). FTIR Spectroscopy is a technique able to provide a compositional analysis of the organic and inorganic compounds within a material whilst XRF is used to provide an elemental analysis of the inorganic material in a paint sample. XRF does not exclusively provide conclusive information regarding pigments because many pigments share key elements (Stuart 2007, p. 241) however it can aid to highlight certain common characteristics in samples as well as distinguish the presence of certain compounds otherwise not obvious from the IR spectrum (Derrick, Stulik, & Landry 1999, p. 19).

The studies conducted by Theobald Clark (2013) focused on identifying the presence of inorganic and organic elements in oil bound paint samples containing colourants, that Boyd is reported to have used, therefore it is useful to use this data as reference spectra in order to distinguish the various components found within the paint layer of *The Ascending Christ*. The instructions for mural painting with casein tempera detailed in Max Doerner's comprehensive technical handbook (1969) Boyd is cited to have used regularly, also supplement the interpretation of materials that may be found present in the paint formulation.

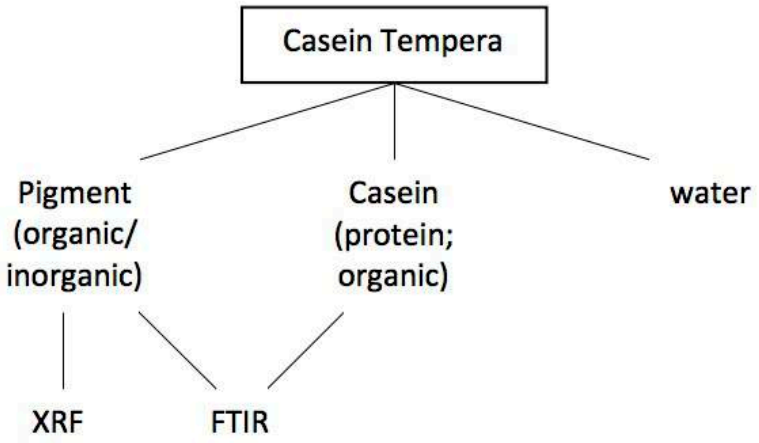


Figure 7. Proposed analytical pathway to verify the binder type/ painting medium casein tempera

In keeping with the scope of this study, only a limited amount of samples were taken for analysis as it was hoped the main outcome would be the presence of common elements amongst the samples to verify the binder type. Figure 7 considers the component characteristics of casein tempera and attributes a logical analytical pathway based on the nature of the samples able to be removed. In order to be of adequate test size for both techniques of instrumental analysis, Schiers suggests the practical sampling area is 2mm²

(Scheirs 2000, p. 78) and because of this the low stratigraphy of the paint layer resulted that most of the samples extracted contained both paint and hardboard particles.

FTIR using Attenuated total reflectance (ATR) with a diamond cell allows a sample to be studied as a solid meaning that the sample can be retrieved and re-analysed without requiring further dissection or preparation (Stuart 2007, p. 113; Hermens and Townsend 2012, p. 353). FTIR-ATR analysis does not destroy the sample completely, although it can crush them during analysis (Stuart 2007, p.117) and so it is beneficial that XRF can be performed first as a non-destructive technique, followed by FTIR-ATR to elucidate the pigment type and binding medium. Both techniques generate data which can identify the presence of one or more detectable elements (Stuart 2007, pp. 117, 241) and will be used to provide a comparative analysis of component materials.

Chapter 5: Interpretation of Results

This chapter collates and aggregates the data collected from object-based and documentary source investigations using a purposefully graphical approach to present data in a way which makes it easy to compare similarities and differences as well as highlighting gaps which require additional data to draw reasoned conclusions. The convergence of data will be used to draw conclusions in the final chapter.

Physical examination & inferences for materials identification

Table 3. Observations and inferences made from basic physical examination organized by component.

Technique	Component	Observation	Inference
Reflected Light	Auxiliary support	100mm wooden bars behind mural that fix it to the wall; recessed into the wall one block thick	Typical of cradling systems used to mount wallboards; functions to eliminate direct contact with the wall by way of crossbars bracing the panels at the rear (Ward 2002, p. 742; Mayer 1991, p. 304)
		Mural does not sit flush against the wall	
		multiple wooden members arranged in a grid-like structure; another wood panel sandwiched between the mural panels and the cross bars	
	Primary Support	smooth, hard front surface	Typical of commercial hardboard Masonite®; standard commercial size (Mayer 1991, p. 303)
		board is 5mm thick	
		panels measure 180 x 112cm	
	Ground	uniform application and generalized mottled texture	Casein preparatory layer is typically used for covering large surfaces because it can be diluted with water and applied through a pressurized spray gun to deliver a continuous and even coating (Mayer 1991, p. 312)
		Paint layer and ground layer well adhered	'Casein sets quickly and well and becomes exceedingly hard and luminous.' (Doerner 1969, p. 218)
	Paint layer	Paint applied in thin opaque layers, pictorial elements modeled by deliberate and concise brushstrokes	small strokes to achieve tonal variation coupled with the hardened and semi-matte film are characteristic of tempera painting (Van Loon, Noble & Burnstock 2012, p. 224).
		Top layer applied in block colours exhibits sponge-like texture	'The painting may in parts be pulled together with a sponge, and a soft, harmonious effect may be achieved by means of powerful outlines and light and dark accents set in while the surface is still wet' (Doerner 1969, p. 298)
		Form is built by contrasting the colours; selective use of impasto to define the white figure from the blue-hued background	
Digital Microscopy	Primary support	friable fibres observed from a point of loss	Characteristic of hardboard (Mayer 1991, p. 270)
	Ground	thin layer of a brilliant white medium is visible where textural brushwork/ impasto has been lost due to abrasion	Casein white in pure form is very brilliant and often used in grounds (Doerner 1969, p. 220; pp. 25-26)
	Paint layer	an area of black paint loss reveal that dark blue tones have been applied to the ground first followed by the solid black outlines of the squares	Casein tempera is best worked as thin coats over the ground (Doerner 1969, p. 25)
		fissures in the impasto	typical drying result of casein painting; accordion-like effect (Doerner 1969, p. 299)

Reading of the architectural layout

Cross-references between architectural plans supplied by the Diocese and photographic documentation made during the site examination was able to demonstrate and account for the climate controls described in the *Report on Natural Lighting* (figure 5) and the HCC guidelines for passive climate control (HCC 2002, pp. 25-38).

The HCC guidelines state that 'in general, east and west facing facades receive the greatest solar loads in summer, while, in Australia, the north façade actually receives less radiation in summer than it does in winter (HCC 2002, p. 25). Figure 8 illustrates the placement of stained glass windows on the East and West facades mitigate the solar load that reaches the mural on the North interior façade. Furthermore, the fact that the mural does not extend the entire height of the North façade appears to employ the HCC principle (2002, p. 26), using the brick wall (light coloured building surface) to absorb any radiation that may enter through the skylight above the sanctuary during times of high altitude sun. Additionally, the construction of a custom-built cradling system (identified during physical examination) so that the mural is distanced from the wall also demonstrates a system in place to filter heat fluctuations associated with conduction through brick walls (2002, p. 26).

Although the indoor environment of the church is not currently monitored, the average shaded air temperature ranges between 14.8-25.8°c (seasonally) and the relative humidity averages between 46-68% (BOM 2016). Typical of the Temperate climate zone of Southern Victoria, Morwell experiences a mild/warm summer and cold winter with few extremes of temperature and precipitation (BOM 2012; ISC 2016). It is generally accepted that the most detrimental environmental factors to painted media are fluctuations in temperature, relative humidity and light levels and it is notable that within the trend statistics obtained from the Bureau of Meteorology (Appendix 4) general environmental conditions for Morwell fall more or less within the allowable fluctuation range in relation to the AICCM 2014 benchmarks for environmental conditions for conservation environments (AICCM 2016) (Table 4).

Table 4. Environmental conditions for Morwell compared to the AICCM benchmarks for environmental conditions for conservation environments

Environmental condition	AICCM benchmark	Morwell	AICCM Allowable fluctuation	variance
temperature	15°c - 25°c	14.8°c - 25.8°c	+/-4°C	-0.2 – 0.8
Relative Humidity (seasonal drift parameters)	40% – 60%	46% - 68%	+/- 5%	1 - 8

The HCC guidelines further explain that 'achieving appropriate environmental conditions in museums and other repository buildings is a specialised architectural task, which is often not well understood by either the heritage conservation or architecture professions' (HCC 2002, p. 8). Pertinently, the *Report on Natural Lighting* shown in Figure 5, highlights the 'special attention' given to the architectural design of the Church and demonstrates plausible correlations with the 'Passive Building Strategies' outlined in section 7 of the HCC guidelines (2002, pp. 25-38). For example, the choice for a limited amount of openings in the West side of the building can be understood to address the consideration of 'Load reduction'(HCC 2002, p. 25) on the building; primarily solar radiation during daytime conditions causing heat gain/ loss) and the 'limited size of glazing on the West face of the building (as well as the East)' can be seen as a design strategy to mitigate the transmission of radiant energy through 'Solar radiation and transparent building materials [such as glass]'(HCC 2002, p. 29). According to the HCC guidelines for 'Natural Light' (HCC 2002, p. 38), 'safe' illumination means that:

> In principle…as long as exclusion of sunlight is guaranteed by a combination of orientation, shading and detail design, and daylight is admitted by openings designed to achieve reflection off painted surfaces, then buildings may be designed to exploit daylighting for display without compromising conservation requirements, and without resort to expensive and degradable filters.

Although the Church is not designed to function as a museum, a review of supporting architectural documentation does provide considerable evidence that passive climate controls are adequately accounted for within the building design and therefor alternative factors, outside the scope of this research; natural disasters, pests, security and fire protection (HCC 2002, p. 8) may present greater risk to the long term conservation of the mural.

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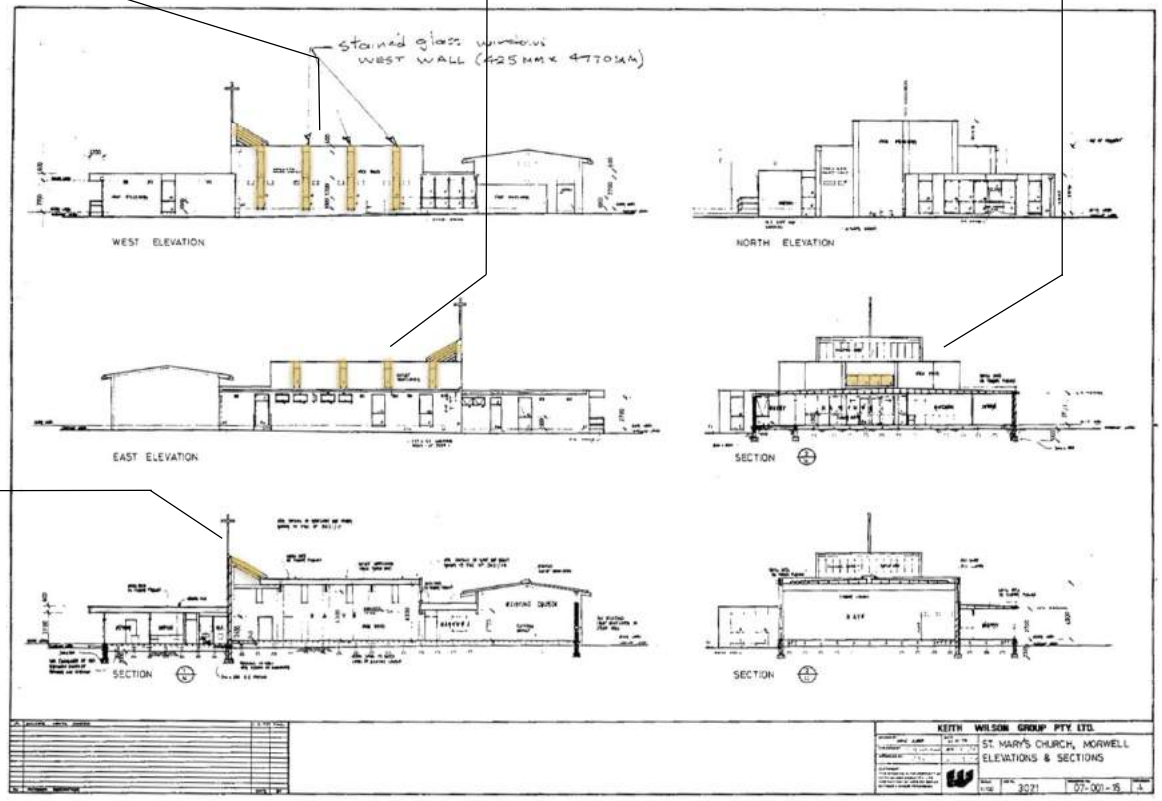

Figure 8. image-based documentation illustrating 'the choice for a limited amount of light' according with *Report on Natural Lighting* found in Diocese archives, photos taken by Dominic King, Yasmin Kopij. Architectural plan courtesy of the Anglican Diocese of Gippsland.

