EXTENT

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TO AUSTRALIA AND
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M12 Motorway

Non-Aboriginal Heritage Thematic Study

Prepared for Transport for NSW

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1. Introduction

1.1 Background

Transport for NSW (TfNSW) is currently seeking approval under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate the M12 Motorway Project to provide direct access between the Western Sydney International Airport at Badgerys Creek and Sydney's motorway network. The M12 Motorway is expected to be opened to traffic prior to opening of the Western Sydney International Airport.

An Environmental Impact Statement (EIS) for the M12 Motorway project was prepared to address the Secretary's Environmental Assessment Requirements for the project and to enable the Minister for Planning and Public Spaces and the Commonwealth Minister for the Environment to make a determination on whether the project can proceed. A Non-Aboriginal Heritage Assessment Report (Oct 2019) was prepared by the Jacobs and Arcadis Joint Venture to support the EIS and present an assessment of the construction and operational activities for the project that have the potential to impact non-Aboriginal heritage.

The EIS outlined a number of management measures to be implemented in order to mitigate impact to the identified non-Aboriginal heritage sites. The management measure related to this was the preparation of a thematic study:

> Transport for NSW must prepare a thematic heritage study of CSIRO and other agricultural research stations, including McGarvie Smith Farm and McMaster Field Station, and other relevant agricultural research stations and similar facilities located in NSW. The thematic study will include a review of the role of such properties in veterinary research, association with agricultural, pastoral and animal husbandry groups, use of pioneering methods and practices and contribution to the development of farming in Australia.
>
> The thematic study must involve sufficient research to define the thematic population, to describe its range and historical context, and to identify which institutions remain extant and in what condition. The focus will be on how the M12 agricultural sites reflect their place in the overall historical and intellectual development of the theme, and how this is reflected in site elements. The research may include, as appropriate, primary and secondary sources. People with specific relevant knowledge may be identified for oral history interview or supplementary research. Site visits to other locations near Sydney may also be appropriate.

The Non-Aboriginal Heritage Thematic Study was broadened to include all sites within the project alignment, thereby examining all those aspects of the area's non-Aboriginal heritage in which further contextual information was required in order to understand and communicate significance.

This study forms part of a larger framework of historic heritage reporting for the project, as outlined below.

1.2 Sites Identification

The M12 Motorway would run between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham for a distance of about 16 kilometres The M12 road alignment traverses large land parcels that were historically used for a range of activities, including agricultural and astronomical research. Through the EIS, an initial review of existing research and previous heritage studies identified 13 heritage items and potential heritage items within the study area. Following a comparative analysis, nine heritage items were assessed as having either local, state or potentially national heritage significance. These were:

- McGarvie Smith Farm
- Fleurs Radio Telescope Site
- Luddenham Road Alignment
- Upper Canal System (Pheasants Nest Weir to Prospect Reservoir)
- McMaster Field Station
- Fleurs Aerodrome
- Cecil Park School, Post Office and School Church
- Exeter Farm Archaeological Site
- South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape

The above heritage items are the focus of this Thematic Study.

1.3 Site identification

The study area lies between the M7 Motorway at Cecil Hills and The Northern Road at Luddenham. The Local Government Areas captured in the study area to a greater or lesser degree include Penrith, Liverpool, Blacktown, Fairfield and Holroyd. The study area is within the Great Western region. The proposed M12 Motorway crosses the Cumberland Plain from east to west.

Figure 1: Map indicating the M12 study area.

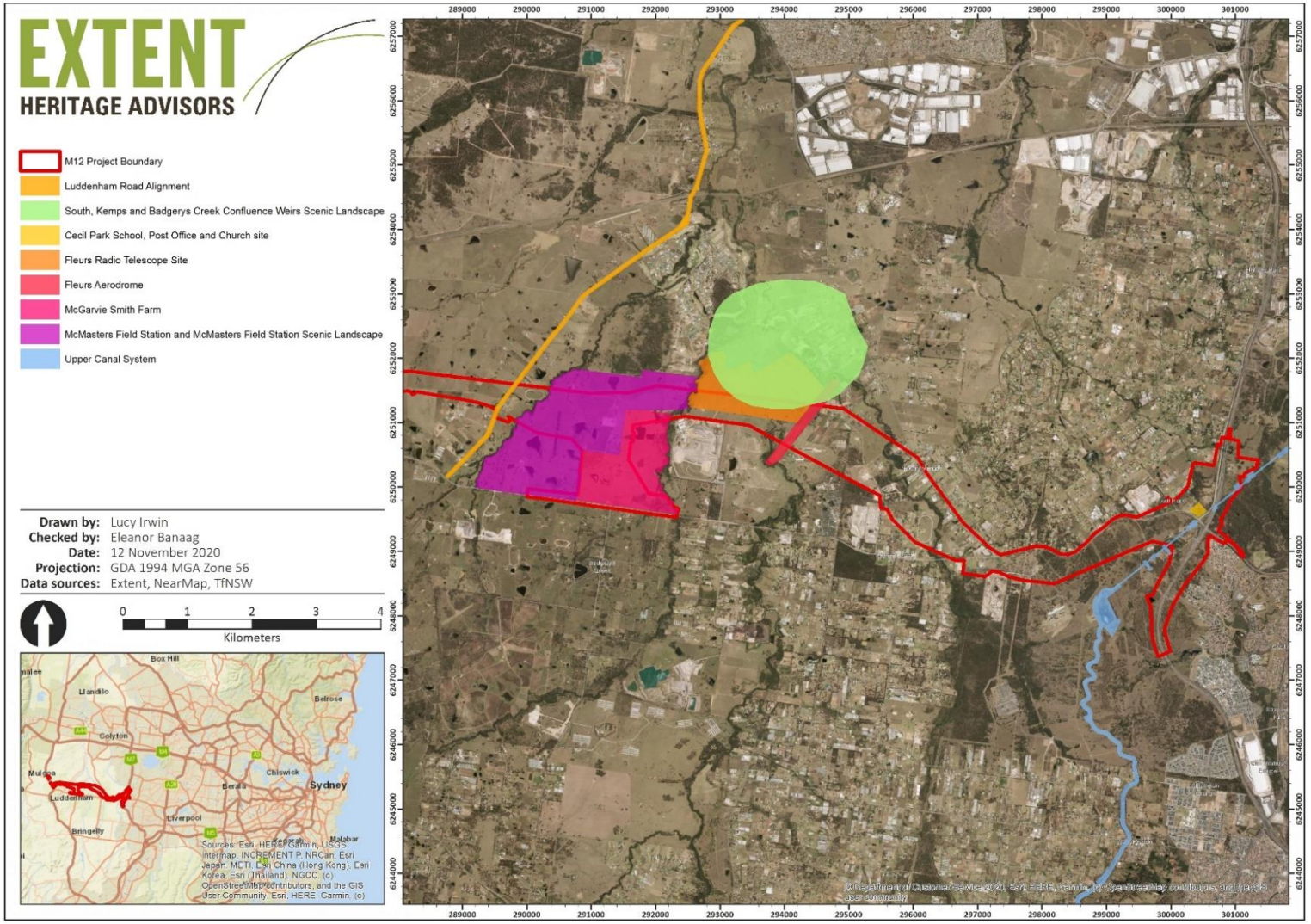

Figure 2: Map showing the heritage items within the M12 study area.

1.4 Methodology

In line with the recommendations of the EIS, the thematic study has focused on the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and University of Sydney agricultural research stations, being McGarvie Smith Farm and McMaster Field Station, as well as other relevant research stations and similar facilities located in New South Wales. The purpose of the thematic study has been to review the role of these properties in veterinary research, their associations with agricultural, pastoral, and animal husbandry groups, use of pioneering methods and practices and contribution to the development of farming in Australia. The thematic study has also taken into consideration the broader agricultural environment and settlement, its history and development, especially where there was a direct connection between historic farming properties and settlements and the institutional research stations.

Further to the agricultural research stations, the same methodology was applied to the other heritage items in the study area, in particular the other government sites and utilities relating to astronomy, defence, and water.

The thematic study has involved sufficient research to define the thematic population, to describe its range and historical context, and to identify which institutions remain extant and in what condition. The focus has been on how the sites within the study area reflect their place in the overall historical and intellectual development of the themes, how this is reflected in site elements and how the identified places fit within the historical context.

The methodology has been informed by the guidelines included in the NSW Heritage Office Heritage Information Series on *Historical Research for Heritage* (2000). The research has drawn upon primary and secondary sources and existing relevant studies and reports.

As part of the documentary research, an analysis of the study area was made to develop an understanding of the area as a whole as well as to examine in more detail the nine individual heritage items already identified within the study area which were pivotal in informing the thematic framework. This examination extended to include other locations near Sydney identified as appropriate and that will provide a robust comparative analysis.

The analysis has considered the local community, residents and businesses to ascertain a sense of the social, cultural and industrial development of the area and how the natural environment, geography and proximity to Sydney and other relevant services and communities has shaped the area and how this is represented by and within the study area. The research and analysis will reveal how this area has changed or stayed the same since European settlement and what the internal drivers as well as outside influences have been that have determined this. This component of the research will also include appropriate community and stakeholder consultation.

The preparation of the thematic study has also taken into consideration that it will form a key resource and reference for the development of the Interpretation Framework and Interpretation Plan that are the other components of the broader project scope.

1.5 Why a Thematic Study?

A thematic study is not intended to be an exhaustive history of a study area and all the individual places (or items) within it from a defined beginning to an end point. Rather it is an analysis of a place in relation to the evidence of change and development, its inhabitants and features, as well as its economic, cultural and social structure and makeup. A thematic study attempts to identify and explain the major elements and events that have influenced the history of an area and shaped its identity as a series of themes or stories that are distinctive and significant to that place and its people. In this way, a thematic study is not strictly set out as a chronological history or necessarily divided into distinct timeframes or years as themes can cover and overlap multiple periods.

A thematic study can be a helpful mechanism in which to put a group of related as well as disparate places or items into both a localised as well as wider context, and examine how their stories of establishment and development relate to broader historical themes. It also reflects on how these items are or might be perceived by the local community as well as those from those outside or visitors to the place that can help understand the heritage significance attributed to them. In many cases, these items can be represented by either just one theme or by a multitude of themes.

A thematic study also acknowledges that the stories and the themes that capture those stories will continue to evolve and change. It is an organic process which, in the passing of time, can present an opportunity to revisit and re-evaluate the themes in the context of how a place has changed and developed and been influenced by new and different impacts and perspectives.

In the case of this thematic study, the focus is mainly on the cultural environment in the post-colonial period. However, as a cultural environment such as this study area has been greatly informed by the natural environment and its original inhabitants, some reflection on these aspects of its past have also been integrated into the themes.

1.6 Authorship and Acknowledgments

The following staff members at Extent Heritage have prepared this study:

- Helen Munt, Principal Heritage Advisor
- Eleanor Banaag, Senior Associate/Team Leader
- Lucy Irwin, Heritage Advisor
- Benjamin Petkov, Heritage Advisor

In addition, feedback was provided by the following stakeholders throughout the consultation undertaken for this project:

- Associate Professor Alice Gorman, College of the Humanities, Arts and Social Sciences, Flinders University.

- Associate Professor Carol Litson, AO, Historian, School of Humanities and Communication Arts, Western Sydney University.

The two consultation meetings undertaken with these respondents were conducted over zoom. Face to face consultation was not undertaken due to the COVID-19 pandemic. These meetings provided an opportunity for these stakeholders to provide relevant information regarding the non-Aboriginal (historical) heritage aspects of the project, including their personal values and historical knowledge. Information and feedback was collected and integrated into both the thematic study and the interpretation framework. Of particular interest to respondents was the Fleurs Radio Telescope Site and the history of convict settlement in the broader area, both containing and surrounding the project boundary.

2. Thematic Framework

2.1 Developing a Thematic Framework

The thematic study has been underpinned by the development of a thematic framework that identifies and sets out the Key Themes as a suite of stories or chapters. The Key Themes are supported by a set of messages. These messages are there to succinctly capture the essence of each theme or can be considered as the hooks from which the stories embedded in each theme hang.

This was a process of first identifying which themes set out in the Australian Heritage Council's *Australian Historic Themes* and the New South Wales Historical Themes relate to the study area and its heritage items.[1] Existing local and regional thematic studies that fall within the study area, as well as other thematic studies that cover particular elements that are found in the study area – such as institutional or specific areas of study (such as astronomy) were also drawn upon where possible. From here, a suite of bespoke themes for the M12 Motorway Project area were formed and overlaid onto the other established themes, thereby aligning the themes to the regional stories of the Greater Western Sydney region and more broadly New South Wales and Australia. The thematic framework also positions each of the heritage items that have been identified under their relevant themes. Sometimes the items only lightly touched on the theme, but they bear some relevance and association that is still worth making a connection to.

Although the focus of this thematic study has been Non-Aboriginal heritage, the themes and stories that have been developed out of a separate process of consultation with Registered Aboriginal Parties for the M12 Motorway Project have also been drawn into this thematic framework and ultimately into the stories presented within the themes. The purpose of this was to acknowledge that the history of the area under investigation began long before the British colonisation of New South Wales, and when the British arrived the area and its natural and cultural environment had already been developed and shaped by the traditional owners. Including these themes and stories relating to the Aboriginal people who are connected to this place also gives the themes greater depth and meaning, acknowledges that their history and culture did not stop at colonisation but has endured and continues to the present day and highlights our different as well as shared history and stories.

[1] Australian Heritage Commission, *Australian Historic Themes: A framework for use in heritage assessment and management*, Commonwealth of Australia, 2001; and Heritage Council of New South Wales, News South Wales Historical Themes, 2006.

2.2 M12 Motorway Thematic Framework

Key themes and messages	Australian Historic Themes and Sub-themes	New South Wales' Historical Themes	Heritage Items	Aboriginal connections and key themes*
THE NATURAL ENVIRONMENT Life Earth Water Sky	**1. Tracing the evolution of the Australian environment** 1.1 Tracing climatic and topographical change 1.3 Assessing scientifically diverse environments 1.4 Appreciating the natural wonders of Australia	Environment – naturally evolved	Upper Canal System South Kemps and Badgerys Creek Confluence Weirs Scenic Landscape (adjacent) Fleurs Radio Telescope Site McGarvie Smith Farm McMaster Field Station/ McMaster Farm	**Connection** Connection to country Connection to culture Connection to people **Interconnectedness** Time – macro: past, present, future and micro: day, night, dawn, sunset Culture – passing down of tradition, caring for Country, rules of respect in welcoming to Country The Natural World – that has changed and evolved over time and since colonisation Travel – the proposed corridor following traditional travel tracks and spiritual Songlines **Themes** Local Totems Dreaming Stories Creeks and Freshwater Place Native Flora and Fauna Key Sites Red Silcrete Natural Resources – Reading the Landscape Aboriginal Astronomy Celebration and Respect of Aboriginal Culture

Key themes and messages	Australian Historic Themes and Sub-themes	New South Wales' Historical Themes	Heritage Items	Aboriginal connections and key themes*
ARRIVAL AND TRANSFERENCE Exploration and exploitation Settlement and consolidation Creating a livelihood A strange new world	**2. Peopling Australia** 2.2 Adapting to diverse environments 2.4 Migrating 2.5 Promoting settlement 2.6 Fighting for land **3. Developing local, regional and national economies** 3.3 Surveying the continent 3.5 Developing primary production 3.14 Developing an Australian engineering and construction industry **7. Governance** 7.1 Governing Australia as a province of the British Empire **8. Developing Australia's cultural life** 8.14 Living in the country and rural settlements	Migration Aboriginal cultures and interactions with other cultures Towns, suburbs and villages Land tenure Education Domestic life Leisure Religion Social institutions	South Kemps and Badgerys Creek Confluence Weirs Scenic Landscape (adjacent) Exeter Farm Archaeological Site Luddenham Road Alignment Fleurs Radio Telescope Site Fleurs Aerodrome	**Connection** Connection to culture **Interconnectedness** Culture – passing down of tradition, caring for Country, the rules of respect in welcoming to Country The Natural World – that has changed and evolved over time and since colonisation Travel – the proposed corridor following traditional travel tracks and spiritual Songlines **Themes** Creeks and Freshwater Place Native Flora and Fauna Key Sites Red Silcrete
SHAPING AND DEVELOPING Manipulation Establishment and growth Securing a future	**3. Developing local, regional and national economies** 3.5 Developing primary production 3.7 Establishing communications 3.9 Farming for commercial profit	Agriculture Commerce Communication	McGarvie Smith Farm McMaster Field Station/ McMaster Farm South Kemps and Badgerys Creek	**Connection** Connection to country **Interconnectedness**

Key themes and messages	Australian Historic Themes and Sub-themes	New South Wales' Historical Themes	Heritage Items	Aboriginal connections and key themes*
	3.11 Altering the environment 3.12 Feeding people 3.14 Developing an Australian engineering and construction industry **4. Building settlements, towns and cities** 4.5 Making settlements to serve rural Australia **5. Working** 5.8 Working on the land **6. Educating** 6.2 Establishing schools **8. Developing Australia's cultural life** 8.6 Worshipping 8.14 Living in the country and rural settlements	Environment - cultural landscape Pastoralism Utilities Accommodation Labour	Confluence Weirs Scenic Landscape (adjacent) Exeter Farm Archaeological Site Upper Canal System Luddenham Road Alignment Cecil Park School, Post Office and School Church	The Natural World – that has changed and evolved over time and since colonisation Technology – that has served Country well, as evidenced by the archaeological findings **Theme/s** Creeks and Freshwater Place Native Flora and Fauna Key Sites Natural Resources – Reading the Landscape
EXTENDING AND ADVANCING Movement and motion Knowledge and research Communication	**3. Developing local, regional and national economies** 3.4 Utilising natural resources 3.7 Establishing communications 3.8 Moving goods and people 3.14 Developing an Australian engineering and construction industry	Agriculture Communication Environment - cultural landscape Science Technology	McGarvie Smith Farm McMaster Field Station/McMaster Farm South Kemps and Badgerys Creek Confluence Weirs Scenic Landscape (adjacent)	**Connection** Connection to culture **Interconnectedness** Time – macro: past, present, future and micro: day, night, dawn, sunset The Natural World – that has changed and evolved over time and since colonisation

Key themes and messages	Australian Historic Themes and Sub-themes	New South Wales' Historical Themes	Heritage Items	Aboriginal connections and key themes*
	3.17 Inventing devices 3.20 Informing Australians 3.23 Catering for tourists **4. Building settlements, towns and cities** 4.2 Supplying urban services (water) 4.3 Developing Institutions **6. Educating** 6.3 Training people for the workplace 6.4 Building a system of higher education 6.5 Educating people in remote places **8. Developing Australia's cultural life** 8.10 Pursuing excellence in the arts and sciences	Transport Utilities Accommodation Education Social institutions Creative endeavour	Upper Canal System Luddenham Road Alignment	Technology – that has served Country well, as evidenced by the archaeological findings Travel – the proposed corridor following traditional travel tracks and spiritual Songlines **Theme/s** Dreaming Stories Creeks and Freshwater Place Aboriginal Astronomy Celebration and Respect of Aboriginal Culture
LOOKING BEYOND Observing the galaxy Creation and innovation Taking to the air	**3. Developing local, regional and national economies** 3.8 Moving goods and people 3.17 Inventing devices 3.23 Catering for tourists	Environment - cultural landscape Science Technology Transport	Fleurs Radio Telescope Site Fleurs Aerodrome	**Connection** Connection to culture **Interconnectedness** Time – macro: past, present, future and micro: day, night, dawn, sunset

Key themes and messages	Australian Historic Themes and Sub-themes	New South Wales' Historical Themes	Heritage Items	Aboriginal connections and key themes*
	4. Building settlements, towns and cities 4.3 Developing Institutions **6. Educating** 6.4 Building a system of higher education 6.5 Educating people in remote places **8. Developing Australia's cultural life** 8.10 Pursuing excellence in the arts and sciences	Utilities Education Creative endeavour		The Natural World – that has changed and evolved over time and since colonisation Technology – that has served Country well, as evidenced by the archaeological findings Travel – the proposed corridor following traditional travel tracks and spiritual Songlines **Theme/s** Dreaming Stories Aboriginal Astronomy Celebration and Respect of Aboriginal Culture
EXTERNAL INFLUENCES Influences and responses A global community Government policy War and conflict	**7. Governing** 7.4 Federating Australia 7.6 Administering Australia 7.7 Defending Australia **8. Developing Australia's cultural life** 8.10 Pursuing excellence in the arts and sciences	Defence Government and administration Social institutions Creative endeavour	McGarvie Smith Farm McMaster Field Station/ McMaster Farm Fleurs Radio Telescope Site Fleurs Aerodrome Upper Canal System	**Connection** Connection to country **Interconnectedness** Technology – that has served Country well, as evidenced by the archaeological findings Travel – the proposed corridor following traditional travel tracks and spiritual Songlines **Theme/s** Key Sites

Key themes and messages	Australian Historic Themes and Sub-themes	New South Wales' Historical Themes	Heritage Items	Aboriginal connections and key themes*
THE CYCLE AND MILESTONES OF LIFE People, places, names	**4.6 Remembering significant phases in the development of settlements, towns and cities** **9. Marking the phases of life**	Birth and death Persons	McGarvie Smith Farm McMaster Field Station/McMaster Farm Fleurs Radio Telescope Site Fleurs Aerodrome Cecil Park School, Post Office and School Church Upper Canal System South Kemps and Badgerys Creek Confluence Weirs Scenic Landscape (adjacent) Luddenham Road Alignment	**Connection** Connection to people **Interconnectedness** Culture – passing down of tradition, caring for Country, the rules of respect in welcoming to Country **Theme/s** Local Totems Dreaming Stories

* Aboriginal themes identified in Balarinji documents - 'Body of Story Report' and 'Body of Art Plan' (2019)

3. Themes

3.1 The Natural Environment

Life

Earth

Water

Sky

Life

Figure 3: Sketch by J. Heath, By water to Parramatta, with a distant view of the western mountains, taken from the Windmill-hill at Sydney, 1798 (Source: Dixson Library, State Library of NSW)

This is the country of the Darug[2] and Gandangara Aboriginal people who together possessed and held the land. The sky, stars, living things, sunlight and water were all extremely important elements to the Darug as were their local totems and the rhythm of the six seasons.

The Darug people were first known to have occupied the Cumberland Plain during the last Glacial Maximum period around 30,000 - 18,000 years ago. The Darug Country, in particular, spanned the Cumberland Plain from the Blue Mountains to the coast.[3] At this time, the temperature of the Cumberland Plain would have been 6-10 degrees cooler than today and

[2] Darug is also spelt as Dharug, Dharuk, D'harawal, Daruk, Thurrawal, Dhurrawal and their area Daruganora.

[3] Balarinj, 'M12 Aboriginal Cultural Interpretation Project', Preliminary Aboriginal Narrative, "Life Before European Settlement", 2018, p. 8.

there was significantly less rainfall. The flatter topography of the Cumberland Plain would have provided a different range of resources than would have been found on the coastline. Some of the megafauna would still have been abundant in the area.[4]

The available local resources governed the lives of the Darug, with most of their needs having to be derived and managed from the naturally occurring geology, soils, vegetation and animals of this Western Sydney area. The success of Aboriginal people in managing a fragile landscape that drew upon local resources and knowledge obtained over many thousands of years' is testament to their skills in employing and exploiting these naturally occurring local resources in innovate and sustainable ways.[5]

They developed a range of tools, implements and processes they needed to manage the landscape and their food sources. Certain stones were selected depending on their hardness or ability to be shaped into tools for hunting and skinning large and small game. Spears, axes, sticks, were fashioned from a variety of local woods and hafted using heated plant resins.[6] Aboriginal scarred trees, although quite rare on the Cumberland Plain, were created when bark was cut from trees to make canoes that were used both for holding food as well as for traversing the waterways. [7]

Figure 4: Sketch by Joseph Lycett of Aboriginal Australians night fishing by torches, NSW, c1817 (Source: National Library of Australia nla.gov.au:443/tarkine/nla.obj-138499378)

[4] Balarinji, 'M12 Aboriginal Cultural Interpretation Project', Preliminary Aboriginal Narrative, "Life Before European Settlement", 2018, p. 5.
[5] Balarinji, 'M12 Aboriginal Cultural Interpretation Project', Body of Story, 2018, p.18.
[6] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Thematic History, 2007, p. 13.
[7] Kass, Terry, 'Western Sydney Thematic History: State Heritage Register Project', 2005, p. 56.

Earth

Pemulwuy…Aboriginal warrior, was born near what was later named Botany Bay, on the northern side of the Georges River, New South Wales. His name (also spelt as Pemulwhy, Pemulwoy or other variations) was derived from the Darug (Dharug) word pemul, meaning earth. [8]

The M12 study area is situated in the regional area of Western Sydney on the Cumberland Plain, also defined as the Wianamatta Shale Plain, a gently undulating landscape which commences west of Parramatta and ends at the Nepean River.[9]

The main geographical feature of the area is the significant Nepean–Hawkesbury river system which carves through the landscape. The major tributaries or creeklines that drain north and west are Cosgroves Creek and Oaky Creek to the west of the study area, then travelling east crossing Badgerys Creek, South Creek, Kemps Creek and a small portion of Ropes Creek to the very north west boundary.

The geology of this general area is characterised by the deep gorges cut into the hard Hawkesbury sandstone and river flat that occurs over soft shale and successive deposits of river alluvium. The soils found in this area have been mainly influenced by the presence of the Wianamatta shale found mostly in the upper layer, generally offered up fertile soils and Hawkesbury sandstone present in the lower strata, produced a poorer, sandy soil as well as the substantial alluvial deposits along the numerous river systems which provide a major source of plant nutrients. Isolated pockets of igneous rock formations are also located throughout the area.[10] The predominance of sand and gravel deposits generally around the localities of Penrith and Richmond produced swampy land and poor soils.

The climate is characterised by hot dry summers and mostly cool, sunny winters with occurrences of frost.[11] This area of Western Sydney is the driest part of the Cumberland Plain with the rainfall increasing further east towards the coast. It also experiences uneven and unreliable rainfall, owing to its location within a rain shadow which was compounded by the regular occurrences of the extremes of both drought and floods.

The natural vegetation of Cumberland Plain on the Wianamatta shale was principally characterised by Eucalypt woodlands with stands of box, blue and other gums, varieties of casuarina as well as narrow-leaved ironbark, stringybark and woollybutt, and thick treeless grasslands. The vegetation was dispersed around different parts of the landscape with grey box found on the higher land, forest red gums on the lower slopes and in the depressions, ironbarks and stringybarks on the hilly land. Along the Hawkesbury-Nepean Rivers, the woodland included Sydney blue gum, forest red gum plus some angophora and river oaks.[12] To the north

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[8] Kohen, J. L. 'Pemulwuy (1750-1802)', in *Australian Dictionary of Biography*, supplementary volume 2005.
[9] Balarinji, 'M12 Aboriginal Cultural Interpretation Project', Preliminary Aboriginal Narrative, "Life Before European Settlement", 2018, p. 7.
[10] Kass, Terry, 'Western Sydney Thematic History: State Heritage Register Project', 2005.
[11] Kass, Terry, 'Western Sydney Thematic History: State Heritage Register Project', 2005.
[12] Kass, Terry, 'Western Sydney Thematic History: State Heritage Register Project', 2005.

of Penrith and in the area of Castlereagh were low fertile tertiary clays, gravels and sandy soils that supported woodlands comprising species that could tolerate the poorly drained soils such as ironbarks and scribbly gums, with pockets of banksia woodland and river oaks. Upstream of Penrith where the gorge of the river cut through the Hawkesbury sandstone the vegetation on the flats and hill slopes included river oaks and Deane's gum. Along the Nepean River the rich alluvial soils favoured broad-leaved apple, forest red gum, cabbage gum and river oak.[13]

The woodlands of the Cumberland Plain were exploited and modified for thousands of years by Aboriginal people before the arrival of British colonists.[14] This explains to a degree why the Darug people were sometimes referred to as the 'woods tribes' in the records of the early European diarists.[15] The practice of firing was traditionally employed as an important land and food management strategy. Areas of grassland were fired to keep scrub down and encourage the growth of grass in order to attract game and grazing animals such as kangaroos which they would then hunt. Fire was also employed to smoke out game in areas of thick timber and into open areas. Firing also promoted the growth and flowering of tuberous plants such as orchids and lilies '…and areas on the Cumberland Plain where these were abundant would have been frequently burnt by Aboriginal people'.[16] Firing was also employed for other purposes such as to scatter bees and to make pathways and improve sightlines.