Interpretation of X-ray Fluorescence (XRF) Spectroscopy

Evident in figure 9, all samples, exhibited the presence of titanium (Ti), zinc (Zn) and calcium (Ca) indicating characteristic inorganic white pigments commonly used in tempera painting (Eastaugh, Nadolny & Lowengard 2012, p. 208). Considering S03, the sample containing the top layer of paint only, produced very weak signals at the baseline, it is presumed the pigments have been used for the undercoat. The presence of these elements in all of the samples tested could support either or both that the pigments were used for the ground and/ or the paint/gesso layer. Historically, the tempera technique has been practiced where the painter would prepare coloured pigments and white and then mix them in various proportions (Eastaugh, Nadolny & Lowengard 2012, p. 208) before adding water or oil to extend them as paint medium, as well as whites were added in measure to glue-water as gesso layers to form the ground (Doerner 1969, p. 23).

In accordance with Doerner's technique (1969, pp. 23-26), tempera emulsions used with whites may also be made containing casein. Casein used in this manner is useful for paint setting as it imparts a strong 'adhesiveness' to the solution whilst being able to be thinned by water as desired (Doerner 1969, p. 23). To prepare a casein emulsion Doerner suggests the casein must be thinned with water and then, mixed with an 'equal measure of Chalk ($CaCO_3$) or gypsum ($CaSO_4 \cdot 2H_2O$) etc., (and) an equal measure of Zinc White (ZnO)' (Doerner 1969, p. 23).

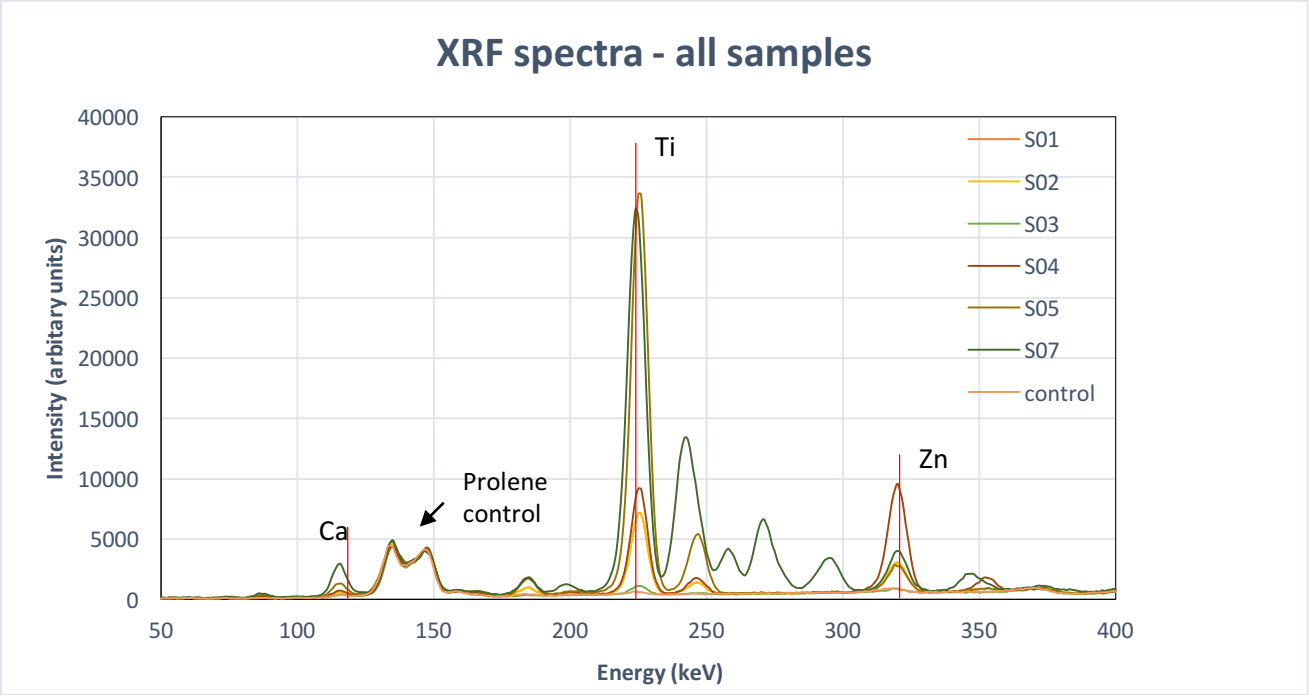

Figure 9. XRF spectrum of all samples taken from *The Ascending Christ* (c.1960) by Arthur Boyd with identification of key correlating peaks Ca, Ti, Zn and prolene control sample.

The white undercoat appears characteristic of a casein tempera composition with trace levels of calcium for body and zinc or titanium dioxide for white colour and high hiding power. This would account for the bright white underlayer observed at points of loss of impasto and would also attest to the hardness and bonding observed of the subsequent paint layers. Without elemental extraction, the white pigments can not be conclusively characterized and it is also noted that in the presence of high concentrations of calcium, titanium and zinc, signals of one element can interfere with the spectral quantification of another (Scheirs 2000, p. 259).

Interpretation of Fourier Transform Infrared Attenuated Total Reflectance Spectroscopy (FTIR-ATR)

The spectra output did not produce peaks that were strong enough to assign characteristic Amide I (between 1600 and 1700 cm^{-1}) and Amide II (between 1510 and 1580 cm^{-1}) absorbance bands to identify if the painting material contained the protein casein (Stuart 2007, p. 119). Comprehensive FTIR-ATR Spectra output for *The Ascending Christ* paint samples is contained in Appendix 4. The lack of correlation between the spectra output and the pigment reference samples of Theobald Clark (2013) did not assert useful grounds for further discussion in this study however the absence of the functional group bands for oils and other pigments identified by Theobald Clark (2013) was useful to eliminate potential groups of materials whilst the media was still unconfirmed.

In the analysis of thin paint films by FTIR-ATR, it is not uncommon for interference fringes to occur due to multiple reflections transmitted from different pigmented layers (Scheirs 2000, pp. 72-73). It is possible that characterisation of the pigments and compounds were masked by interference or scattering due to the inorganic white colourants assumed present through XRF analysis. Although the number of scans, duration of scanning and degree of penetration can be adjusted to possibly reduce the 'scattering' phenomenon on the transmission spectra, the presence of inorganic pigments and additives can also interfere with IR absorbance by partially covering or shifting the relative absorption peaks of other pigments (Scheirs 2000, p. 75). In the case of identifying proteins, it is also possible that denaturation of proteins, could also change the appearance of their characteristic amide bands thus implicating them to be recognized (Stuart 2007, p. 120).

The principal peaks identified in the spectral data of *The Ascending Christ* paint samples is laid against the region of spectrum for proteins and for oils (according to Stuart 2007, p. 119) in tables 9 and 10 below.

Table 5. Principal Peaks in FTIR-ATR Spectra of *The Ascending Christ* that correlate with region of spectrum for oils according to Stuart (2007, p. 119).

Region of spectrum/ cm-1 (oils)	**S01**	**S02**	**S03**	**S04**	**S05**	**S07**
3200-3600	-	3273	3290	-	-	-
2800-3000	2923	2917	2921	2917, 2849	2922	2920
1730-1750	-	-	-	-	-	-
1300-1480	1306,1363, 1411	1318, 1414	1386	1320, 1410	1375, 1321	1363, 1323
900-1300	982	1017, 1157	1089	1016	1015, 1111	981, 1014
700-750	-	-	-	-	-	-

There were no peaks of amplitude that signified the characteristic carbonyl bands of drying oils or oil binders. Linseed oil is characterised by peaks at 1740cm-1 and the oil triplet peaks 1246cm-1, 1174cm-1, 1110cm-1 (Learner 1998, pp.12-15) and Theobald Clark's reference spectra for Linseed oil displayed strong peaks at 2923, 2852 and 1711 cm-1, as well as the three peaks resembling the characteristic oil triplets at 1240, 1166 and 1096 cm-1.

Table 6. Principal Peaks in FTIR-ATR Spectra of *The Ascending Christ* that correlate with region of spectrum for proteins according to Stuart (2007, p. 119).

Region of spectrum/ cm-1 (proteins)	S01	S02	S03	S04	S05	S07
3200-3400	-	3273	3290	-	-	-
1600-1660	-	-	-	-	-	-
1500-1565	-	-	-	-	-	-
1300-1480	1306, 1363, 1411	1318, 1414	1386	1320, 1410	1375, 1321	1363, 1323

The identification of proteins (in order to indicate the presence of casein in the painting material) is aided by the appearance of characteristic Amide I and II bands (Stuart 2007, p. 119) found in the range between 1600 and 1700 cm^{-1} and 1510 and 1580 cm^{-1} region, respectively. Considering the scattering of the overall spectra observed and the knowledge that the absorbance ratio of the amide I/ II bands can change as denaturation of the proteins occurs (Stuart 2007, p. 120), the presence of proteins could not be reliably interpreted from the spectra. Further analysis with techniques such as gas-chromatography mass spectrometry to isolate and quantify amino acids present would be required to provide an indication of the presence of casein (Stuart 2007, p. 304).

Conclusions and Future Research

This minor thesis has presented an in depth investigation of the materials and techniques of *The Ascending Christ* (c.1960), by Arthur Boyd and provided a basis for The Anglican Diocese of Gippsland to begin an appropriate conservation planning strategy. Considering the intangible significance of *The Ascending Christ* has already been recognized by The Latrobe City Heritage Study (2010), the premise of this thesis was to contribute greater technical knowledge about the mural in order to understand the key factors required to manage the material aspects of its conservation.

Whilst the main impetus for research was found to be a lack of evidence-based documentation pertaining to the mural itself as well as a lack of object-specific guidelines that address conservation in a religious context, a consideration of the body of knowledge relating to the materials and techniques of mural painting, Arthur Boyd's scholarship and conservation practice outside of conventional museum environments demonstrated a methodology to interpret data relevant to conserving *The Ascending Christ* was also needed. Both of these areas were addressed through the convergence of data obtained from existing documentary sources and scientific analysis of the painting materials of *The Ascending Christ*, however a more detailed physical examination of the mural at heights is advisable to be carried out to fully account for the current condition phenomena of the mural.