The Aboriginal people mined sites to obtain suitable stone, clays and ochres used in artefact manufacture. Different shades and qualities of silcrete were found at different quarry sites along the creeks within the north western Cumberland Plain at St Marys, Colebee/Dean Park (Plumpton Ridge), Marsden Park, Llandilo and Ropes Creek.[17] Sites adjacent to the Hawkesbury/Nepean River contained high proportions of chert and other fine-grained rocks found in the river gravels, while sites further east and south contain higher proportions of silcrete.[18] Red silcrete was the local substitute for red ochre found in the Western Sydney region. Other raw materials included indurated mudstone from Nepean River gravels and quartz and volcanic stone which were likely derived from Rickabys Creek gravels.[19]

Water

The Darug connection to the creek-centric landscape of the Western Sydney area also influenced their survival and culture. The creeks were important freshwater places that provided a wealth of resources '…ranging from food and medicine through to construction materials.'[20] At a cultural level, the creeks were significant for their associations with local songlines, learning

[13] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History 2007, p. 8.
[14] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, 2007, Penrith Thematic History p. 12.
[15] Kohen, J. L. and R. Lampert, 'Hunters and Fishers in the Sydney Region', in D. J. Mulvaney and J. P. White, *Australians to 1788*, Fairfax, Syme and Weldon Associates, 1987, p. 384.
[16] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 13.
[17] Balarinji, 'M12 Aboriginal Cultural Interpretation Project', Body of Art, and Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 13.
[18] Balarinji, 'M12 Aboriginal Cultural Interpretation Project', Preliminary Aboriginal Narrative, "Life Before European Settlement", 2018, p. 7.
[19] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 13.
[20] Balarinji, 'M12 Aboriginal Cultural Interpretation Project', Body of Story, 2018, p. 28

and stories that guided them for thousands of years. In recognition of this continued cultural association, South Creek has recently been given the dual Indigenous name of 'Wianamatta' which means 'Mother Place' in the Darug language.[21]

The Darug predominantly camped along the edge of the waterways which gave them close proximity to sources of stone, clays and ochres, fresh water and food sources, particularly at the confluence of South, Badgerys and Kemps Creeks and their associated slopes. They regularly moved campsite as food sources became depleted which allowed for the natural rhythms of breeding and seasons to replenish their food supplies. Shelter was provided either by naturally occurring caves, ledges and overhangs of the Hawkesbury sandstone or they would make campsites in the exposed flat plains using bark for shelter.[22]

The Hawkesbury-Nepean River and tributaries provided an abundance of wildlife and food sources. Here the Darug people would exploit the estuarine environment, trapping and hunting animals and foraging.[23] The fertile riverbanks, lagoons and ponds as well as the mangroves provided seasonal supplies of freshwater fish, shellfish, eels. Reeds and rushes from freshwater swamps also provided sources of edible roots, rhizomes and tubers.[24] Native yams (murnong) found in the area were a major food source as was the nutritious kangaroo grass found in the scrubby, grassy understorey. Native fruits such as the lilly pilly, the geebung and the Port Jackson fig provided important variety to their diet. Plants were also used for medicinal purposes and provided raw materials for domestic items such as fibres for bags (shrub bark), fishing lines (inner bark of the Kurrajong tree) and leaves and lilies used to make baskets.[25]

Figure 5: Sketch by Joseph Lycett of Aborigines hunting waterbirds NSW, c1817 (Source: National Library of Australia nla.gov.au:443/tarkine/nla.obj-138499073)

[21] Balarinji, 'M12 Aboriginal Cultural Interpretation Project', Body of Story, 2018, p. 28.
[22] Liverpool City Council, *Liverpool Heritage Strategy*, draft 2019-2023, p. 8.
[23] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 13.
[24] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 12.
[25] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 12.

Sky

Aboriginal people were the first astronomers. All across Australia relied on the night sky and stars; these were a navigation system and calendar, as well as a cultural diary indicating when to travel and when to eat certain foods.[26] However, Aboriginal astronomy differed from the dominant western culture which looked to light in the night sky as guidance and enlightenment, whereas Aboriginal people looked to the darkness. Within the darkness is what are called dark constellations as represented by the Emu in the Sky (Mariong) which is one of Australia's most well-known of these dark constellations and an important local totem. The emu was a guide in cosmology and can be seen below the Southern Cross '…stretched across the Milky Way constellation'.[27] The emu also represents Mother Earth in art song and dance broadly with Aboriginal culture, and in Darug country it was mostly affiliated with Women's business.

Figure 6: The Emu in the Sky constellation (Source: photograph by Barnaby Norris, at Australian National University website, https://services.anu.edu.au/campus-environment/trails-tours/mt-stromlo-heritage-trail/australias-first-astronomers)

[26] Balarinji, 'M12 Aboriginal Cultural Interpretation Project', Body of Art, p. 26.
[27] Balarinji, 'M12 Aboriginal Cultural Interpretation Project', Body of Art, p. 26.

3.2 Arrival and Transference

Exploration and exploitation

Settlement and consolidation

Creating a livelihood

A strange new world

Exploration and exploitation

The Nepean/Hawkesbury River system and its many tributaries was a source of fascination for the early British settlers and frequently referred to in personal narratives of the day '…which exulted the rugged beauty of the natural scenery'.[28] The presence of these watercourses and the rich alluvial soils of the river floodplain were major factors in attracting permanent settlement to the area by the early British settlers who were keen to make their fortune from agricultural and pastoral pursuits. Hunger and possible starvation were the keenest of all motivators for outward expansion.[29]

Figure 7: Sketch by Joseph Lycett of View upon the Nepean River at the Cow Pastures, NSW, 1825 (Source: State Library of Victoria, Image 30328102131561/18)

The first British discovery of the Nepean River around Penrith was made by Captain Watkin Tench and his party in 1789. Tench went on to explore the source of the river, finding that the Nepean and Hawkesbury were in fact one river.[30] In 1791, Tench undertook a second exploratory journey travelling from Prospect Hill in a south-southwest direction towards the upper Nepean. The course of his outward journey took him through the lowland near the junction of South Creek and Kemps Creek and then through Bringelly. Tench and his party also came into contact with the Darug people during these explorations and noted evidence of Aboriginal occupation along the Hawkesbury.

[28] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 8.
[29] Thorp, Wendy, 'The Penrith Heritage Study: the Historical Archaeology Component', 1983, p. 27.
[30] Thorp, Wendy, 'The Penrith Heritage Study: the Historical Archaeology Component', 1983, p. 17.

Prospect Hill in the centre of the Cumberland Plain is Sydney's largest body of igneous rock. Its dominance in the landscape of the area was an important reference and observation point for early British explorers and settlers.[31] The area was a traditional camping area for the Aboriginal people, taking advantage of the creek catchments as well as the elevated landscape. Settlement in this area by the British started occurring from the late 1780s, when it was realised that the soils on its slopes, weathered from the basalt cap, were richer than the sandstone derived soils of the Cumberland Plain.

To encourage emigration, the Imperial Government initiated schemes as early as 1792 that provided free passage to those willing to come to the new colony with little to no obligations placed upon these early settlers. Despite the clear presence of Aboriginal people, the land was considered "terra nullis" and therefore available to be taken up, divided up, fenced off and developed. In 1803, Hunter's successor, Governor King (1800-1806), spurred on settlement in the area with land grants marked out all along the eastern bank of the Nepean River. Aboriginal resistance to the spread of settlement led to the Aboriginal men, women and children being driven away which often meant armed hostilities and tragic consequences such as people being shot-on-sight.

The earliest known British explorations into the Liverpool area were late in 1795 when George Bass, a naval surgeon, and Matthew Flinders, a naval officer, sailed up the Georges River. Pleased by their favourable reports of the countryside, Governor Hunter (1795-1800) named the area Banks Town and began to award grants of land in the area, including to Bass and Flinders.[32] The Liverpool district became the nucleus for further explorations to the south and south-west where large areas of country and grazing land valuable for pastoralists were identified.

In 1805 and 1806, James Meehan undertook initial surveys for land grants along South Creek, the district being named Bringelly.

Settlement and consolidation

During the early nineteenth century British settlement within the study area, extending through the present-day suburbs of Badgerys Creek, Kemps Creek, Luddenham and Bringelly, was established through the creation of grants of land that varied in size from 30 to 6000 acres setting up the beginnings of local agricultural and pastoral economies. Most of the large land grants in this district were used for grazing and were given by Governor Macquarie either as rewards for good deeds or as incentives to newly arrived settlers. However, there were also new settlers who, in the absence of receiving a grant, took to squatting along the rivers and creeks.

[31] Karskens, Grace, *Holroyd: a Social History of Western Sydney*, NSW University Press, 1991.
[32] Liverpool City Council, *Liverpool Heritage Strategy*, draft 2019-2023, p. 8.

Figure 8: Sketch by Joseph Lycett of Liverpool NSW c1824 (Source: National Library of Australia nla.gov.au/tarkine/nla.obj-135702359)

Situated 30 miles from Sydney in the Cumberland District, Badgerys Creek is one of the oldest settled areas in Australia. In 1803 James Badgery, from whom the creek and suburb take their names, was originally granted 100 acres on the Hawkesbury River, however the 1806 floods forced him to seek property elsewhere. By 1810, Badgery was granted 640 acres between South Creek and what is now known as Badgerys Creek, north of present-day Elizabeth Drive. Badgerys farm was named "Exeter Farm" after his hometown in England. Over subsequent years Badgery extended the holdings of Exeter Farm, buying up other properties on land south of Elizabeth Drive. The properties were subsequently divided between his family after Badgery's death in 1827. These properties were subdivided in the 1880s as the Exeter Farms subdivision. Exeter House was demolished by 1980.

The greatest land releases in the region were those progressively issued by Governor Macquarie between 1810 and 1822. These were mostly 30 to 500 acres in size. Towns in the area such as Windsor, Richmond, Wilberforce and Pitt Town were also established around the same time. These towns were the first of what was commonly termed the "Macquarie Towns", planned and set out during the period of Governor Lachlan Macquarie (1810-1821).[33]

The local government area that became Penrith - and now centred on the regional city of Penrith - was essentially defined by the localities of Emu Plains to the west, St. Marys to the east, Agnes Banks to the north and Wallacia to the south. The first land grants around Penrith were issued to William Neate Chapman and Daniel Woodriffe. John Best, Simeon Lord and John Single. However, settlement was relatively sparse and slow to develop with many of the early grants held by absentee landowners with few actually living on their grants. The first town officially planned in the Penrith area was Castlereagh, on a site chosen by Macquarie in 1810.[34]

[33] Liverpool City Council, *Liverpool Heritage Strategy*, draft 2019-2023, p. 8.
[34] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 1, Study Report, Historical Context, 2007, p. 11.

Also in 1810, Liverpool was founded as a large district available for settlement by the British. Liverpool also a played a significant role in the convict-based economy, becoming the site for a convict and military barracks, a courthouse, a gaol, a convict hospital and a church.

Robert Lowe was granted 1,000 acres (400 ha) in the Parish of Bringelly in 1812 and is believed to be the first British settler in the area. One of the most noted free settler to take up a land grant in the Nepean area was John Blaxland, whose huge grant of 6710 acres, taken up in 1813, became the "Luddenham Estate".[35] The name Luddenham was Blaxland's home village in England. This land also covered part of the present-day suburb of Badgerys Creek. John's brother Gregory had also acquired land nearby in 1909, establishing his pastoral estate "Lee Holme". The brothers then formed their own private road to connect their respective estates, which would later be known as Luddenham Road. While some of the land was used to establish Blaxland's business enterprises the larger part of Luddenham was retained for grazing. In 1841, Blaxland mortgaged Luddenham then following his death in 1845 his son Edward took over the estate but failed to revive the earlier fortunes of the property. The Luddenham Estate was sold by the Australian Trust Company to Charles Nicholson in 1851. Nicholson established a private village of Luddenham at the eastern end of the estate, on The Northern Road. Tenant farmers occupied much of the farmland within the remainder of the estate. Luddenham Road was originally a private road formed by the Blaxland brothers in the early 1800s to connect their estates and later was formalised and became a significant link for pastoral activities in the area in the nineteenth century.

What became known as the "Fleurs Estate" was originally a large estate owned by Nicholas Bayly Snr who acquired the land, located at South Creek a few miles south of the village of St Mary's, in the early 1800s. By 1814 Nicholas Bayly had constructed a house on his property he called "Bayly Park". Bayly died in 1823 at his home on the estate, and his son Henry took over Bayly Park.[36] Following Bayly's death, his consolidated properties were purchased in 1826 by Sydney merchant Richard Jones In 1826 part of the estate of Bayly Park was listed for sale by auction which had a house, outhouses and other erections – comprising 2030 acres '…abundantly supplied with excellent water, in the driest seasons; and is equally adapted for cultivation or grazing'.[37] Bayly Park was purchased by Richard (China) Jones, merchant banker ship-owner and member of Parliament, who renamed the property "Fleurs". Fleurs, which was permanently watered by both South and Kemps Creek, was used by Jones to keep a dairy herd, pigs, poultry and a vineyard:

> …by far the most important is the estate of Fleurs, the beautiful seat of Richard Jones, Esq., merchant of Sydney, whose flock of pure electoral sheep and rams are well worth turning off the high road to examine. They were the first Saxony sheep imported into New South Wales, and promise at no distant day, in our mild and equable climate, to surpass in excellence of fleece, the present stock of Saxony itself.[38]

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[35] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 11.
[36] *Cumberland Argus and Fruitgrowers Advocate*, 15 January 1931.
[37] *Sydney Gazette and NSW Advertiser*, 9 January 1826, p. 3.
[38] *The Australian*, 17 March 1827.

Jones later built a house in Sydney townsite which he also called “Fleurs” (or sometimes referred to as the Flower of Sydney). Jones was declared insolvent in the 1842-44 depression and all his estates, including Fleurs, were sold.

Another locality to be established in the area in the early nineteenth century was Cecil Park, originally home to the Cabrogal people who traditionally occupied much of the greater Fairfield area. In 1817, Thomas Wylde was granted 1,000 acres of land originally known as Macquarie Park on the northern side of Elizabeth Drive and west of Wallgrove Road. Wylde’s son, Sir John Wylde, was granted 2000 acres in the Parish of Cabramatta opposite to his father’s land, with Elizabeth Drive forming its northern boundary. He named his estate Cecil Hills, from which the suburb Cecil Park - where his father Thomas Wylde’s land was located - would take its name. Apart from the Wyldes, one of the first white settlers in the Cecil Park area was Simeon Lord, who had originally come to NSW as a convict and was granted a small portion of a 200-acres grant in the 1820s.

In 1809, Anthony Fenn Kemp, a soldier in the NSW Corps and a merchant, received an initial grant of 500 acres of land on the eastern side of Kemps Creek and later a further grant of 300 acres named “Mount Vernon”.

During the mid- to late-1820s several grants were absorbed and consolidated to create large estates, held in the main by absentee landholders. Under Governor King the system of offering free passage to prospective settlers had changed to allow only those migrants who could demonstrate that they could support themselves. By 1814 free passage was abolished which would change the type of settlers now coming to the new colony. By the first few decades of the 1800s, a number of large estates had been granted to wealthy settlers - including relations of the residing Governors and serving officers. These estates started to generate more activity and consolidate settlement with the substantial houses built on these estates becoming the nucleus of social interaction and activity. So too, the establishment of churches would also stimulate the development of small townsites and communities such as St Stephens at Penrith. In the 1840s, a small village along the Great Western Road at the South Creek crossing evolved out of an original private subdivision where the church of St Mary Magdalene had been built by endowment of the well-known King family in 1840. This informal townsite would become known as St Marys, after its church. West of St Marys, Samuel Marsden established his fine merino flock at his property of Mamre which also featured a handsome house, fine garden and orchard.[39] Mamre Road would take its name from this property.

Early farming ventures in and around the study area met with varying degrees of success with the new settlers not always adapting to the conditions of the Australian climate and landscape, still practicing methods they would have used in England. After floods in 1809, settlers were encouraged to move to the Cumberland Plains where there was higher ground.

[39] Paul Davies Pty Ltd, ‘Penrith Heritage Study’, Vol 1, Study Report, Historical Context, 2007, p. 12.

Creating a livelihood

Farming was based on pasturing of cattle, horses, sheep and goats and maize, wheat, vegetables fruit. Some poultry and pigs were also kept. Around Kemps Creek there was orchards and dairying as well as other ventures such as horse breeding and quarrying.

Grain production was the dominant industry but by the 1820s the Government was leaning more towards beef production thereby switching the focus to cattle grazing.

The 1830s saw the economy boom, significantly due to local wool production and large country estates were established by the wealthy wool farming families. In the 1830s, at 'Mamre' Farm in Orchard Hills, owned by father and son, Reverend Samuel and Charles Marsden, early sheep breeding experiments were carried out specifically in the importing and breeding of Merino sheep in Australia.

However, the late 1830s and early 1840s saw a convergence of factors that resulted in a decline in the viability of many of these farming ventures. The first was an extreme drought which started in 1838 and saw a significant decline in the fortunes of the grain producing areas such as Penrith. The other occurred in 1840, when transportation of convicts to NSW finally ceased. The depletion of grain, loss of stock with no feed and the loss of cheap labour resulted in extensive crop failures and by the 1840s the area was in the grip of a severe pastoral depression.[40]

The effects of this series of disasters spiralled, and by 1843 many landowners were in dire straits, faced with rising mortgages, plummeting land values and stock numbers markedly decreasing. The economic depression during the 1840s saw wool prices fall causing capitalists that had borrowed heavily in the 1830s in order to purchase land now unable to service their debts. For some owners of the larger estates some source of relief was sought by providing tenancies on their land.

Fortunately, recovery came relatively quick after the drought ended in 1844. Wool prices increased and expansion resumed. By the end of the 1840s, the recovery and subsequent fortunes derived from the local industries established in the area supported a relatively prosperous and well settled rural community, even though significant government ownership of land as well as the large estates taken up in the early years did inhibit greater settlement.

Some large estates were subdivided from the 1850s and the improving agricultural sector attracted small-scale farmers and led to the formation of village centres, including at Luddenham and Bringelly. These centres were established to cater for the surrounding pastoral land and farming communities, with smaller lot subdivisions supporting standard residential lots, and larger rural/pastoral lots located outside the townships.[41] While land continued to be subdivided and developed, the rural character and agricultural uses remained through the nineteenth and into the twentieth century, along with a number of the early buildings and structures.

[40] Thorp, Wendy, 'The Penrith Heritage Study: the Historical Archaeology Component', 1983, p. 34.
[41] Liverpool City Council, *Liverpool Heritage Strategy*, draft 2019-2023, p. 8.

There are still market gardens and agricultural farms extant and functioning in the area today, however this will inevitably and quickly change over the next decade or so to make way for more commercial and other enterprises that will come with the development of the Aerotropolis.

A strange new world

Although this was the driest part of Sydney in terms of rainfall, periodic flooding of parts of the Nepean/Hawkesbury River system and inundation of the surrounding land of the Cumberland Plain over millennia resulted in deep alluvial soils that would prove attractive to early agricultural activity in the area. These rich soil deposits along the numerous river systems were not encountered elsewhere in the greater Sydney regional areas to the same scale and were a stark contrast to the sandy soils found around Sydney Cove. The Wianamatta shale derived soils had high water-holding capacity, were a major source of plant nutrients and retained these nutrients better making them suitable for cropping. These soils were particularly prevalent around the Parramatta area and this was where the first successful farming ventures were located. In contrast, the sandstone predominantly located in the northern part of western Sydney such as in the Baulkham Hills area, saw only certain pockets of successful agricultural ventures.

Within the stretches of fertile land once cleared of trees, agriculture was initially undertaken by former soldiers and emancipated convicts around and by the government at the agricultural station at Emu Plains which the Europeans took little time to locate the isolated pockets of igneous rock formations such as Prospect Hill to the east. By the 1820s, much of the land around Prospect Hill had been cleared for agricultural and pastoral use. The basalt derived soils associated with such outcrops were evidently noted by the early settlers around the South Creek system with James Erskine's (Erskine Park) and Henry Bayly's grants including areas that have since been quarried for road building materials. At Orchard hills the basaltic soils are associated with vineyards.[42]

However, as well as the opportunities offered by the land and its natural resources, there would be major challenges to contend with by the nascent settlers in this new environment, in particular those presented by unwanted and uncontrollable acts of nature. The other side to being in proximity to such a major river system was the threat and impact of flooding of the river and creek systems which wrought great loss of life, stock and property and was a significant factor that determined settlement patterns and long-term success and sustainability. Conversely the ever-present threat of drought also resulted in a settlement pattern which valued access to the naturally occurring creek lines offering potable water. These first farmers, newly arrived from England, therefore experienced the contrasting ravages of both drought and flood. Another event that also had to be accounted for were bush fires that occurred in seasonal high temperatures and where high fuel loads had accumulated. This was not only exacerbated by long-term drought conditions, but further compounded by the cessation of the traditional practise of regular firing of the Cumberland Plain undertaken over millennia by the Aboriginal people that also contributed to the control the build-up of high fuel loads. As with floods and drought, seasonal bushfires were a destructive force for the new settlers, not just

[42] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 9.

impacting on life, stock and property, but also the native flora and fauna resources that would also prove devastating in the long run.[43] Periodic insect plagues, hitherto not experienced or understood, also caused havoc and major setbacks.

It was by no means only the new settlers who were adjusting and adapting to a new way of life and the challenges it was bringing. Far more devastating was the impact of colonisation on the traditional owners. By 1820s, almost all the land within the study area had been granted to the new settlers. However, it wasn't just the accelerating expansion of British colonisation and taking up of land that impacted on the local Aboriginal community. As well as being alienated, disease was one of the major impacts on the Aboriginal people. The smallpox epidemic was devastating, decimating their numbers, as well as the deaths through conflicts with the new colonists. Those survivors of various Darug clans on the Cumberland Plain became increasingly dependent on the resources of the colonists and their cultural and social structures completely reshaped in the need to live and work with the colonisers. Sometimes they lived on these properties such as Exeter Farm, even camping particularly on the creeks running through the properties settlers' and working on harvesting and other farm duties. As the years passed, many Aboriginal people were born into this dominant economic and social structure.[44]

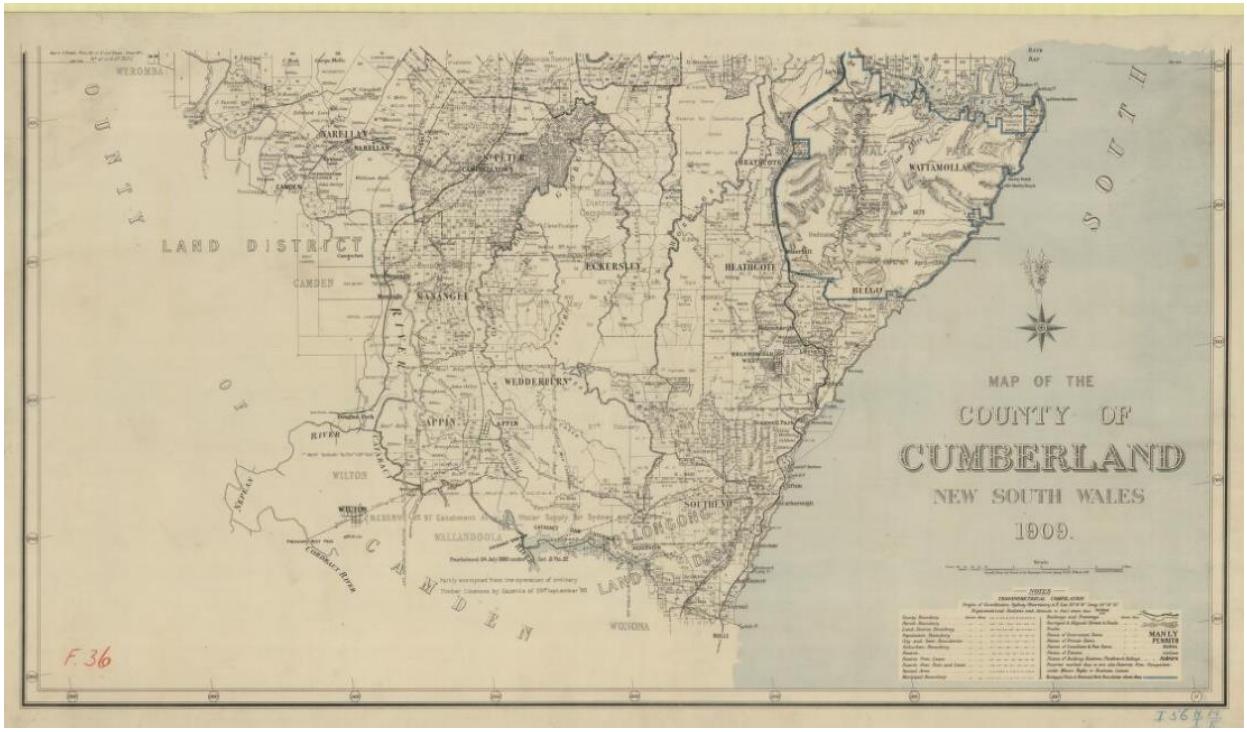

Figure 9: Map of the County of Cumberland, 1909. (Source: NLA ID No. 3884106)

[43] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 9.
[44] Martin, M., *On Darug Land: an Aboriginal Perspective*, Greater Western Education Centre Collective, 1988, p. 80.

3.3 Shaping and Developing

Manipulation

Establishment and growth

Securing a future

Manipulation

The effect of colonisation on the landscape would be noticeable. As beautiful as the natural scenery was considered - and was the source of the original attraction of this Western Sydney area - later consolidation of British settlement would inevitably and permanently change this landscape. Throughout the nineteenth century the Cumberland woodland colonies of the Darug Country were gradually cleared to provide areas for grazing of stock, native yams were wiped out by pasturing animals, and wetlands found along the Hawkesbury River were gradually cleared or filled in.[45]

One of the principal activities undertaken in the first two decades of the twentieth century was wood-cutting or timber-getting. Timber-getting was not only an industry in itself that stimulated a local economy, but with vast tracts of trees cut down to supply timber, land then became available to be opened up for farming. On the downside, much of the natural woodlands, forests and associated vegetation around this area was decimated. Native vegetation was cleared to such an extent that very little of the pre-Contact vegetation distribution remained, and many of the indigenous plant communities quickly came under threat of extinction.