The research methodology employed, collating, aggregating and synthesising data from the multiple sources functioned to validate the reasonably sound condition of the mural and indicate considerations for its maintenance. Basic physical examination techniques proved sufficient to positively identify the materials of the auxiliary support and technical construction of the mounting system and assisted to further support the inferences for identifying the use of a casein is some aspect of the media layer. Confirming the presence of casein in the painting materials hoped to account for the stable condition of the paint layer and eliminate some of the degradation issues such as discolouration and embrittlement associated with aging and environmental influences on mediums containing oils or paintings not well constructed by the artist. The absence of characteristic carbonyl peaks looks like a more promising attribution that the pigments are bound in proteins, rather than of oils and fatty acids, supporting the purported use of casein as a binding medium. Although characteristic protein bands could not be accurately identified during FTIR-ATR analysis, the elimination of an oil binder may be useful to correctly characterize other unknown media using more complex laboratory analytical procedures and significantly eliminates concerns of deterioration associated with oil paintings. Additionally, XRF analysis was able to identify characteristic white pigments in the paint material, which may explain why the paint layer is so well adhered to the ground layer and could impact on cleaning and retouching strategies in the future.

Finally, by cross-referencing existing documentary sources with photographic documentation created during site examination it was possible to identify passive climate controls in place at St Mary's Anglican Church. From which, it was demonstrated plausible that the relatively sound condition of the mural is due to the virtue of its architectural design and if modifications to the building or the internal heating, light and airflow are to be implemented for the purpose of human comfort, the building's climate controls should also be modified accordingly to ensure the condition of the mural is maintained. The various environmental guidelines identified throughout this thesis, such as the AICCM environmental guidelines and HCC *Guidelines for Environmental Control in Cultural Institutions* may also be useful to review at this time.

It should be acknowledged that the objectives of conserving the material aspects of religious heritage objects goes beyond ascribing a definitive value to an artwork. Defining both the tangible and intangible qualities embodied by an artwork can help to identify options for reconciling the needs of the religious community and those of the object, ultimately to encourage a conservation approach that is both actionable and sustainable. This minor thesis suggests that at the base level, The Anglican Diocese of Gippsland integrate regular conservation documentation practices into internal management procedures and as necessary, adopt a proactive approach to conservation that foregrounds currency and engagement with the St Mary's Church community.

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Appendix 1

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EXAMINATION & CONDITION REPORT
INDOOR MURAL

Registration

Item Details	
Reference number:	HO386 (Latrobe City Heritage Overlay number)
Artist /maker/ origin:	Arthur Boyd
Title:	The Ascending Christ
Date:	c.1960
Location:	St Mary's Anglican Church, Morwell
Address:	8 Latrobe road, Morwell VIC 3840
Item type:	(mural painting) Casein tempera on hardboard

Dimensions	
Auxiliary support (hxw):	wall
Primary support (hxw):	720m x 448m
Sight(hxw):	720m x 448m

Client details	
Owner/ custodian:	Anglican Diocese of Gippsland
Contact name:	Brian Norris, Registrar
address:	PO Box 928, Sale
state:	Victoria
postcode:	3850
Telephone:	(03) 5144 7183
Email:	BrianN@gippsanglican.org.au
Mobile:	0418 633 446

Student details	
Student name:	Yasmin Kopij
Student ID number:	672579
Creation date:	12/01/16
Name of supervisor:	Dr Nicole Tse

Report Notes

The following condition report was compiled over the period of a two-day site visit to St Mary's Anglican Church, Morwell which houses *The Ascending Christ* mural. The mural was examined visually from ground level and then documented graphically, photographically and in written form. 'Condition' is based upon the surface area that could be examined from standard eye height and so the observations made refer generally to the conservation problems and patterns of deterioration that effect the two lowest rows of panels.

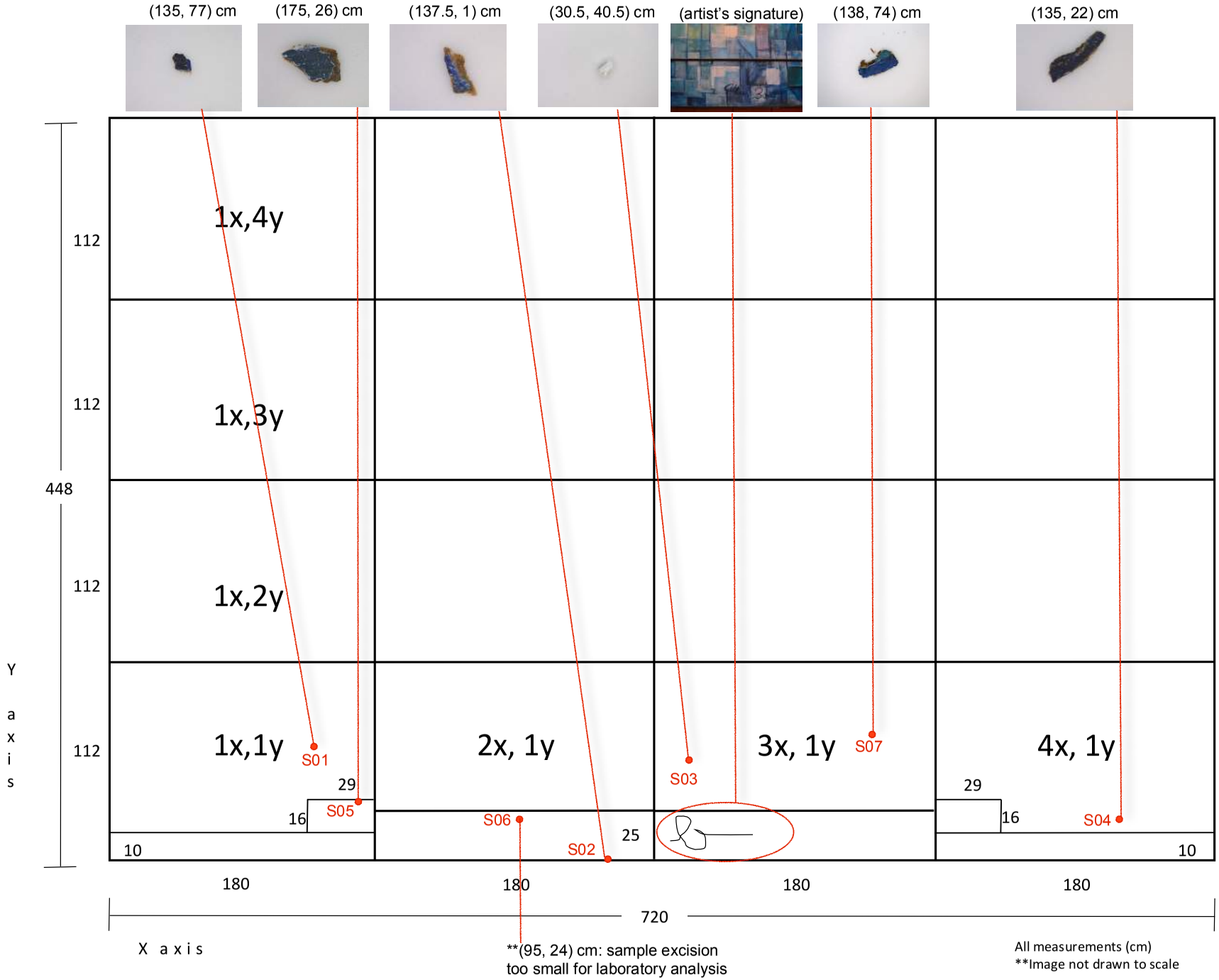

Figure 10. Diagram showing mural dimensions and sample locations

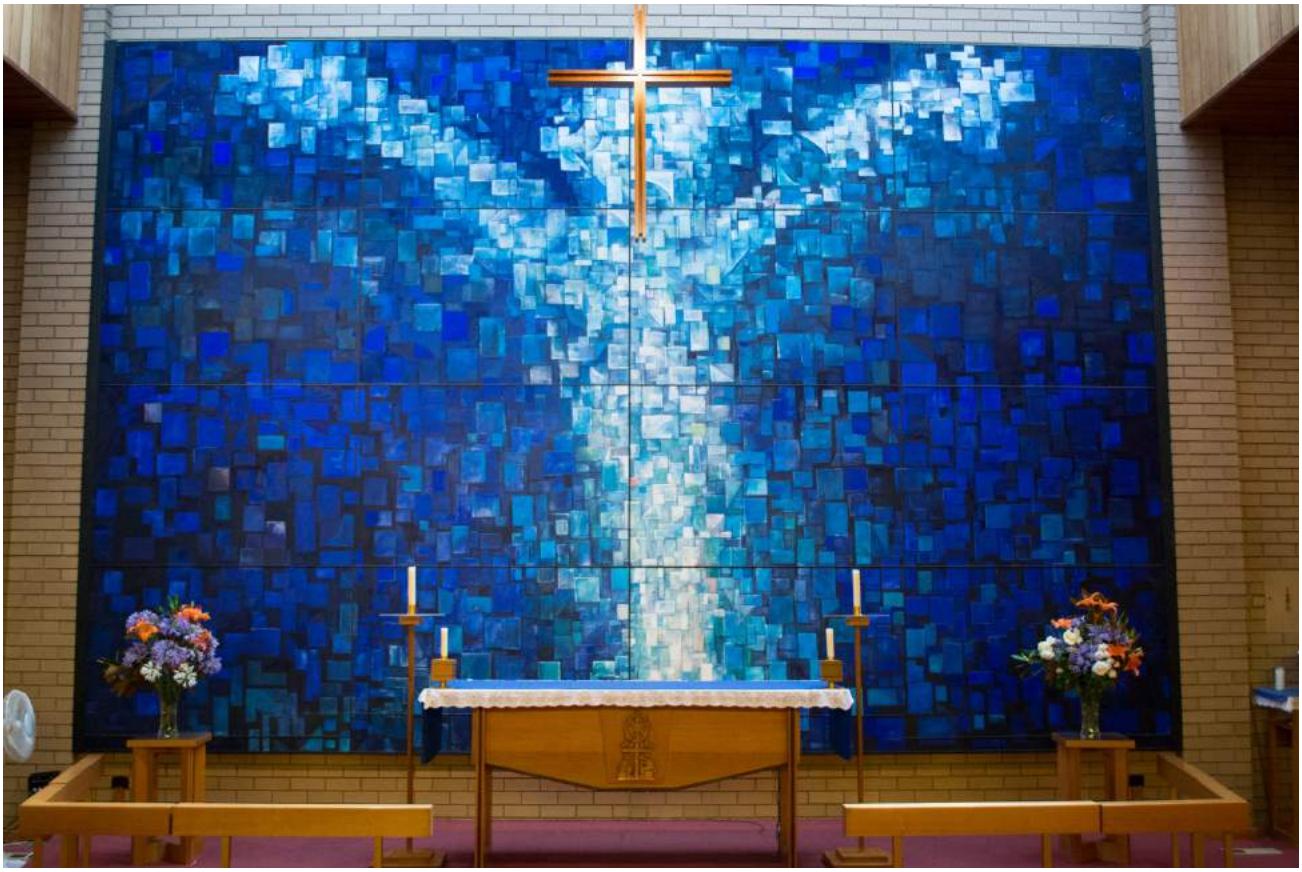

Figure 11. *Ascending Christ* (c.1960), by Arthur Boyd, St Mary's Anglican Church, Morwell. Photo taken by Dominic King.

General Description

Iconography:

Mural depicts abstract figure with arms outstretched; commissioned response to the theme of 'the Ascension'(Huguenin 1996, p. 48); interpretation of the biblical narrative that describes the manner that Jesus was taken up to Heaven in his resurrected body (Oxford Dictionary of the Bible 2010).

Location:

Interior, North wall

The mural is located on the North wall of the church behind the high altar. It measures approximately eight by five metres and comprises 16 hardboard panels arranged four by four in a horizontal grid.

A roof skylight that runs the entirety of its width casts an oblique angle from the roof to the North wall (fig. 12). Diffused light flows through amber windows set in both the upper West and South walls but does not directly illuminate the mural.

At both sides of the mural there are two small air vents located on the ground approximately 70cm from the wall.

AUXILIARY SUPPORT

The mural is fixed to the building's North wall, recessed into the wall one block thick (fig. 12). The wall supporting the mural is constructed of brick of standard block size consistent with the other adjoining walls of the building. The condition of the wall is good and appears to be structurally stable.

Figure 12: (top) image showing skylight and mural recessed into the North wall, Figure 13: (bottom right) artist's signature located third bottom panel from the left, Figure 14: (bottom left) image taken from below mural showing mounting system. Photo taken by Dominic King.

Measurements taken from beneath the base of the mural reveal that the mural does not sit flush against the wall (15mm void). It appears to be mounted to wood panel of the same approximate size (identified through a loss in the centre of the mural, fig. 16) and a series of wooden members arranged in a grid-like structure (fig. 14). Although the mount system is concealed behind the panels, it is common practice that a cradling system such as this is employed to reinforce panel paintings (Mayer 1991, p. 304).

PRIMARY SUPPORT

The primary support for *The Ascending Christ* is made from hardboard, identified by characteristic friable fibres (Mayer 1991, p. 270); observed with the naked eye from a point of loss in the centre of the mural (located panel 1x,1y (144, 26)cm). Measured at the point of loss, the board is 5mm thick, typical of patented Masonite® board that has been commonly employed as a support for mural paintings throughout the 20th century due to its smooth, hard surface (Mayer 1991, p. 271). The panels are a standard commercial measure 180 x 112cm (W x L) however the bottom row of panels now consist of two pieces reminiscent of the off-cuts that were reinstalled in the piece when it was moved to Morwell from Yallourn (Huguenin 1996, 48). The off-cuts measure 180 x 10cm (far left and far right) and 180 x 25cm (bottom centre). The artist's signature is painted in the lower section of the bottom centre right panel but is obstructed from view by the altar. There are also two small pieces that appear to have been cut and then re-inserted in far bottom left and far bottom right panels; the colour and texture of the paint work appear different to rest of the mural suggesting that they were new additions to compensate for pieces that were displaced during the mural's relocation.

Figure 15: archival image showing panel installation at St John's Church, Yallourn, n.d. Image courtesy of The Anglican Diocese of Gippsland.

The mural extends all the way to edges of the wall recess and the panel joints are concealed by 12mm domed extrusion capping. The extrusions appear to be made of black plastic and a similar joining system is depicted in a photo (fig. 15, anon. n.d) showing the mural being installed at St John's Yallourn. This implies that the mural panels were intended to be assembled in this aesthetic manner.

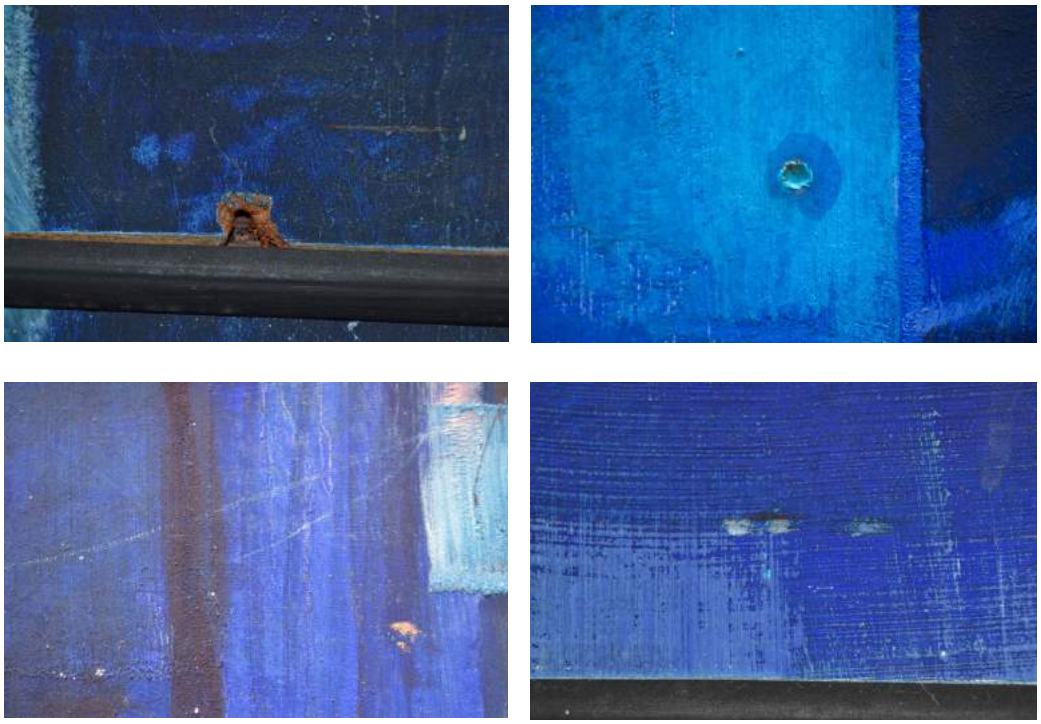

Figure 16: (top left) friable fibres characteristic of hardboard, Figure 17: (top right) overpaint on nailhead, Figure 18: (bottom right) paint loss revealing white ground, Figure 19: (bottom left) surface abrasions throughout the bottom row of panels. Photos taken by Eleanor Vallier.

Screws adhering the panels to backboard are slightly visible beneath a layer of paint; generally 14 screws have been used per panel (fig. 17). There are a few abrasions to the surface that result in slight linear indentations near to the base of the bottom row of panels but there is no significant paint loss (fig. 19). Parishioners report that abrasions in this region are likely to be unintentionally caused when people pass the mural during service to perform liturgical tasks (Kopij 2016, pers. comm., 13 January).

GROUND

It is unclear whether a pigmented ground layer has been applied to the gesso however a thin layer of a brilliant white medium is visible where textural brushwork/ impasto has been lost due to abrasion (fig. 18). The ground layer exhibits a smooth texture that seems to account for the adhesive strength of the paint to the ground and the subsequent lack of paint deterioration.

Considering the uniform application and generalized mottled texture of the paint layer it is possible that casein has been used as a binder for the preparatory layers. Casein gesso is typically used for covering large surfaces because it can be diluted with water and applied through a pressurized spray gun to deliver a continuous and even coating (Mayer 1991, p. 312).

PAINT LAYER

The paint layer is highly saturated in colour and although appears brittle and dry is not friable (fig. 20). Paint has been applied in thin opaque layers and the pictorial elements have been modeled by deliberate and concise brushstrokes. The use of small strokes to achieve tonal variation coupled with the hardened and semi-matte film are characteristic of tempera painting (Van Loon, Noble & Burnstock 2012, p. 224).

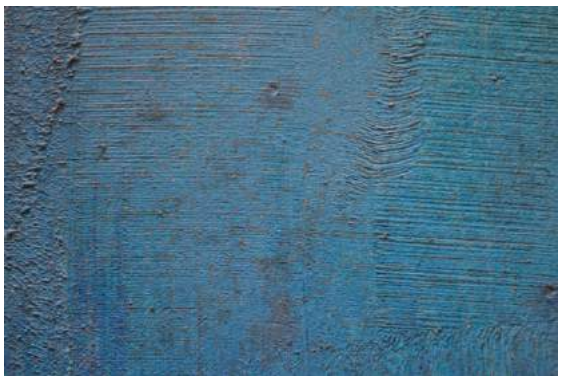

Figure 20:(left) thin layers of paint exhibit brittle appearance although are well adhered, figure 21: (right) directional brushstrokes originating from base layer. Photos taken by Eleanor Vallier.

Technically the painting is very considered and effectively composed. Small cubes of colour are employed similar in effect to mosaic tesserae to suggest the composition of a Y-shaped crucifix. Form is built by contrasting the colour and shape of the cubes with selective use of impasto to define the white figure from the blue-hued background. A flat headed brush measuring 60mm has been used to apply the base layers of paint in a single direction (fig. 21); either rigidly horizontal or vertical, and then a smaller round tipped brush 10mm used to outline squares a to fill the squares with more painterly effects. Visual examination of an area of black paint loss (located panel 1x,y (107, 14)cm) reveal that dark blue tones have been applied to the ground first followed by the solid black outlines of the squares. Impasto is applied in block colours with a sponge suggesting it is a final addition to the paint layer used to emphasise the figure within the composition.

For the most part the palette is limited to a consistent set of blue shades and occasional use of green, commonly associated with holiness and humility in religious contexts (Gage 1999, p. 129). Mixtures based on these colours have been repeated throughout the composition, creating a sense of overall harmony and balanced perspective. White and black has been used in pure form. The crucifix figure is formed in white with shadows of the various colours. ‘Drawing’ the figure with white once the pigment layers have been laid references early central Italian techniques of using a tinted ground to establish a tonal unity from which subtle nuances in light and dark suggest a natural beauty rather than one relying on the contrasting of colours (Gage 1999, p. 132).

The paint layer is robust although it appears flat and variegated in lustre due to accumulated surface layers (dirt/ degradation product) (fig. 22). Overall the composition is sound and the condition of the paint layer is consistent throughout. There are fissures in the impasto, characteristic of drying cracks (Nicolaus 1998, p. 167) however overall only small patches of impasto exist and there is no cracking in the paint layer observed otherwise.

Figure 22: detail paint condition. Photo taken by Eleanor Vallier.

figure 23: detail paint condition demonstrating surface spotting. Photo taken by Eleanor Vallier.

SURFACE COATING

None apparent.
Surface appears generally to be covered in a layer of dust/ dirt. Possible degradation product concentrated in isolated areas throughout.

GENERAL CONDITION OBSERVATIONS

Colour saturation is consistent throughout (from top to bottom). Paint appears matte and flat all over but when observed from different angles and in different times of the day some brushstrokes are more luminous than others and reflect light differently.

Difficult to differentiate between dust and possible degradation product. Dust, spider webs, spider nests and insect tracks can all be sighted but is not concentrated in particular areas. Visual reflected light and shows discolouration and surface spotting follows lines of black brush strokes in RH corner of mural but then also spotting occurs within the squares on other colours (fig. 23). It is difficult to tell by visual appearance if the spotting is a selective to some colours more than others. Spotting appears most prominent in bottom L and R corners where air vents are closely located 70cm from base of mural on the ground.

Small panels inserted in the far left and far right bottom panels exhibit no impasto and appear less effected by dust and possible degradation product. This further supports that these panels are additions to the mural in place of off-cuts that were lost during the mural's relocation.

Overall the painting appears wholly intact, although abrasion from frequent contact with passers by is visible in isolated locations.

References

Gage, J 1999, *Color and culture: practice and meaning from antiquity to abstraction*, California University Press, California.

Huguenin I 1996, 'Arthur Boyd's moving ascension', *Gippsland Heritage Journal,* no.19, pp. 47-48.

Mayer, R 1991, *The artist's handbook of materials and techniques*, Viking, New York.

Nicolaus, K 1998, *The Restoration of Paintings*, Konemann, Cologne.

Van Loon, A, Noble, P & Burnstock, A 2012, 'Ageing and deterioration of traditional oil and tempera paints', *Conservation of Easel Paintings*, Routledge, New York, pp. 214-241.