Most of the large stands or trees had gone, and there were clear traces of the scarring and polluting impacts of industry, agriculture and constant subdivision. In addition, the trees and other native vegetation that were cut down and removed in the early twentieth century were replaced with introduced and exotic species such as wheat, maize, barley and oats as well as fruit trees and vegetables. A new aesthetic was created by crops, orchards and even domestic and homestead gardens. It was only due to the dereliction of many of the larger grazing properties during the latter part of the nineteenth century that saw some regrowth of native timbers and vegetation.

A major impact of more than 200 years of post-contact settlement on Aboriginal sites would have been the destruction of carved and scarred trees, which would have been removed as part of clearing for agricultural activities and the construction of infrastructure such as buildings and roads. However, there is some potential for culturally modified trees to survive in areas where there are stands of remnant native vegetation.

The level of flooding was also reduced by successive damming of the upper Nepean River undertaken during the first half of the twentieth century, which would alter the natural flow of the natural waterways. The Upper Nepean Scheme/Upper Canal System would be another major change not just to the landscape but also to the natural local water supplies. Built in 1888, the purpose so this major canal system was to supply water to Sydney's burgeoning population who

[45] Kass, Terry, 'Western Sydney Thematic History: State Heritage Register Project', 2005.

were at this time in dire need for a much larger, more reliable water supply than was being provided by existing sources. Before the end of the nineteenth century, as Sydney continued to develop, the scheme had to be expanded further and works undertaken to increase capacity and improve flow. Dams were progressively built across the Cataract, Cordeaux, Nepean and Avon rivers from 1902 until the 1930s as part of the Upper Nepean Scheme with the water from these storage dams fed into the Upper Canal System.[46] The myriad of associated channels, dams, roads, bridges, flumes and even workers cottages constructed as part of this major scheme created a new sprawling cultural landscape that is still extant today.

Establishment and growth

As settlement out of Sydney expanded further west, the pressure for residential land increased and led to large holdings being subdivided into smaller agricultural lots. These lots eventually developed into settlements and later suburbs. Key suburbs within the precinct boundaries include Luddenham, Badgerys Creek, Kemps Creek and Bringelly. Population increased markedly in the Western Sydney area between the 1860 and 1880. Land speculation was peaking by the 1880s to take advantage of the swelling population in the area, and large estates started to be subdivided into smaller lots and even new model towns being formed. However, in the early years, most subdivisions stagnated or failed due to the absence of infrastructure such as railways and serviceable roads. In addition, there was a need for more services, shops, schools, churches and post offices which consolidated local settlements and communities.

In 1871, Penrith had become well established and was formally proclaimed a municipality. By the 1870s, the settlement in Liverpool had not spread far beyond the nucleus of dwellings established in the 1820s, with expansion mainly being housing allotments near the major workplaces of the township. The subdivision of the large rural landholdings into smaller farming allotments from the 1870s onwards drew an increased population to the district and enhanced the number of people living in the town itself. However, many of these properties were found to be uneconomical and as a result eventually became deserted.[47]

In 1890, municipal status was granted at St. Marys followed by Mulgoa in 1893 then Castlereagh in 1895.

When Blaxland's Luddenham Estate at Wallacia was put up for sale in 1885, the land was also subdivided to create smaller farms, attracting more farmers to the area who would go on to establish orchards and vineyards.

It was also in the 1880s that the Buffier family arrived in the area, part of their property "Barangaroo Estate" at St Mary's, later becoming McMaster Field Station.

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[46] Upper Canal Conservation Management Plan, 2016, Government Architect's Office, 'Upper Canal: Pheasant's Nest to Prospect Reservoir, Conservation Management Plan', prepared for WaterNSW, 2016 p. 108.

[47] Liverpool City Council, *Liverpool Heritage Strategy* draft 2019-2023.

Over the years, China Jones' Fleurs Estate changed ownership many times and was greatly expanded. It was subdivided in 1883 and later sold to land speculators to become the Fleurs Estate. In 1895 the eastern portion of Jones' former property Fleurs was subdivided as the "Fleurs Estate" with blocks for sale varying in size from 7 to 100 acres. The survey plan of the Fleurs Estate shows Lots 60, 61, 64, 65, 66, 67, 68, 69 and 70 which would later become the site of the Fleurs Radio Station. In 1906, the Fleurs Estate had gone into liquidation and was offered for sale. The estate changed hands again several times over the next 30-40 years, but no real improvements carried out during this time, the land mostly being used for grazing. In 1945, two butchers purchased the land, and in 1949, they leased a portion to CSIRO, which would eventually lead to the establishment of the Fleurs Radio Station.

Figure 10: Fleurs Estate subdivision showing Lots 60-61 and 64-70 that became Fleurs Radio Station (Source: National Library of Australia)

The Wylde family held their Cecil Park and Cecil Hills grants until the late 1800s after which they were purchased and subdivided first into large lots in 1886 then into smaller rural lots in 1906. These grants became the suburbs of Cecil Park and Cecil Hills. As with other settlements and villages, as land holdings became smaller the population grew necessitating an increase in services such as schools, post offices and churches.

At Cecil Park, a timber and iron school building was erected in 1896, located on Elizabeth Drive near the intersections with Wallgrove Road, and a timber school teacher's residence was also built. The first school master was Mr William Flood. The following year, the Cecil Park Post Office was built at the school site, also run by Flood. After only a short time, the school was considered unsatisfactory and unable to fixed, therefore a new building was required. After petitioning from Cecil Park District & Progress Association a new brick school building was constructed in 1898.

Before a church was built at Cecil Park, religious services were held at a local creamery. Finally, in 1903, a church for the school was added, the cost of the construction funded by the Church Society as well as local residents. The new church, built of timber and iron, was opened by the Archbishop of Sydney, Dr William Saumarez Smith and dedicated to St Paul. As with other churches in these regional localities, St Paul's also served as a community hall.

Flood remained at the school until 1904. Other teachers to follow included Mrs Alice Jones and Mr Joseph Kenniff. The last school master was Alderman Wilf Davis, also a member of the local council, who remained at the school until its closure in 1940. The tradition of the head teacher taking on the postmaster duties continued throughout the school's history.

By the 1930s, Cecil Park was still a relatively small but close-knit community:

> It is a very small place, with a post-office and a public school. The public school holds about 25 pupils. The dance hall is almost next to the school, and dances are held here every Saturday night. The people of Cecil Park go in mostly for poultry farming, but some have orchards and cattle. There is a sheep station also. Altogether, Cecil Park is a very lovely place.[48]

The school buildings continued to be used by the local community until the 1950s. The church celebrated its Golden Jubilee in 1953 but closed shortly afterwards. The post office continued to operate until 1963. Although the school, church and post office buildings were demolished in 1965, they had been pivotal in establishing the heart of the early Cecil Park community. Archaeological investigations carried out in 2019 confirmed the presence of some remains of the former brick school and the timber Church of St Paul and the large exotic trees planted in the school grounds are also a reminder of their existence.[49]

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[48] *The Sun*, 22 May 1938 p. 3.

[49] Jacobs-Arcadis Joint Venture, 'Former Cecil Park Historical Complex, Historical Archaeological Assessment, Research Design and Test Excavation Report', 2019, pp. 13-14, Annexure B of Appendix J *Non Aboriginal Heritage Assessment Report, M12 Motorway Environmental Impact Statement,* for TfNSW Roads and Maritime Services, October 2019.

James Badgery's Exeter Farm was also gradually being subdivided into smaller landholdings from around the 1890s. In 1920 and 1923 two large sections of Exeter Farm was gazetted for use as part of the soldier settlement scheme under the provisions of the Soldier Settlement Act 1919, although the subdivision into small farming blocks did not progress at this time.

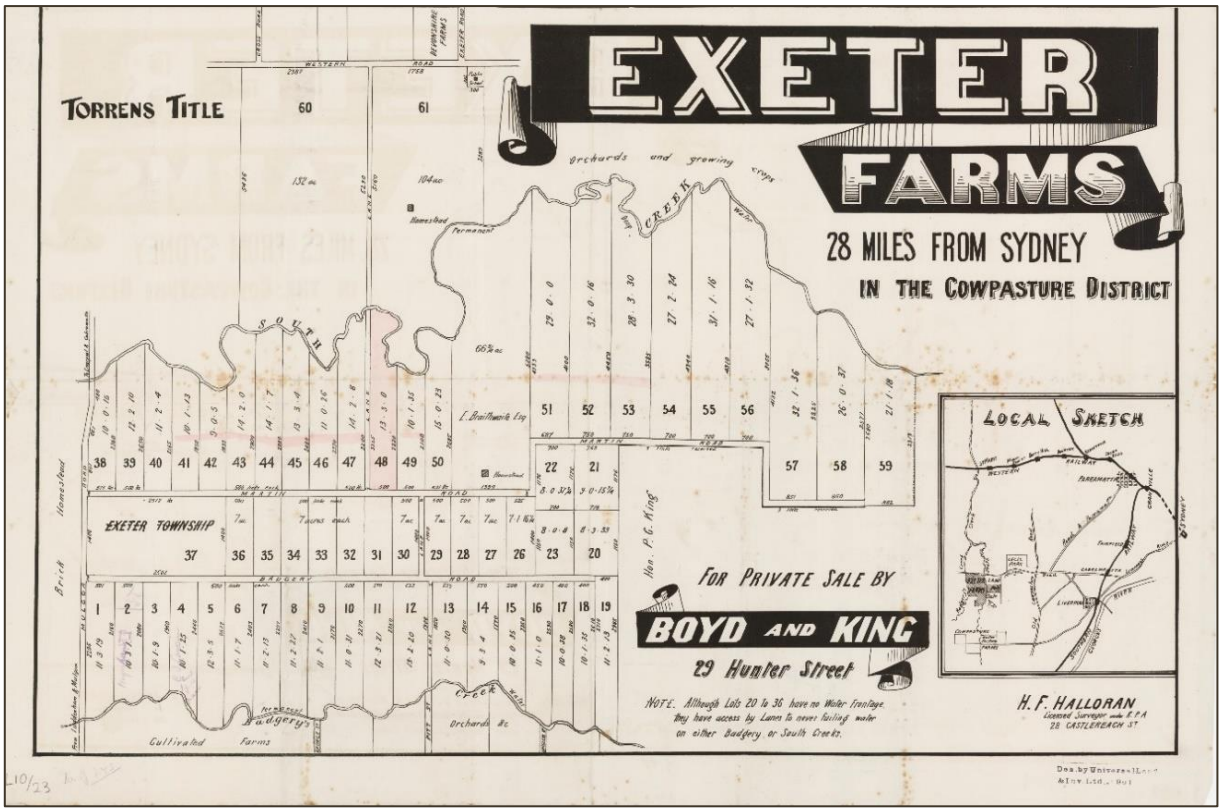

Figure 11: The subdivision of Exeter Farms (c1893) (Source: NLA MAP LFSP 434, Folder 33)

As tourism grew in the early twentieth century, and agricultural and pastoral centres declined, the houses on the old estates, particularly at Mulgoa and Wallacia, were established to cater for visitors were gradually converted to guesthouses and boarding-houses.

In 1949, St Mary's, Mulgoa and Castlereagh were amalgamated with the local government of Penrith. By the 1950s a strong impetus for growth had emerged, tied to the general expansion of the functions of the metropolitan area of Sydney.

Securing a future

Farming was still the primary industry in the late 1800s, however it suffered heavily from water shortages, which resulted in a decline in local sheep numbers. In the 1860s another significant challenge appeared on the landscape: rust. By 1863, the onset of fungoid stem rust severely afflicted wheat and other crops, bringing about the collapse of wheat farming particularly at Luddenham and Exeter farms. With the collapse of the production of cereal grains across the Cumberland Plain and the Prospect Hill areas attention mainly turned to livestock. As Sydney became the chief market for meat and livestock, many of the cleared areas along the Great Western Highway and the roads to Windsor became stock resting paddocks for the herds of cattle and sheep on their way to market.

Further to this, the reduced land sizes resulting from ongoing subdivision of the early land grants and estates would inevitably impact on agricultural sustainability, in that the production capacity of these smaller lots was often uneconomic, but this in turn stimulated a move away from traditional ventures into new markets with mixed success. For example, estates such as Devonshire Farms and Exeter Farms were subdivided in the early 1890s, opening up the area for smaller farms which were used for fruit growing, dairy farming, poultry farming and timber getting.[50]

During the second half of the nineteenth century many of the large grazing properties ceased sheep breeding and switched to agistment, fattening of cattle and horse-breeding. There were a number of attempts to develop a dairying industry, but this required good pasture and a reliable water supply, both of which were problematic in this rain shadow area. Dairy cattle began to replace other livestock with the advent of refrigeration in the 1880s, however the numbers were still low by comparison with other livestock numbers.

Irrigation areas were created during the 1890s all around the south-west of the Cumberland Plain area with the construction of canal lines, dams, weirs and floodgates. These are still present in the landscape today.

In the late nineteenth and early twentieth centuries the district was now supplying fruit, vegetables and milk produce for the Sydney urban market, activities that relied on the expanding railway network.[51] Pig-raising, potato-growing, grazing and grain production were other staple activities. Other industries such as the processing of agricultural products, meatworks, tanning, fellmongering and wagon-building also evolved in this period.[52]

In the twenty-first century, there has been a significant growth in market-gardening along South Creek, with an increase in the use of glasshouses and a general intensification of cultivation where soils and water permit. The years of World War Two saw a hiatus in development generally, although there was obviously activity stimulated by the presence of both local and overseas military as well as increased defences. However, there was notable population growth after the war which was similar to that experienced during the mid-nineteenth century gold rushes.