Appendix 2

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Photographic record sheet

Item Details	
Heritage overlay number:	HO386 (Latrobe City)
Artist /maker/ origin:	Arthur Boyd
Title:	*The Ascending Christ*
Date of creation:	c. 1960
Location:	St Mary's Anglican Church, Morwell
Address:	8 Latrobe road, Morwell VIC 3840
Item type:	mural painting

date	file/image name	aspect	direction the image was taken	photographic equipment details				photographer
				f stop	speed	lens	Camera	
16/9/15	P1230195.jpg	amber windows	East	3.3	1/25	4.1mm	Panasonic DMC-TZ6	Yasmin Kopij
13/1/16	DSC_0694.jpg	Artist signature	North	3.5	1/60	18mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0758.jpg	Artist signature	North	5	1/8	135mm	NIKON D3100	Dominic King
13/1/16	DSC_0759.jpg	Artist signature	North	5.6	1/8	200mm	NIKON D3100	Dominic King
13/1/16	DSC_0781.jpg	Back of church	East/ external	4	1/800	24mm	NIKON D3100	Dominic King
13/1/16	DSC_0782.jpg	Back of church	East/ external	4	1/800	24mm	NIKON D3100	Dominic King
16/9/15	P1230171.jpg	Below, mounting system	North	3.3	1/30	4.1mm	Panasonic DMC-TZ6	Yasmin Kopij
16/9/15	P1230172.jpg	Below, mounting system	North	3.3	1/15	4.1mm	Panasonic DMC-TZ6	Yasmin Kopij
16/9/15	P1230214.jpg	Detail paint condition	North	3.3	1/8	4.1mm	Panasonic DMC-TZ6	Yasmin Kopij
16/9/15	P1230217.jpg	Detail paint condition	North	3.3	1/8	4.1mm	Panasonic DMC-TZ6	Yasmin Kopij
13/1/16	DSC_0683.jpg	Detail paint condition	North	8	1/60	44mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0685.jpg	Detail paint condition	North	5	1/35	38mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0687.jpg	Detail paint condition	North	3.5	1/60	18mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0688.jpg	Detail paint condition	North	5.6	1/60	55mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0691.jpg	Detail paint condition	North	5	1/60	38mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0692.jpg	Detail paint condition	North	5	1/60	38mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0693.jpg	Detail paint condition	North	4.5	1/60	30mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0696.jpg	Detail paint condition	North	5	1/20	36mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0697.jpg	Detail paint condition	North	5.6	1/15	55mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0698.jpg	Detail paint condition	North	4.8	1/30	32mm	NIKON D3100	Eleanor Vallier

13/1/16	DSC_0699.jpg	Detail paint condition	North	5.3	1/25	40mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0700.jpg	Detail paint condition	North	4.5	1/20	29mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0701.jpg	Detail paint condition	North	4.5	1/25	30mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0703.jpg	Detail paint condition	North	4.5	1/25	30mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0704.jpg	Detail paint condition	North	4.5	1/30	30mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0706.jpg	Detail paint condition	North	4.8	1/30	32mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0707.jpg	Detail paint condition	North	4.8	1/40	32mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0713.jpg	Detail paint condition	North	4.2	1/50	26mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0677.jpg	Detail paint loss	North	8	1/60	52mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0679.jpg	Detail paint loss	North	8	1/60	55mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0797.jpg	E. Vallier sampling	North	3.8	1/50	20mm	NIKON D3100	Dominic King
13/1/16	DSC_0801.jpg	E. Vallier sampling	North	3.8	1/30	22mm	NIKON D3100	Dominic King
13/1/16	DSC_0810.jpg	E. Vallier sampling	North	5.3	1/40	44mm	NIKON D3100	Dominic King
13/1/16	DSC_0816.jpg	E. Vallier sampling	North	3.8	1/40	22mm	NIKON D3100	Dominic King
13/1/16	DSC_0821.jpg	E. Vallier sampling	North	3.5	1/40	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0750.jpg	E. Vallier, Rev. D. Head	North	4	1/25	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0752.jpg	E. Vallier, Rev. D. Head	North	4.5	1/13	100mm	NIKON D3100	Dominic King
13/1/16	DSC_0755.jpg	E. Vallier, Rev. D. Head	North	5	1/15	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0756.jpg	E. Vallier, Rev. D. Head	North	4.5	1/25	100mm	NIKON D3100	Dominic King
13/1/16	DSC_0793.jpg	front of church	West/ external	3.5	1/400	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0794.jpg	front of church	West/ external	3.5	1/800	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0796.jpg	front of church	West/ external	3.5	1/800	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0787.jpg	High set windows	South	3.5	1/30	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0788.jpg	High set windows	South	3.5	1/30	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0789.jpg	High set windows	South	4.5	1/30	29mm	NIKON D3100	Dominic King
13/1/16	DSC_0717.jpg	Morning tea with parishioners	North	3.5	1/100	18mm	NIKON D3100	Dominic King
16/9/15	P1230164.jpg	Mural overall	North	3.5	1/13	5.7mm	Panasonic DMC-TZ6	Yasmin Kopij
16/9/15	P1230165.jpg	Mural overall	North	3.8	1/10	7.9mm	Panasonic DMC-TZ6	Yasmin Kopij
13/1/16	DSC_0725.jpg	Mural overall	North	4	1/80	22mm	NIKON D3100	Dominic King
13/1/16	DSC_0729.jpg	Mural overall	North	4	1/50	24mm	NIKON D3100	Dominic King

13/1/16	DSC_0733.jpg	Mural overall	North	3.8	1/200	20mm	NIKON D3100	Dominic King
13/1/16	DSC_0734.jpg	Mural overall	North	3.5	1/50	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0736.jpg	Mural overall	North	3.5	1/30	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0737.jpg	Mural overall	North	3.5	1/30	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0739.jpg	Mural overall	North	4.5	1/20	29mm	NIKON D3100	Dominic King
13/1/16	DSC_0740.jpg	Mural overall	North	4.5	1/20	30mm	NIKON D3100	Dominic King
13/1/16	DSC_0741.jpg	Mural overall	North	3.5	1/20	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0742.jpg	Mural overall	North	4.5	1/25	28mm	NIKON D3100	Dominic King
13/1/16	DSC_0743.jpg	Mural overall	North	3.5	1/20	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0744.jpg	Mural overall	North	5	1/20	34mm	NIKON D3100	Dominic King
13/1/16	DSC_0779.jpg	Mural overall	North	5	1/13	34mm	NIKON D3100	Dominic King
16/9/15	P1230166.jpg	Mural overall, skylight	North	3.3	1/30	4.1mm	Panasonic DMC-TZ6	Yasmin Kopij
16/9/15	P1230174.jpg	Mural overall, skylight	North	3.3	1/30	4.1mm	Panasonic DMC-TZ6	Yasmin Kopij
13/1/16	DSC_0680.jpg	Paint condition	North	8	1/60	18mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0681.jpg	Paint condition	North	3.5	1/60	18mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0686.jpg	Paint condition	North	3.5	1/60	18mm	NIKON D3100	Eleanor Vallier
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13/1/16	DSC_0709.jpg	Paint condition	North	5	1/60	35mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0710.jpg	Paint condition	North	5.6	1/25	50mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0711.jpg	Paint condition	North	3.5	1/60	18mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0712.jpg	Paint condition	North	5.6	1/60	55mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0731.jpg	Paint detail	North	5.6	1/40	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0747.jpg	Paint detail	North	5.6	1/3	200mm	NIKON D3100	Dominic King
13/1/16	DSC_0748.jpg	Paint detail	North	4.5	1/6	98mm	NIKON D3100	Dominic King
13/1/16	DSC_0753.jpg	Paint detail	North	4	1/80	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0757.jpg	Paint detail	North	4.5	1/6	100mm	NIKON D3100	Dominic King

13/1/16	DSC_0761.jpg	Paint detail	North	5	1/5	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0764.jpg	Paint detail	North	4	1/8	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0765.jpg	Paint detail	North	4.2	1/13	65mm	NIKON D3100	Dominic King
13/1/16	DSC_0766.jpg	Paint detail	North	5.6	1/10	200mm	NIKON D3100	Dominic King
13/1/16	DSC_0768.jpg	Paint detail	North	4.5	1/13	100mm	NIKON D3100	Dominic King
13/1/16	DSC_0769.jpg	Paint detail	North	4	1/25	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0776.jpg	Paint detail	North	4.5	1/30	100mm	NIKON D3100	Dominic King
13/1/16	DSC_0818.jpg	Samples	North	4	1/160	24mm	NIKON D3100	Dominic King
16/9/15	P1230189.jpg	skylight	North	3.3	1/60	4.1mm	Panasonic DMC-TZ6	Yasmin Kopij
13/1/16	DSC_0783.jpg	skylight	North	4.5	1/80	28mm	NIKON D3100	Dominic King
13/1/16	DSC_0792.jpg	Stained glass windows	West	4.5	1/30	29mm	NIKON D3100	Dominic King
16/9/15	P1230196.jpg	Stained glass windows, light	West	3.3	1/30	4.1mm	Panasonic DMC-TZ6	Yasmin Kopij
13/1/16	DSC_0673.jpg	Y. Kopij making condition report	North	3.5	1/60	18mm	NIKON D3100	Eleanor Vallier
13/1/16	DSC_0770.jpg	Y. Kopij, E. Vallier sampling	North	4	1/15	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0772.jpg	Y. Kopij, E. Vallier sampling	North	4	1/25	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0773.jpg	Y. Kopij, E. Vallier sampling	North	4	1/20	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0774.jpg	Y. Kopij, E. Vallier sampling	North	4	1/20	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0775.jpg	Y. Kopij, E. Vallier sampling	North	4	1/20	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0819.jpg	Y. Kopij, E. Vallier sampling	North	4	1/60	24mm	NIKON D3100	Dominic King
13/1/16	DSC_0799.jpg	Y.Kopij making condition report	North	4	1/30	22mm	NIKON D3100	Dominic King
13/1/16	DSC_0802.jpg	Y.Kopij making condition report	North	3.8	1/15	22mm	NIKON D3100	Dominic King
13/1/16	DSC_0803.jpg	Y.Kopij making condition report	North	3.8	1/15	18mm	NIKON D3100	Dominic King
13/1/16	DSC_0804.jpg	Y.Kopij making condition report	North	5	1/13	36mm	NIKON D3100	Dominic King
13/1/16	DSC_0806.jpg	Y.Kopij making condition report	North	5.3	1/20	40mm	NIKON D3100	Dominic King
13/1/16	DSC_0808.jpg	Y.Kopij making condition report	North	5.3	1/20	40mm	NIKON D3100	Dominic King
13/1/16	DSC_0809.jpg	Y.Kopij making condition report	North	5.6	1/40	55mm	NIKON D3100	Dominic King
13/1/16	DSC_0811.jpg	Y.Kopij making condition report	North	5.3	1/15	44mm	NIKON D3100	Dominic King
13/1/16	DSC_0813.jpg	Y.Kopij making condition report	North	3.8	1/15	22mm	NIKON D3100	Dominic King
13/1/16	DSC_0815.jpg	Y.Kopij making condition report	North	4.8	1/15	32mm	NIKON D3100	Dominic King
13/1/16	DSC_0822.jpg	Y.Kopij making condition report	North	4	1/40	24mm	NIKON D3100	Dominic King

13/1/16	DSC_0823.jpg	Y.Kopij making condition report	North	4	1/100	22mm	NIKON D3100	Dominic King
13/1/16	DSC_0824.jpg	Y.Kopij making condition report	North	4	1/80	22mm	NIKON D3100	Dominic King

*Prepared in accordance with the Victoria State Government photographic log conventions:

Gardiner, R 2007, 'Photographic recording for heritage places and objects', technical note, Victorian Government Department of Planning and Community Development, Melbourne, available at < http://www.dtpli.vic.gov.au/heritage/research-and-publications/technical-guidance>.

**Images recorded as high and low resolution JPEG format for research purposes however RAW format copy of images are stored in archival backup.