Following World War Two the region returned primarily to agricultural activities. The *County of Cumberland Planning Scheme* was introduced in the 1950s, creating a green belt that would encircle Sydney. The Scheme required that subdivisions could not be smaller than 5 acres, but the minimum limit was taken advantage of and as a result the subsequent subdivisions were predominantly only 5 acre Lots. Many of these Lots were taken up by migrant families who took on poultry production and market-gardening. A great many lots were also taken up as 'hobby farms' and suburbs such as Kemps Creek, Bringelly and Badgerys Creek became essentially dormitory suburbs. The success of many of the enterprises of these post-war migrants saw a

[50] *Sydney Mail*, 25 November 1893.
[51] Penrith Thematic History Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Thematic History, 2007, pp. 23-24.
[52] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 1, Study Report, Historical Context, 2007, p. 12.

period of economic growth, stimulating a building boom of the 1960s with increased demand for housing.[53]

Rural land use intensified from the 1960s on with some new farming practices and specialist crops evolving and replacing more traditional ones, with the establishment of dairy and poultry farming, beekeeping, timber and horse and dog training, but the district saw little development thereafter. Less productive land was turned over for urban development and institutional uses. From here on, industrial growth stepped up and manufacturing was showing the largest percentage increase in the outer zone of Sydney.

The remaining rural area will be transformed significantly over the coming decades with the development of the Western Sydney International Airport which is currently under construction with the first runway set to open in 2026. The population in Western Sydney is expected to increase, along with the housing and infrastructure and utilities in the area. The region will also gain its first rail link with the construction of the Sydney Metro-Western Sydney Airport line from St Marys to the Aerotropolis Core. Further major road links are proposed with the construction of the M12 and Outer Sydney Orbital.

[53] Gwyther, G. 'From Cowpastures to pigs' heads: The development and character of western Sydney', *Sydney Journal* 1(3), December 2008.

3.4 Extending and Advancing

Movement and motion

Knowledge and research

Communication

The main developments captured by this Theme and the proceeding Theme are particularly associated with advances in science and technology in connection to agriculture, astronomy, transport and communication, as well as defence in relation to the first and second World Wars. The associated infrastructure that was built took advantage of lands that had been gradually acquired by the Commonwealth Government and would transform the traditional rural landscape into a scientific landscape.

Situated in the undulating landscape of the Cumberland District, and with the Blue Mountains to the west, the area sits in what is termed a rain shadow which means rainfall is restricted because it is sheltered from prevailing rain-bearing winds. Receiving an average annual rainfall of around 25 inches the area was also prone to drought and extended rainless periods thereby restricting agricultural development and viability. Although one of the oldest settled areas in Australia, and after more than 150 years of trial and error, nothing had been done to address the underlying problem of '…the notorious uncertainty of rainfall in this strip of coastal country behind Sydney.[54] Local farmers were sometime fortunate when there had been a good season and a good rainfall but more often, those who discovered they could not cultivate any crops '…gave up in disgust'.[55] The generally undeveloped nature of the land in this area as a result of the problems with rainfall was in fact one of the major reasons for its attraction to the Government for scientific agricultural research and for the harnessing of water.

The establishment of the agricultural research stations, such as McMasters and McGarvie-Smith, by the Council for Scientific and Industrial Research (CSIR) (later the Commonwealth Scientific and Industrial Research Organisation (CSIRO), came at a time when agricultural development had also stagnated with onset of the economic depression in the 1930s. On top of this, soils were becoming exhausted, drought, fire and pests had been taking their toll, and there was a significant loss of men in their prime working years to the war service, some of whom would never return from active service. It had also become obvious that Australia was lagging behind as a wool producing country and solid research into wool production needed to start if Australian wool was to be competitive on the local and global market, especially with the growing pressure resulting from the manufacture and availability of artificial fibres.

World War Two brought further changes to the area when a network of aerodromes was established across New South Wales to assist in training and defence. With its wide expanses of flat land, Western Sydney was ideally suited to accommodate many of these aerodromes, represented by the construction of Fleurs Aerodrome.

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[54] *Argus*, 13 June 1955, p. 4.
[55] *Beaudesert Times* (Qld), 25 February 1955 p. 1.

After World War Two, air travel would take an even further leap with the advent of the space race and the endeavours to put humans on the moon. CSIRO's research into space science had its beginnings around 1944 in radar research to aid the war effort that would lead to engagement in space research and finding an important role in furthering international radio astronomy.

Other technological and industrial advances would emerge after World War Two. There was a significant increase in private car ownership and use of cars and trucks as the main form of transportation. Then came the expansion of air travel, now not just for the purposes of defence, but also into the domestic and tourism market. With its ready access to population and industry at Sydney, development of a new Western Sydney International Airport and surrounding Aerotropolis precincts, initially flagged in the 1980s and which has now commenced. This has triggered the planning and development of new motorways and major road links such as the M12 and Outer Sydney Orbital and the development of the Sydney Metro-Western Sydney International Airport line from St Marys to the Aerotropolis Core. With the first runway set to open at the Western Sydney International Airport in 2026, the cultural landscape will once again experience a period of major transformation over the coming decades.

Movement and motion

Roads and bridges

In the early years of colonisation, transportation and movement of people and stores inland, away from the coastal areas, depended greatly on existing pathways that had been established by the Aboriginal people or informal tracks and bridle paths that connected the properties of the early settlers. Of enormous significance was also the local river systems, and boat travel and transportation were essential until bridges and good roads could be constructed.

The route west to the Nepean was not really established until 1815, after Gregory Blaxland, William Lawson and William Charles Wentworth crossed through the great mountain ramparts and a road was constructed by William Cox at the Nepean, to coincide with a tour of inspection by Governor Macquarie. By 1817, this road was well established as the Great Western Road, which connected to the road to Parramatta. It is one of the oldest and most important road routes in the State, providing the first important line of communication and travel for the area.[56] As the decades rolled on, it formed the main access to the lands of the interior and spurred the development in the western part of the County of Cumberland. It also led to the establishment of a guard house and military depot and later courthouse at Penrith.[57] The gold rushes commencing in the early 1850s led to a significant increase in traffic on the Great Western Road between Sydney and Bathurst. The constant impact on the roads by horses and wagons caused substantial deterioration. In 1865 the Great Western Road between Parramatta to Penrith was surfaced with 'metal', or stone flakes.

[56] Thorp, Wendy, 'The Penrith Heritage Study: the Historical Archaeology Component', August 1983, p. 12.
[57] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 1, Study Report, Historical Context, 2007, p. 11.

Through the 1820s, a network of roads that had been mapped by surveyor, Robert Hoddle, started appearing on the landscape. Elizabeth Drive dates back to the early 1800s as an access road to the main land grants in the area at Luddenham, Bringelly and Mt Vernon. It was originally made from round logs, called a 'corduroy' road, and called Orphan School Road because it ran from the Male Orphan School in what is now Bonnyrigg, and connecting the town settlement at Liverpool with the Mulgoa Valley and Blaxland's crossing of the Nepean River at Wallacia. It became an important boundary between the Parishes of Claremont and Cabramatta and the councils of Penrith and Liverpool. The name was later changed to Mulgoa Road and then in honour of the visit of Queen Elizabeth II in 1963, it was changed to Elizabeth Drive.[58]

By 1821 the Old Northern Road (later Bringelly Road) had been formed connecting the Camden district with Richmond.[59] This road also crossed the Great Western Road in the north providing access to Penrith and St Marys. Other early roads included Campbelltown Road, Cowpasture Road and Castlereagh Road.[60]

From the 1880s Luddenham Road became a significant link for pastoral activities in the area in the nineteenth century. Originally a private road created by the Blaxland brothers, John and Gregory, in the early 1800s to connect their estates, it was more formally developed to provide a link between Bringelly and St Marys. The road ran north-south connecting Mamre Road to the northeast with Elizabeth Drive (originally Orphan School Road). By 1887, Luddenham Road had become important enough that it was metalled. Eventually Luddenham Road became a Government Road, first appearing on the Claremont Parish Map c.1898. Eventually Luddenham Road became an asphalted two-lane road.

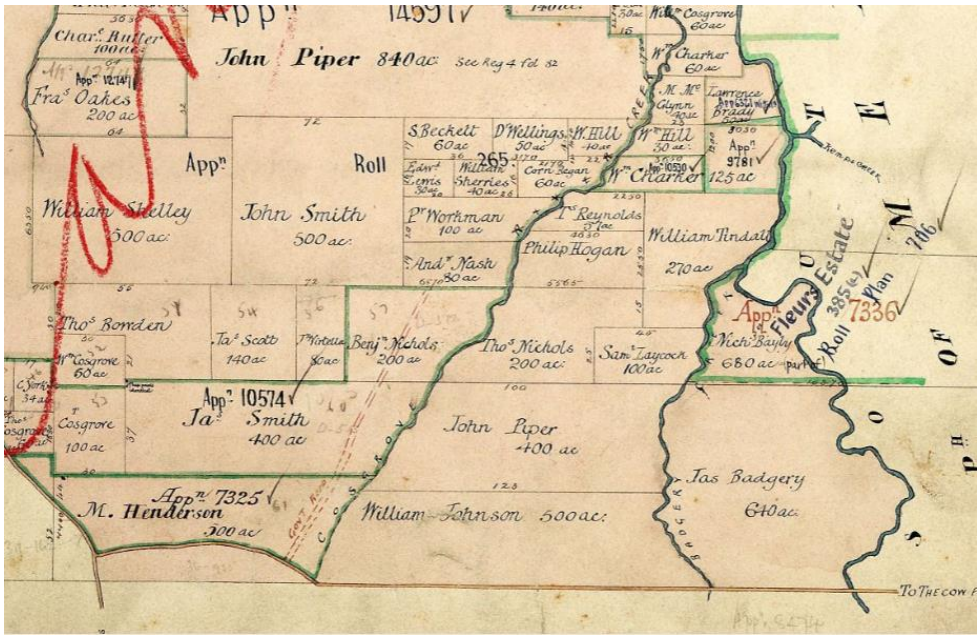

Figure 12: Parish of Claremont, 1898 showing part of Luddenham Road, bottom left, marked as 'Govt Road'. (Source LPI HLRV 14070101)

[58] Penrith City Local History at www.penrithhistory.com
[59] *Sydney Gazette*, 15 September 1821, p. 1.
[60] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 2, Penrith Thematic History, 2007, p. 41.

Another important road constructed in the later nineteenth century was Liverpool Road, constructed in 1893, that extended from the eastern end of Elizabeth Drive to St Marys which by now had developed as an important regional centre. Its name was changed to Mamre Road after Rev. Samuel Marsden's property "Mamre" and is today the major thoroughfare from St Marys to Elizabeth Drive and on to Liverpool.

In 1855 and 1860 the first attempts to bridge the Nepean River were made. Prior to this, river crossing was made by either ford then a ferry service which commenced in the 1820s a ferry crossing was provided. Unfortunately, both these bridges were short-lived having been swept away by floods. In 1867 the Victorian Bridge in Penrith was built to cater for both road and rail traffic, but in 1907 a dedicated rail bridge was constructed.

South Creek Bridge has been another notable bridge in the area. Several timber bridges were constructed to cross South Creek on the Great Western Road prior to the construction of the current concrete beam bridge in 1934. The original timber bridge was designed to connect the lower flat area south of the creek with the higher bank on the northern side. The current South Creek Bridge was one of over 1,000 bridges constructed during the period 1925-1940 by the Government. The bridge reflects the changing relationship between roads and bridges and advances in technology in this period in which bridges could be designed to accommodate a smooth line of road, were generally wider and with an improved load capacity and also responded to the improvements in motorised vehicles. Concrete was favoured in many instances because of its lower maintenance requirements and structural capacity. A duplicate structure was constructed directly upstream of the South Creek Bridge in 1986 to carry westbound traffic with the 1934 bridge therefore only carrying eastbound traffic.

Figure 13: Remains of the original South Creek Bridge, 2019 (Source EIS Section 7.6, p. 536)

During the later part of the nineteenth century, the construction of the Upper Nepean Scheme also resulted in many new bridges in the landscape. Initially movement along the Canal was via roads and tracks then bridges were added to carry major roads and "occupation bridges" which were specifically to allow access for property owners. In the 1920s and 30s new over-bridges and flumes were constructed and upgraded in the 1970s and 80s.

In the last few decades, the significant upgrading of existing main roads in this area, and better access to these main roads, has resulted in the development of new warehousing and transport facilities on many of the former rural properties. Further to this is the development of new Motorways such as the M12 to access the new Western Sydney International Airport.

Railways

Despite the creation of some formal roads to service the area, access to waterways for taking perishable goods to market was still limited and, in many cases, only basic tracks provided access to isolated properties. As a result, the early commercial agricultural activities tended to be relatively small-scale servicing mainly the local market.

The arrival of railways in the 1850's changed the character of Western Cumberland almost immediately, particularly in the Penrith and Liverpool districts and then by 1863 the Western Railway was extended to connect Penrith with Blacktown, making Penrith a major railway depot.

The railway, which had become the dominant form of transport, not only provided important connections and stimulated population growth but also changed the emphasis on the local primary industries. Originally focussed on beef and sheep grazing, many farms started expanding further into vegetable and fruit growing and dairying beyond just for subsistence, taking advantage of the transportation link provided by the rail straight to the markets in Sydney were also established.

With the number of sidings along the railway line, this triggered subdivision shifting the population to the western area and consolidating settlement. The railway also opened up avenues for other types of employment such as with work gangs working on the railway construction, as well as local farmers and labourers securing short-term contracts for carrying, excavating, fencing or supplying timber not just for the railway but also for domestic purposes thereby further developing the timber-getting industry in the Western Cumberland.[61] Sawmills were set up at a number of the sidings. Other businesses that emerged at this time included abattoirs and woolwashes, paper milling, wagon and carriage building and wheelwright businesses, the latter continuing into the 1950s until the dominance of the motorised vehicle took over.[62]

Electric trains and improved roads from the 1930s onwards significantly changed the economic fabric of areas such as Penrith and Liverpool. The network of roads and bridges constructed in and around the study area would also provide virtually uninterrupted access across the

[61] Paul Davies Pty Ltd, 'Penrith Heritage Study', Vol 1, Study Report, Historical Context, 2007, p. 11.
[62] Liverpool City Council, *Liverpool Heritage Strategy*, draft, 2019-2023; and Thorp, Wendy, 'Penrith Heritage Study: the Historical Archaeology Component', August 1983, p. 17.