Appendix 3: Instrumental Analytical Procedure

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Instrumental X-ray Fluorescence (XRF) Spectroscopy

XRF analysis was conducted directly on all samples with a prolene intermediary film between. The samples were positioned prone on the XRF device that was positioned on a table. XRF spectra were collected from the top side of each of the samples using a Bruker Tracer III-SD® energy-dispersive XRF analyser (Bruker AXS Handheld Inc., Kennewick, WA, USA), equipped with a silicon drift detector (SDD). Scans were conducted for 60 seconds and set with a maximum voltage of 40.00 kV and 10.70μA anode current. Peaks were identified using Bruker S1PXRF® software. The instrument operation was performed by student researcher Yasmin Kopij and the initial spectra analysis was provided by Dr Nicole Tse (GCCMC).

Fourier Transform Infrared Attenuated Total Reflectance (FTIR-ATR) Spectroscopy

Following XRF analysis, Fourier transform infrared (FTIR) analysis was undertaken on the six paint samples to identify the presence of organic pigment elements and to confirm the presence of proteinaceous material to support the characterization of Casein Tempera. All samples were tested and Spectra were collected using a Bruker Alpha-P FTIR spectrometer equipped with a diamond attenuated total reflection (ATR) window (Bruker Optik GmbH, Ettingen, Germany). All spectra were recorded in the spectral range of 4000-375cm-1 with 128 co-added scans at a spectral resolution of 4cm-1. Prior to collecting spectral data, the diamond ATR crystal was cleaned with Isoproponal and a cleanness test function and new background measurement was performed. Samples were placed onto a glass slide with tweezers prior to transfer to the ATR window. All samples were analysed top side down. Data acquisition and processing was performed with OPUS 6.5® spectral software. Peak picking was undertaken and samples were compared against control samples obtained from the research findings of Sophie Theobald Clark (2013; Table 7) and the literature published by Learner (1999), Schiers (2000) and Stuart (2007) regarding the characterisation of paint containing casein.

Table 7. *Principal Peaks in FTIR Spectra of Reference Samples (Theobald Clark 2013)*

Region of spectrum/ cm^{-1}	Linseed Oil	PY 3 (Kremer)	PR 3 (Kremer)	PR 112 (Langridge)	PB 15 (JNH)	PB 27 (JNH)	PB 60 (Kremer)	PG 7 (JNH)
2000-3000	2923vs 2852s							
1700-2000	1711vs					2069vs		
1600-1700		1670s	1619m	1671s		1611s	1654vs 1628s	
1500-1600		1583m 1533s 1501vs	1562s	1591s 1551s 1536s	1507s		1578s	1556m
1400-1500	1461s 1414m	1477vs 1441s	1497s 1469s 1446s	1477vs 1447vs	1465m 1421s	1415m	1491vs	1496m
1300-1400	1377m	1336vs	1321m 1301s	1390s 1322s	1333s		1345s 1325s	1389s 1319s 1302vs
1200-1300	1240m	1279vs 1259s	1254s	1281s 1251s 1203s	1287s		1262vs	1274vs 1207vs
1100-1200	1166vs	1176vs 1138s	1188vs 1128s	1158s 1120s	1166s 1119vs		1184s 1153s 1117m	1148vs
1000-1100	1096s	1035m	1095m	1061s 1013vs	1091vs 1068s		1077s 1013s	1092vs
900-1000		958m	986m	906m	900s	983m		946s
800-900		892m 810s	869m 848s 812s	867m 828m	865m		862m 834s	873m
650-800	723s	792s 748vs 708m	752vs 744s 722s	759s 744vs 702s 680m	770s 754s 721vs	603s	744s 708vs 671s	769s 746vs
450-650						492vs	639s 605s 495m 475m 411s	

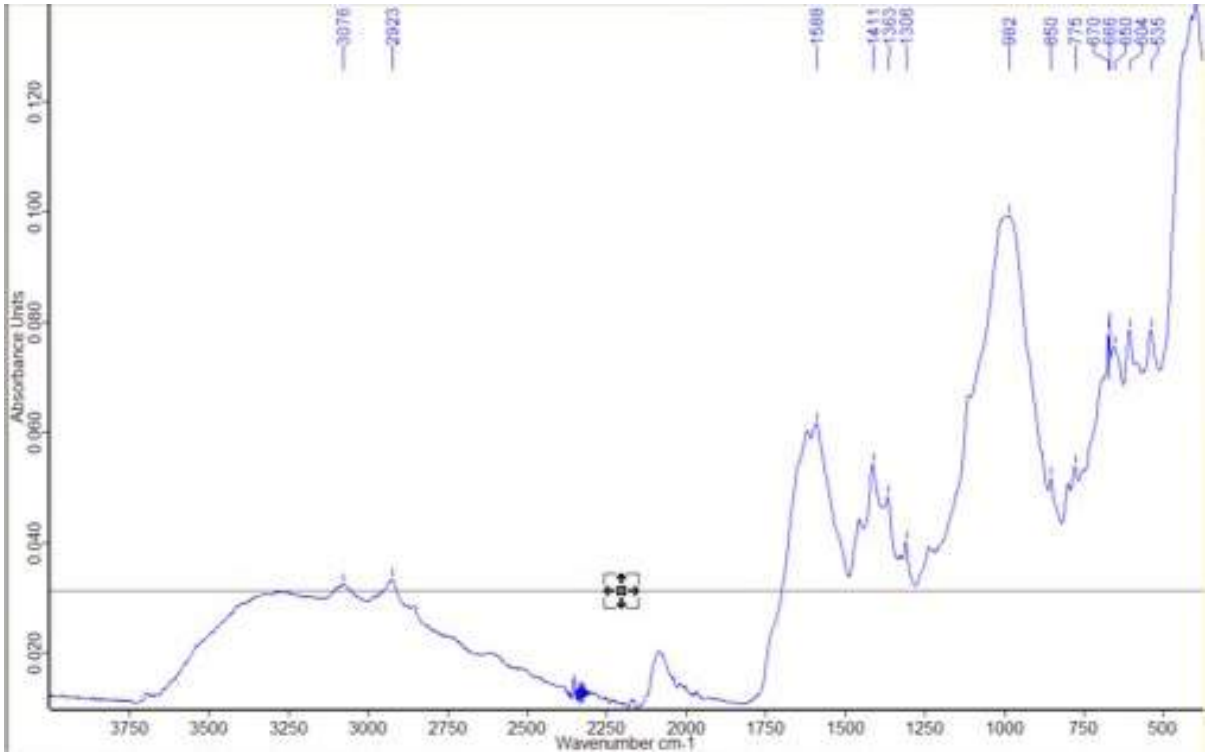

Figure 24: FTIR-ATR spectra (absorbance [y] versus wavenumber [x] of sample S01 from *The Ascending Christ*, conducted by Yasmin Kopij, 22 March 2016, Interactive peak picking determined by OPUS 6.5® spectral software.

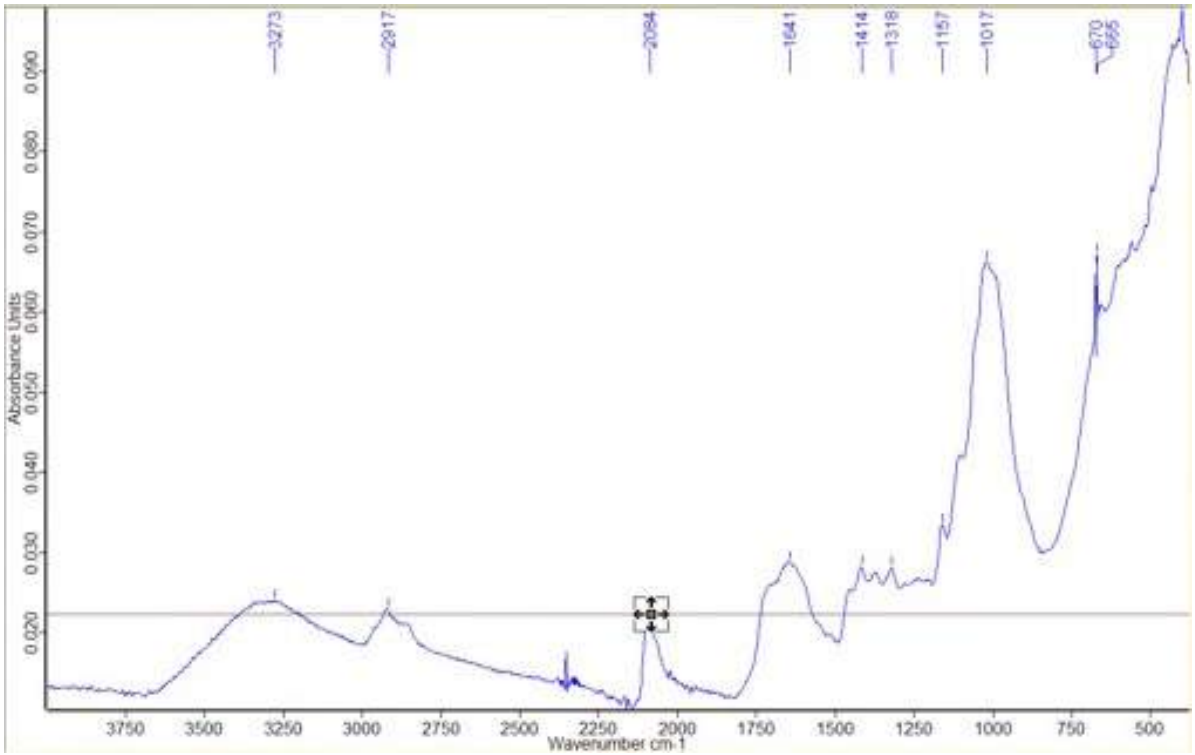

Figure 25: FTIR-ATR spectra (absorbance [y] versus wavenumber [x] of sample S02 from *The Ascending Christ*, conducted by Yasmin Kopij, 22 March 2016, Interactive peak picking determined by OPUS 6.5® spectral software.

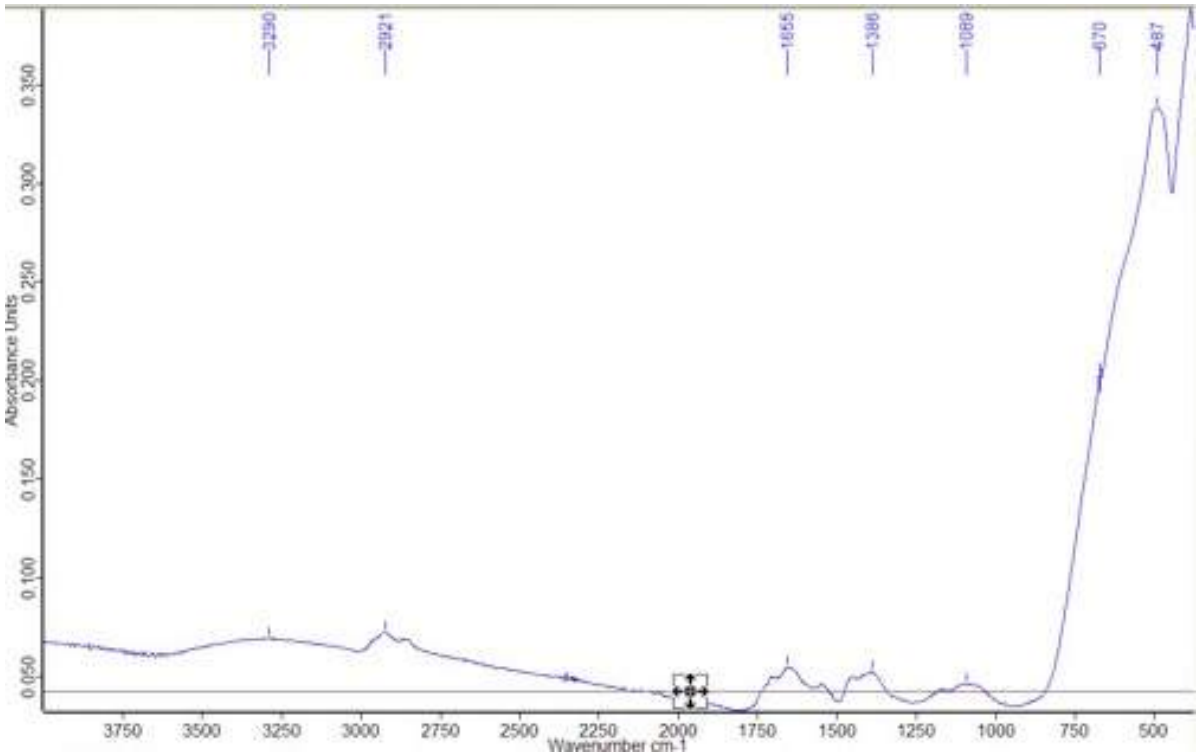

Figure 26: FTIR-ATR spectra (absorbance [y] versus wavenumber [x] of sample S03 from *The Ascending Christ*, conducted by Yasmin Kopij, 22 March 2016, Interactive peak picking determined by OPUS 6.5® spectral software.

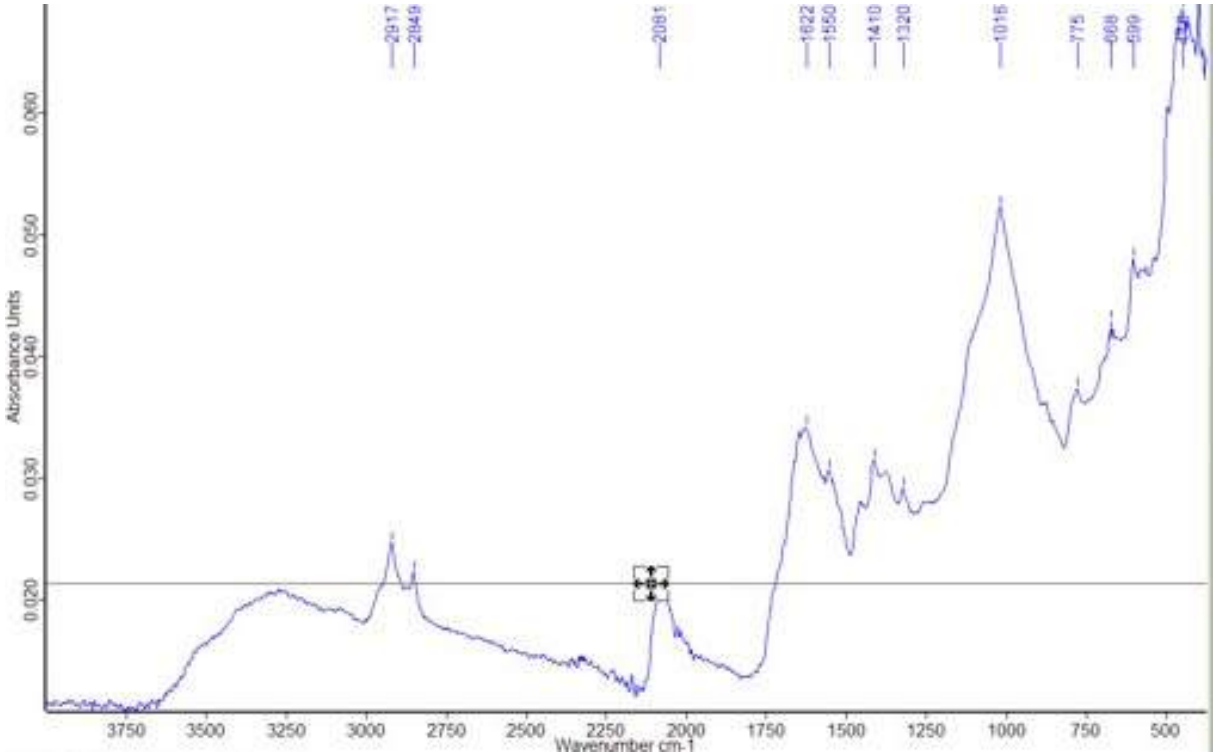

Figure 27: FTIR-ATR spectra (absorbance [y] versus wavenumber [x] of sample S04 from *The Ascending Christ*, conducted by Yasmin Kopij, 22 March 2016, Interactive peak picking determined by OPUS 6.5® spectral software.

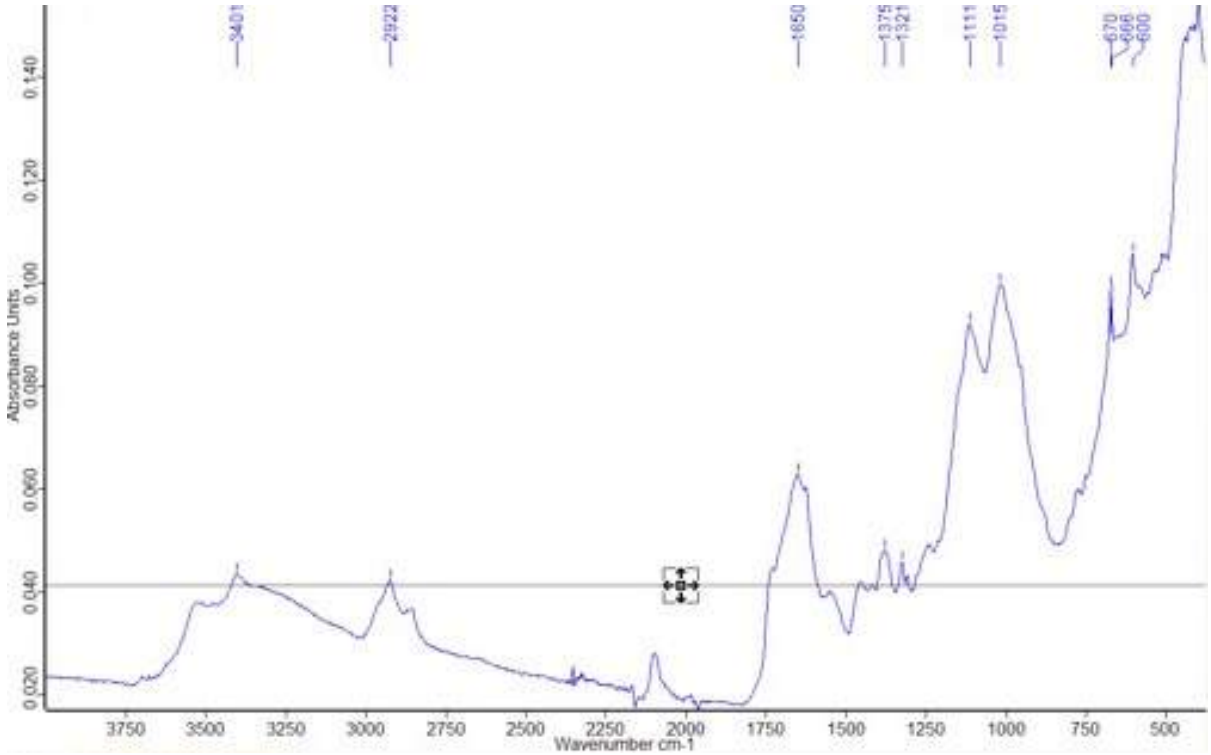

Figure 28: FTIR-ATR spectra (absorbance [y] versus wavenumber [x] of sample S05 from *The Ascending Christ*, conducted by Yasmin Kopij, 22 March 2016, Interactive peak picking determined by OPUS 6.5® spectral software.

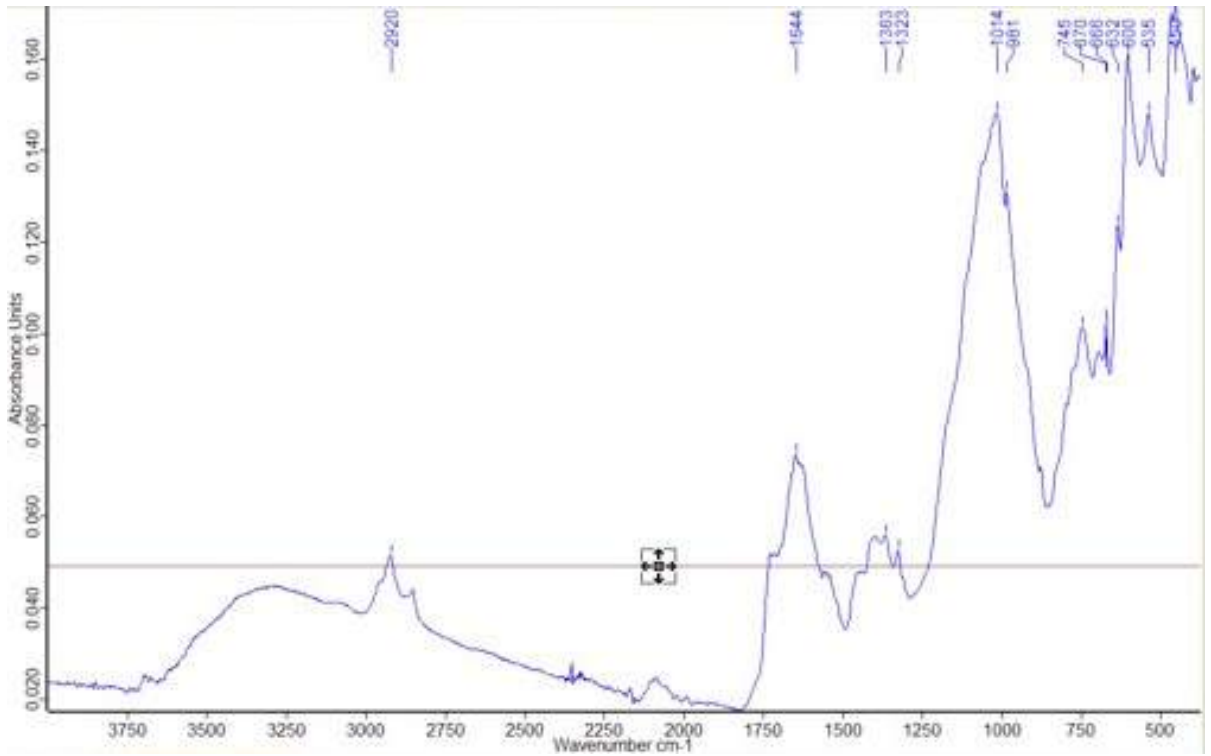

Figure 29: FTIR-ATR spectra (absorbance [y] versus wavenumber [x] of sample S07 from *The Ascending Christ*, conducted by Yasmin Kopij, 22 March 2016, Interactive peak picking determined by OPUS 6.5® spectral software.

Table 8. Principal Peaks in FTIR Spectra of *The Ascending Christ* correlated with region of spectrum for proteins and oils according to Stuart (2007, p. 119. Peaks identified by OPUS 6.5® spectral software.