Cumberland Plain. Hitherto small quiet towns and villages turned into major urban centres, and became feeder suburbs of Sydney, providing workers for industry and commerce and later land for physical expansion of housing. Local industries and family business replaced by major firms or closed as work moved towards Sydney.[63]

Water

A modern city today could not exist without water, for where there is water there is life, without it there is nothing.[64]

A period of dry weather in the 1860s combined with the increasing population of Sydney raised the need for a much larger, more reliable water supply than that provided by the existing sources at Botany Swamps. In 1867, the Governor of NSW appointed a Commission to recommend a scheme to supply water to all areas across Sydney, and by 1869 the Upper Nepean Scheme had been recommended. An appropriation Act was passed in 1880 and construction was commenced with its massive team of contractors working under the direction of the Harbours and Rivers Branch of the NSW Public Works Department.[65]

The Upper Nepean Water Supply Scheme consisted of two diversion weirs constructed in the Upper Nepean River catchment, the water moving naturally through a series of rivers (Cataract, Cordueax, Nepean, Avon) until it reached Pheasants Nest Weir and Broughton's Pass. From here the water collected began its journey in the man-made section of the Scheme, the Upper Canal System. The 64km long Upper Canal comprising a series of tunnels, canals and aqueducts through which water was fed by gravity from the catchment into Prospect Reservoir. The Upper Nepean Scheme, along with Prospect Reservoir, was completed and operating in 1888, supplying water to Sydney's suburbs.

Cottages all along the Canal were also constructed by the Water Board to accommodate workers and enable them to be onsite, such as the engineers, maintenance men, inspectors and valve controllers.

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[63] Liverpool City Council, *Liverpool Heritage Strategy*, draft, 2019-2023.
[64] The Water Project, an Australian Wool Bureau Production, 1956.
[65] Government Architect's Office, 'Upper Canal: Pheasant's Nest to Prospect Reservoir, Conservation Management Plan', prepared for WaterNSW, 2016, p. 108.

Figure 14: a rock cut and masonry lined section of the Canal c1898 with flume in the background and showing the serpentine nature of the Canal system [66]

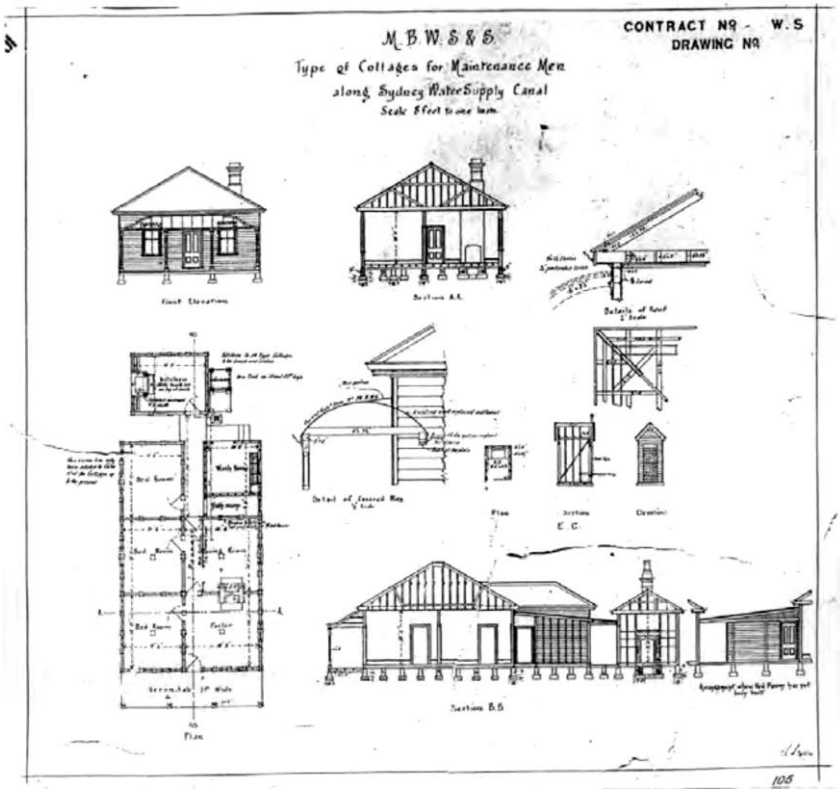

Figure 15: Typical plan for the workers' cottages[67]

[66] Photographed sourced from Government Architect's Office, 'Upper Canal: Pheasant's Nest to Prospect Reservoir, Conservation Management Plan', prepared for WaterNSW, 2016, p. 110.
[67] Plan reproduced from Government Architect's Office, 'Upper Canal: Pheasant's Nest to Prospect Reservoir, Conservation Management Plan', prepared for WaterNSW, 2016, p. 118.

Barely a decade after the completion of the Upper Nepean Scheme, Sydney ran dangerously low on water as a result of the Federation drought in 1901-02 and Sydney's ever-increasing population which was putting additional demands on the scheme. In 1902 a Royal Commission was set up to consider Sydney's water supply network including the Upper Canal. Fortunately, the scheme's original design lent itself to progressive expansion. Some initial works to bring increase the Upper Canal's capacity and improve flow were undertaken. Four new dams were then built between 1907 and 1935 to supplement the scheme's supply: the Cataract, Cordeaux, Avon and Nepean Dams. Today, water from these four major storage dams is still fed into the Upper Canal System however the water now bypasses the Prospect Reservoir and is fed directly into the Prospect Water Filtration Plant.[68]

Initially movement along the Canal was via roads and tracks. Later on, bridges were added to carry major roads and "occupation bridges" which were specifically to allow access for property owners. In the 1920s and 30s new over-bridges and flumes were constructed improving both access and water quality, and which were again upgraded in the 1970s and 80s.

The Upper Canal is unique in NSW and in other parts of Australia, as an extensive gravity fed water supply canal system supply fresh water to a large city and its population from a distant source in the hinterland, and a fine example of advances in hydraulic engineering in the late nineteenth century.

The area and the way it has developed has been and is still very much defined by the major creeks of South, Ropes, Badgerys and Kemps, both in their natural state and also the various ways in which they have been managed and their resources harnessed. The South, Kemps and Badgerys Creek Confluence Weirs Scenic Landscape is another important feature along with the Upper Canal System underpinned by the extensive network of waterways. The name is given to the weirs and surrounds located at the confluences of Badgerys and Kemps Creek with South Creek, with its distinctive remnant vegetation found along the creeks and cultural landscape associated with roads and early homesteads connected to the traditional rural activities and settlement. This confluence area, and the associated slopes that extend away from these watercourses along with its abundance source of silcrete, was also an important focus of traditional Aboriginal use and occupation in particular for tool manufacture.

Irrigation and Flood Management

Although there was no shortage of rivers and waterways, that did not necessarily equate to a good and reliable water supply for farmers. Restricted rainfall, owing to the rain shadow, combined with the disastrous effects of flooding were the main culprits for stymied agricultural growth. In the early years of colonisation and establishment, settlers were attracted to the Nepean district by good prospects for agriculture. However, periodic floods which built up the fertile soil along the riverbanks, at times, caused disastrous losses of crops and buildings.

[68] Upper Canal Conservation Management Plan, 2016, Government Architect's Office, 'Upper Canal: Pheasant's Nest to Prospect Reservoir, Conservation Management Plan', prepared for WaterNSW, 2016 p. 108.

In 1810, after a series of major floods on the Hawkesbury, Governor Macquarie proclaimed the 'Macquarie Towns' of Windsor, Richmond, Wilberforce, Castlereagh and Pitt Town in an attempt to ensure that development was restricted to higher ground, free of flooding. The devastation caused by another major flooding in 1817 again prompted Macquarie to act by issuing a notice for settlers to build their residences above the established flood levels.

The most devastating flood occurred in 1867 causing immense loss of property. Many houses were carried into the river by landslides.

By the 1950s, flood mitigation became a major management issue in the Hawkesbury-Nepean Catchment when there was a change from a drought-dominated regime to a flood-dominated regime. This was driven by the increased magnitude and frequency of flooding at that time and the demand from the local community for some protection of flood plains.[69]

In 1982, a Flood Plain Management Study for the Hawkesbury-Nepean Valley was released which encouraged a coordinated approach and great collaboration between local and state government authorities. The major thrust of the study was to stimulate specific projects to reduce flood losses –- improve the environment of flood plain areas, collect data and promote research in flood mitigation. Strategies included the development of the 1 in 100-year flood level and works to reduce damage and even loss of local bridges such as the Victoria, Menangle and Wallacia Bridges, through stabilisation of the Nepean's western bank and stream clearing.[70]

The first experiments in relation irrigation in order to revive agricultural practices and make it more viable with a rising started occurring in the late 1800s such as in the Mulgoa Valley area. Irrigation areas were created during the 1890s all around the south-west of the Cumberland Plain area with the construction of canal lines, dams, weirs and floodgates. These are still present in the landscape today.

Further innovative and significant developments in water harvesting, flood management and irrigation were also made at the McGarvie Smith Farm presented further on in this Theme.

Knowledge and Research

Agriculture

Financing a contingency like drought places considerable pressure on CSIRO because, without extra funds, money has to be redirected away from research.[71]

Government-established agricultural stations in these parts can be dated back to 1814, when a stockyard was set up at Emu Plains to house and pasture the government herds of cattle. This became '…the nucleus of an agricultural station which included an extensive complex of

[69] https://penrithhistory.com/environmental-heritage/floods-in-the-nepean-district/
[70] https://penrithhistory.com/environmental-heritage/floods-in-the-nepean-district/
[71] Dr Ken Ferguson, CSIRO Director of Institute of Animal and Food Sciences, in*Canberra Times*, 24 April 1981, p. 16.

buildings, services and cultivated areas'.[72] By 1819 a second government agricultural station at Emu Plains had been established by Macquarie. Its use as a farm was relatively short-lived and it became more of a stockade for road gangs until it closed in the mid-1830s. Governor Macquarie also set aside a paddock in Penrith, the first military depot on the road west from Sydney, to provide for travelling sheep and cattle crossing to Sydney from the mountains.

As opposed to being experimental or model farms, these early government farms were really established to serve two main roles – to produce food to supplement dwindling supplies for the growing colony as well as to provide labour for the convicts and therefore being not much more than prison farms. Even so, they were not always welcomed by the local farmers as they were a direct competitor in the marketplace.

McMaster's Field Station

At a time when many primary producers were openly critical of the value of science in agriculture, Sir Frederick saw the need for the scientific approach, and did everything possible to promote it.[73]

The land at Badgerys Creek that would become the McMaster's Field Station was purchased by the Commonwealth Government as land reserved for pastoral and agricultural research undertaken by the then Council for Scientific and Industrial Research (CSIR). It was named the F D McMaster Field Station after Sir Frederick D McMaster who was a noted pastoralist and prominent philanthropist and had also greatly contributed to CSIR and the University of Sydney in the advancement of scientific research in agriculture.

This wasn't the first such facility dedicated to F D McMaster or that he was associated with. McMaster's associations with agricultural research and CSIR dated back to the early 1930s. Following an appeal for support into scientific research into the problems being experienced by pastoralists by the NSW Government, McMaster donated £20,000 which made possible the building of the McMaster Animal Health Laboratory in the grounds of Sydney University which was opened in 1931. The laboratory became the centre for research in Australia on nutritional, bacteriological and parasitological problems. It was here that the discoveries were made of the organism that caused footrot (Caseous lymphadenitis) in sheep and the technique for treating it, as well as other significant developments such as the lanolin-based branding fluid (LBE), worm drenching liquids and the best applications, and use of vitamin supplements in feed all of which were adopted around the world. [74]

Although CSIR had its new animal health laboratory, what it still needed was a field station where research trials could be conducted under actual farming conditions. McMaster stepped in again by offering a lease on very generous terms of part of his 2,000-acre property, *Hinchinbrook*, near Liverpool. Not all the land was required so McMaster sub-leased a paddock of 300 acres. This arrangement allowed the staff to use the paddock to keep sheep under controlled conditions by subdividing the area into smaller paddocks. However, McMaster was

[72] Thorp, Wendy, 'Penrith Heritage Study: the Historical Archaeology Component', August 1983, p. 13.
[73] *Sydney Morning Herald*, 3 December 1954, p. 18.
[74] *Sydney Morning Herald*, 3 December 1954, p. 18.

happy for them to also run sheep who did not need to be kept under exacting conditions on the rest of the property. CSIR accepted the offer and by 1932 had established a temporary field station on the property.

CSIR were still keen to secure its own land located close to the university campus which would be convenient for staff and students to visit and also to relieve the increasingly cramped conditions at the laboratory. They found the ideal property situated on Luddenham Road, St Mary's, which was part of the Buffier family's "Bangaroo Estate". In 1936, Norman Buffier, the son of the late Daniel Buffier, had offered part of the estate for sale or lease. The CSIR and Sydney University negotiated an arrangement whereby they could jointly take on the land each establishing their own field station – CSIR for its agricultural research and the Sydney University for veterinary research. The Commonwealth Government purchased 800 acres of the Buffier estate, of which 400 acres would be transferred to the university a year later. This was the genesis of the McMaster Field Station and McGarvie Smith Farm.