Region of spectrum/ cm-1	S01	S02	S03	S04	S05	S07
3200-3600	-	-	-	-	-	-
3400-3200	-	3273*	3290*	-	3401*	-
3000-3400	3076♦	-	-	-	-	-
2000-3000	2923♦	2917♦, 2084	2921♦	2917♦ 2849♦, 2081	2922♦	2920♦
1700-2000	-	-	-	-	-	-
1600-1700	-	1641*	1655*	1622*	1650*	1644*
1500-1600	1588	-	-	1550*	-	-
1400-1500	1411♦	1414♦	-	1410♦	-	-
1300-1400	1363♦*, 1306♦*	1318♦*	1386♦*	1320♦*	1375♦*, 1321♦*	1363♦*, 1323♦*
1200-1300	-	-	-	-	-	-
1100-1200	-	1157♦	-	-	1111♦	-
1000-1100	-	1017♦	1089♦	1016♦	1015♦	1014♦
900-1000	♦982	-	-	-	-	981♦
800-900	850♦	-	-	-	-	-
650-800	775♦, 670, 666	670, 665	670	775♦, 668	670, 666	745, 670, 666
450-650	650, 604, 535	-	487	599	600	632, 600, 535

♦ Oils: 3600 – 3200, 3000-2800, 1750-1730, 1480-1300, 1300-900, 750-700

*Proteins: 3400-3200, 1660-1600, 1565-1500, 1480-1300

Appendix 4

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Climate statistics for Morwell (Latrobe Valley Airport)
obtained from the Commonwealth of Australia, Bureau of Meteorology

Site information

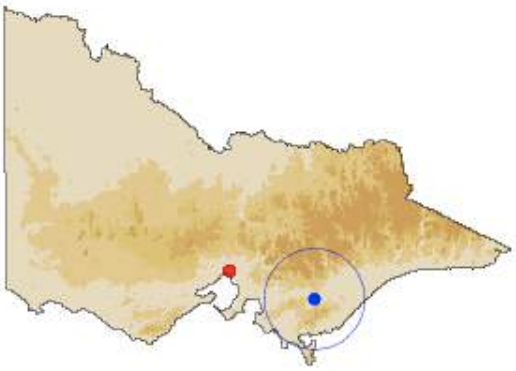
Site name: MORWELL (LATROBE VALLEY AIRPORT)
Site number: 085280
Latitude: 38.21 °S **Longitude:** 146.47 °E
Elevation: 56 m
Commenced: 1984 **Status:** Open
Latest available data: 26 May 2016

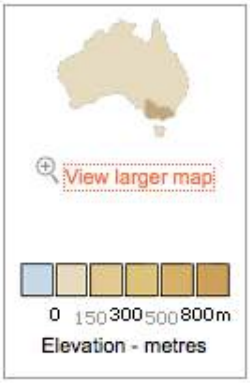
Additional information

Additional site information

Nearest alternative sites

1. 085098 YALLOURN (6.6km)
2. 085103 YALLOURN SEC (12.7km)
3. 085199 MOONDARRA RESERVOIR (14.8km)





Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Maximum temperature															
Mean maximum temperature (°C)	26.5	26.7	24.4	20.5	16.8	14.1	13.6	14.8	17.0	19.5	22.0	24.3	20.0	32	1984 2016
Highest temperature (°C)	45.1	46.3	40.4	35.0	26.7	23.5	21.8	26.8	31.0	35.1	38.6	42.2	46.3	32	1984 2016
Date	30 Jan 2009	07 Feb 2009	16 Mar 2008	14 Apr 2004	01 May 1997	08 Jun 2005	21 Jul 2009	25 Aug 1995	27 Sep 1987	12 Oct 2006	20 Nov 2009	10 Dec 2006	07 Feb 2009		
Lowest maximum temperature (°C)	14.1	14.4	13.0	11.2	7.4	6.7	7.6	7.8	7.4	8.9	11.2	12.4	6.7	32	1984 2016
Date	05 Jan 1991	28 Feb 1996	05 Mar 2005	28 Apr 2008	28 May 2000	12 Jun 1993	01 Jul 1986	10 Aug 2005	05 Sep 1995	16 Oct 1984	07 Nov 1994	27 Dec 1998	12 Jun 1993		
Decile 1 maximum temperature (°C)	20.1	20.1	18.6	16.0	13.6	11.6	11.0	11.9	13.1	14.7	16.5	18.4		32	1984 2015
Decile 9 maximum temperature(°C)	34.8	34.6	31.6	25.9	20.8	17.0	16.9	18.6	22.3	25.8	29.4	31.9		32	1984 2015
Mean number of days ≥ 30 °C	7.5	7.2	4.8	0.5	0.0	0.0	0.0	0.0	0.1	0.8	2.7	4.9	28.5	32	1984 2016
Mean number of days ≥ 35 °C	3.0	2.6	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.4	8.4	32	1984 2016
Mean number of days ≥ 40 °C	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	32	1984 2016
Minimum temperature															
Mean minimum temperature (°C)	12.7	12.9	11.3	8.7	6.5	4.4	3.7	4.4	5.9	7.5	9.5	11.2	8.2	32	1984 2016
Lowest temperature (°C)	1.8	1.9	1.9	-0.5	-2.6	-3.6	-3.5	-3.4	-2.1	-2.3	0.6	1.7	-3.6	32	1984 2016
Date	03 Jan 2009	27 Feb 1985	24 Mar 2000	23 Apr 1992	24 May 2008	30 Jun 1986	23 Jul 1994	04 Aug 1992	26 Sep 2006	16 Oct 2006	03 Nov 1999	01 Dec 1994	30 Jun 1986		
Highest minimum temperature (°C)	22.5	22.4	19.9	17.4	14.4	14.5	13.1	12.5	15.7	16.6	20.2	22.0	22.5	32	1984 2016
Date	27 Jan 2006	08 Feb 1997	08 Mar 2016	30 Apr 1988	24 May 1987	09 Jun 1991	31 Jul 2014	17 Aug 1995	16 Sep 1996	13 Oct 2004	03 Nov 2005	20 Dec 2015	27 Jan 2006		
Decile 1 minimum temperature (°C)	8.0	8.0	6.6	3.9	2.0	-0.2	-0.4	0.2	1.5	3.1	5.2	6.8		32	1984 2015
Decile 9 minimum temperature (°C)	17.2	17.1	15.4	13.3	10.7	9.0	8.0	8.2	9.7	11.4	13.6	15.4		32	1984 2015
Mean number of days ≤ 2 °C	0.1	0.0	0.1	1.0	3.4	8.5	10.5	7.7	4.2	1.8	0.4	0.1	37.8	32	1984 2016
Mean number of days ≤ 0 °C	0.0	0.0	0.0	0.2	0.8	3.6	4.7	2.8	1.2	0.2	0.0	0.0	13.5	32	1984 2016
Other daily elements															
Mean daily wind run (km)	352	328	314	272	270	239	279	324	336	331	343	370	313	11	1999 2016
Maximum wind gust speed (km/h)	80	113	94	89	89	78	93	87	100	91	122	84	122	17	1997 2016
Date	31 Jan 2010	04 Feb 2011	06 Mar 2010	06 Apr 2012	12 May 2015	25 Jun 2014	10 Jul 2011	17 Aug 1997	06 Sep 2012	01 Oct 2013	29 Nov 2011	02 Dec 1997	29 Nov 2011		
Mean daily sunshine (hours)															
Mean daily solar exposure (MJ/m^2)	23.8	20.3	15.8	11.1	7.7	6.2	6.9	10.0	13.4	17.8	21.1	23.3	14.8	26	1990 2016
Mean number of clear days	3.7	3.6	3.8	2.9	2.0	1.4	1.7	2.3	2.2	2.4	2.3	2.7	31.0	27	1984 2010
Mean number of cloudy days	11.6	10.4	12.5	13.3	15.9	15.4	15.2	15.9	15.0	13.3	14.7	14.5	167.7	27	1984 2010
Mean daily evaporation (mm)															

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Rainfall															
Mean rainfall (mm)	48.9	44.6	48.7	57.7	53.8	64.1	63.6	64.2	74.5	71.2	74.9	65.5	742.6	27	1984 2016
Highest rainfall (mm)	200.0	145.0	125.0	132.6	138.0	151.2	104.0	115.2	162.8	175.2	135.8	203.2	947.4	32	1984 2016
Date	1991	2011	1989	2001	1988	1991	1993	1990	1993	1989	1994	1985	2011		
Lowest rainfall (mm)	0.0	7.0	8.8	10.2	11.4	8.4	24.8	33.0	25.6	13.0	26.8	9.8	464.0	32	1984 2016
Date	1990	2016	1986	1993	2001	2006	1994	2002	2015	2006	1989	2015	2006		
Decile 1 rainfall (mm)	20.8	10.9	13.9	23.5	19.6	35.4	30.8	35.6	43.3	27.0	33.8	23.8	567.2	32	1984 2016
Decile 5 (median) rainfall (mm)	43.6	36.1	42.6	53.2	50.3	59.7	65.7	59.4	67.6	64.6	70.2	61.9	751.4	32	1984 2016
Decile 9 rainfall (mm)	74.9	70.9	85.1	97.5	94.6	97.3	98.7	97.2	118.2	123.0	121.7	96.0	914.7	32	1984 2016
Highest daily rainfall (mm)	62.4	55.0	58.0	70.0	56.8	43.2	34.0	40.8	33.4	33.6	57.2	56.6	70.0	32	1984 2016
Date	06 Jan 1991	03 Feb 2005	07 Mar 2010	12 Apr 2011	18 May 1988	13 Jun 2013	11 Jul 1989	28 Aug 2015	15 Sep 1993	20 Oct 1989	12 Nov 1998	11 Dec 1988	12 Apr 2011		
Mean number of days of rain	9.4	8.6	10.9	13.2	15.1	17.5	18.8	18.6	16.8	14.8	13.0	12.2	168.9	32	1984 2016
Mean number of days of rain ≥ 1 mm	6.2	5.6	6.9	8.4	9.1	10.1	11.2	11.7	12.0	10.3	8.9	8.1	108.5	32	1984 2016
Mean number of days of rain ≥ 10 mm	1.6	1.5	1.5	1.6	1.7	1.8	1.5	1.5	2.3	2.4	2.5	2.1	22.0	32	1984 2016
Mean number of days of rain ≥ 25 mm	0.2	0.4	0.3	0.2	0.1	0.3	0.2	0.2	0.1	0.1	0.4	0.5	3.0	32	1984 2016

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
9 am conditions															
Mean 9am temperature (°C)	17.5	16.9	15.3	13.1	10.2	7.7	7.1	8.5	11.0	13.3	14.6	16.3	12.6	27	1984 2010
Mean 9am wet-bulb temperature (°C)	14.8	14.8	13.6	11.8	9.2	6.9	6.0	7.1	9.3	11.0	12.4	13.6	10.9	23	1984 2010
Mean 9am dew-point temperature (°C)	12.4	13.1	12.0	10.4	8.4	6.1	5.3	5.9	7.5	8.6	10.2	11.1	9.2	27	1984 2010
Mean 9am relative humidity (%)	73	79	82	85	89	90	89	85	80	74	76	72	81	27	1984 2010
Mean 9am cloud cover (oktas)	5.3	5.3	5.2	5.3	5.7	5.8	5.7	5.5	5.4	5.3	5.7	5.7	5.5	27	1984 2010
Mean 9am wind speed (km/h)	13.4	11.3	10.5	10.1	8.8	9.0	9.7	12.5	14.3	16.6	14.5	15.8	12.2	26	1984 2010
9am wind speed vs direction plot															

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
3 pm conditions															
Mean 3pm temperature (°C)	24.6	24.8	22.8	19.2	15.7	13.1	12.4	13.5	15.4	17.7	20.2	22.3	18.5	27	1984 2010
Mean 3pm wet-bulb temperature (°C)	16.8	17.0	16.1	13.9	12.2	10.1	9.4	10.0	11.4	12.8	14.4	15.5	13.3	23	1984 2010
Mean 3pm dew-point temperature (°C)	10.9	11.4	10.3	9.1	8.6	7.1	6.1	5.8	6.9	7.9	9.6	10.1	8.6	27	1984 2010
Mean 3pm relative humidity (%)	46	46	48	55	64	68	67	61	59	56	54	49	56	27	1984 2010
Mean 3pm cloud cover (oktas)	5.0	4.7	4.9	5.1	5.6	5.6	5.7	5.6	5.4	5.4	5.5	5.3	5.3	27	1984 2010
Mean 3pm wind speed (km/h)	20.7	18.5	17.7	16.6	15.0	15.8	17.4	19.5	20.4	20.8	19.4	21.1	18.6	26	1984 2010
3pm wind speed vs direction plot															

red = highest value blue = lowest value

Product IDCJCM0035 Prepared at Thu 26 May 2016 00:29:53 AM EST