Although no longer requiring McMaster's land, McMaster's extraordinary generosity did not end there. CSIR needed 100 to 150 ewes, in order to test the hypothesis of a particular research project being undertaken by one of its staff but could not afford to buy the animals. When asked if he could help by loaning the ewes for the duration of the project, McMaster replied: 'It will give me the greatest pleasure to present this number to CSIR outright, and it only remains with you how and when you will take them'.[75] McMaster also donated stud ewes and a team of four draught horses and pasture improvement implements. Ewes and rams were also provided by other graziers including Busby and White, Camden Park Estates and Mr Hamilton.

To acknowledge the important role McMaster had played in achieving its goals, CSIR decided to name its new acquisition the F.D. McMaster Field Station, which was officially opened on 30th June 1938 by Sir George Julius, Chairman of CSIR. Sir Frederick McMaster was also at the opening. As part of the opening ceremony, the Memorial Laboratory was formally presented to the CSIR by Norman Buffier. The laboratory was adapted and modified from an original building built by Daniel Buffier for his farm. A tablet was placed near the front door dedicated to the memory of Buffier and was unveiled by Mrs Norman Buffier. After this, the formal guests and about 50 visitors were invited to inspect the building and equipment.[76] Its opening predated the official opening of the adjoining McGarvie Smith Farm by only a few months.

[75] Ward, Colin, 'Sir Frederick Duncan McMaster [1873-1954], 2011, CSIROpedia.
[76] *Sydney Morning Herald*, 1 July 1938 p. 9.

Figure 16: Animal Health/McMaster Field Station general view of property 1923-1932. (Source: NAA B5626, 426)

Figure 17: McMaster Field Station experimental sheep dip 1923-1932 (Source: National Archives of Australia B5626, 422)

Figure 18: McMaster Field Station experimental sheep yards 1923-1932. (Source: National Archives of Australia, B5626, 427)

Although the landscape was culturally modified for the purposes of CSIRO research - cultivated fields, fence lines, dams and groves of trees - McMaster's picturesque setting created by the undulating country and the natural creeks was still regarded as one of its features.[77]

McMasters was established as a permanent field station for CSIR to research pastoral problems as an extension of the McMaster laboratory at Sydney University.

McMaster Field Station was established as an extension of the activities at the McMaster Laboratory at the Sydney University campus, focusing on animal health and pastoral problems. The work of the farm was managed by a board of farm studies (comprising mainly of lecturers from the university), and Dr R B Kelley, first officer in charge of McMasters and the chief veterinary officer of the Department of Agriculture. The farm manager was George Black.[78] A dwelling was built for Kelly, being '…a neat little building set on a hill, commanding a view of the 1.25 acres of land'.[79]

One of the main areas of study and research was the improvement of wool texture and growth, combating sheep diseases and parasites, as well as the chemistry of wool and the secretions from the sheep's skin such as lanolin, and hereditary wool characteristics – such as why variations occur and how it could be controlled. Fertility in sheep, mineral deficiencies of pasture and blow fly infestation were also investigated. Funds towards this research and its associated field trials were supplemented by the Australian Wool Board.

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[77] *Courier-Mail* (Qld), 1 July 1938 p. 6.
[78] *Sydney Morning Herald*, 9 September 1938, p. 7.
[79] *Sydney Morning Herald*, 1 July 1938 p. 9.

Climatic factors such as rainfall were important considerations in agriculture and especially where there were consequences from the wet weather that would impact on success such as fleece rot which was dire for the wool industry. At McMasters, outbreaks of fleece rot were recorded and analysed. The information was then used for broader studies in many towns across south-east Australia to determine issues such as in which zones fleece-rot might be either a rare or frequent threat.[80]

The effects of improved pastures on wool were observed and recorded showing a definite improvement in yield and cumulative effect that improved pastures had on the wool of several generations of sheep. They also did surveys extending across NSW and parts of Queensland monitoring seasonal changes effect on the fertility of rams - relationship between fertility and the seasons.[81] Other sheep experiments included the effects of physical impairment or deficiency in mammary function in the ewe on the survival and growth of lambs, relationships between milk production of the ewe and growth of the lamb, and the best weaning age and weight of lambs.

The other major focus of the station was on dairy cattle which also attracted international attention and support. Different herds or dairy cattle would be discarded on the basis of observation and experiments for example maternal instincts when the mother would stop lactating owing to separation of their calves and sense of loss influencing hormones that produce milk. Some injections given to see if that could solve problems and keep the cows producing milk even without stimulation from their calves.[82]

In 1952 the Pakistan Government donated some Sahiwal cattle to McMasters. Up until then, the Jersey cow from Europe was considered the best diary breed for the Australian climate and the tropics but it was not ideal. An Australian milking breed that was specifically suited to tropical environments, to improve milk production and reduce tick infestation particularly experienced in tropical areas and in areas of climactic stress such as northern areas where pastures feed quality can decline during certain periods. By 1956,CSIRO had developed a new breed of cattle at McMasters with the assistance of dairy farmers on the north coast of NSW and called it the Australian Milking Zebu (AMZ) – using the Sahiwal and Red Sindhi bulls – *Bos indicus* and *Bos taurus* dairy breeds – were crossed with Jersey cows. The Jersey/Sahiwal was the most successful breeding program with experiments reported across the world especially in countries such as Papua New Guinea. In 1959 the High Commissioner of Pakistan visited the station to view the results of the Jersey/Sahiwal crossbreeding.[83]

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[80] Hayman, R. H., 'Studies in fleece-rot of sheep: some ecological aspects', in *Australian Journal of Agricultural Research 6* (4), 1955.
[81] *Jerilderie Herald and Urana Advertiser*, 7 September 1939, p. 4.
[82] Hayman, R. H., '*Bos indicus* and *Bos taurus* crossbred dairy cattle in Australia. II. Effect of calf removal and prolactin treatment', in *Australian Journal of Agricultural Research* 24(3), 1973.
[83] *Nepean Times*, 8 January 1959 p. 5.

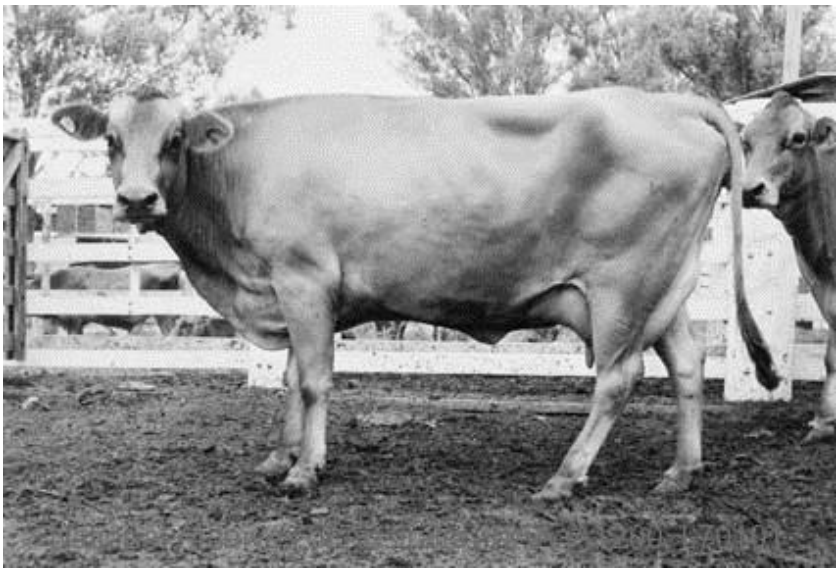

Figure 19: Sahiwal dairy cow developed at McMaster Field Station, 1968 (Source: National Archives of Australia, A1200, L70101)

The station employed general workers and labourers, periodically advertising for labourers with a knowledge of general farming, use of farm machinery and handling livestock. As well as providing work for general labourers, including those who were new migrants to Australia, McMasters also provided some work opportunities for women. Advertised positions specifically for women and girls included: junior technical assistants (laboratory) which required a leaving certificate in maths and biology; assistance in the cattle and sheep breeding research including collecting data, keeping records and statistical analysis; preparing material for examination, as well as general typists. Time off and pay for study leave was also offered. All staff living off-site were required to use the bus service from Penrith Station (7.30am) and returning 5.15pm – the hours at the station laboratory fitting in with this schedule.

Figure 20: Mr Thomas E Allen, senior research worker at McMasters, 1975 (Source: photograph by Alex Ozolins, Australia Information Services, National Library of Australia PIC/10555/467 Loc Box Pic 10555)

In the 1960s, many new buildings and other infrastructure/elements were added to the station. This included a cottage, prefabricated sheep, feed and shearing sheds, construction and expansion of an earth dam, refrigerated farm tanks, spray irrigation plant, and fencing. For some time, parts of the station were also used in radio-astronomy research.

During the drought across Australia of the early 1980s, stations such as McMasters were hard hit with many experiments having to be curtailed or suspended owning to reduction in the size of herds. Having to bring in food and water and could no longer provide its own pastures.

In 1994, the CSIRO decided to sell McMaster's. Still zoned rural, but with the State Government identifying Badgerys Creek as a future growth area, the sale did attract some interest from local farmers and companies. However, plans revealed for the new airport earmarked on the adjoining land resulted in the property being withdrawn from the market owing to uncertainty over its future. In 1996 it was transferred out of government ownership and sold to a private company.[84]

McGarvie Smith Animal Husbandry Farm

The project initiated by Mr Geddes has opened a new vista in the efficient development and use of the water resources of this country. Making the best use of water is of vital importance to the future of Australia and so the foresight planning and effort of one man have finally borne fruit. A symbol for the future, a lamb in lush pasture, a good omen for the future of a country that is learning to conserve its precious water; the lifeblood of a nation.[85]

The McGarvie Smith Animal Husbandry Farm at Badgerys Creek (also known as the McGarvie Smith University Farm and sometimes called St Mary's Farm school) was developed as a veterinary research centre for the University of Sydney. The facility was the first veterinary farm established by Sydney University, teaching all aspects of veterinary science and animal husbandry and producing Sydney's first veterinarians.

Before McGarvie Smith Farm was established, the University had Hawkesbury College and Wagga Experimental Farm. McGarvie Smith Farm in Badgerys Creek was made possible through a grant of £7500 from the McGarvie Smith Institute, one of several university establishments that were set up through this grant. The McGarvie Smith Institute was founded in 1916. John McGarvie Smith graduated from the University of Sydney in chemistry and later developed an interest in bacteriology. He is famous for having discovered a vaccine for anthrax in sheep and cattle that gave protection by a single inoculation. This was pivotal to the development of the live export industry. As his health declined, the Government negotiated with him for the formula, which had been kept secret, only a few months before his death in 1918. In 1928 the McGarvie Smith Institute was incorporated by an Act of the N.S.W. Parliament. Controlled by a Government board and pastoralists of New South Wales, its main remit was to manufacture and distribute the anthrax vaccine.

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[84] Hills Ben, "The Invisible Airport", in *Sydney Morning Herald*, 10 February 2001.
[85] The Water Project, an Australian Wool Bureau Production, 1956.

The university acquired the land for its veterinary farm in 1937 through an arrangement with CSIR who transferred 400 acres of its McMaster Field Station property to the University – the property that was originally part of the Buffier family's "Barangaroo Estate". The grant also provided the financial assistance to equip and set it up as well as £500 a year for 10 years for the ongoing maintenance of the farm. With assistance from the Department of Public Works, paddocks were subdivided, bull paddocks set up, crops sown, fodder conserved, and milking sheds and diary stables, a calf house, piggery, horse stables, barn and machinery shed were erected.[86] Other buildings included a farm manager's residence and accommodation quarters were provided for around 30 students and members of staff using the old timber YMCA Hut (1916) from the Liverpool Military Camp, which had been relocated to the farm.[87] Like McMaster Field Station, the university also relied on the generosity of local philanthropists and farmers to assist in stocking the farm, with a herd of Jersey cattle provided by Sir Archibald Howie, and a herd of middle-white pigs supplied by Sir Frederick Stewart.[88]

Figure 21: The YMCA Hut when it was first opened in 1916 at the Liverpool Military Camp (Source: *Daily Telegraph*, 29 September 1916)

By 8th September 1938, McGarvie Smith Farm was ready to be officially opened by Mr James Kidd, chairman of the McGarvie Smith Institute. A tree was planted at the entrance to one of the main buildings to commemorate opening. Also attending the opening was Sir George Julius, Chairman of the Council for Scientific and Industrial Research (CSIR) – and who had just opened the adjacent McMaster Field Station the week before - and Professor J D Stewart, Dean of the Faculty of Veterinary Science who in his speech reflected on the importance of the establishment of the McGarvie Smith Farm:

> The maintenance of our national prosperity…would be influenced, not so much by increasing our flocks and herds, as by improving quality and reducing costs of production.[89]

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[86] *Farmer and Settler*, 14 July 1938 p. 10 and 15 September 1938 p. 14.
[87] *Daily Telegraph* 29 September 1916, p. 9.
[88] *Farmer and Settler*, 14 July 1938 p. 10.
[89] *Sydney Morning Herald*, 9 September 1938, p. 7

Figure 22: The YMCA Hut after relocation to McGarvie-Smith Farm and refurbishment (Source: *Centaur* No. 9, 1947, p. 4, Sydney University)

Hector J. Geddes was appointed the officer in charge and senior lecturer in Animal Husbandry. The 400-acre farm encompassed many aspects of farm management as part of its teaching facilities. At the farm, the students had the opportunity of learning and observing practical farm activities beyond the university campus. Students were also taught practical skills such as riding horses. To graduate, students were required to have completed at least six months practical experience at the farm.

The teaching of animal husbandry involved the care and management of all classes of livestock, aspects of animal production, systematic instruction in breeds and breeding, feeds and feeding, and the market requirements for milk, beef, mutton, fat lambs and wool. The farm, which relied on the generous donations and offerings of benefactors for their animals, was equipped with Jersey stud cattle and a bull from the Yallara Stud donated by Sir Archibald Howie of Kameruka Estate) and Messrs J K Taylor and Clive Brown's Wollongurry stud, and Stud Tamworth pigs were provided by Sir Frederick Stewart. The farm also held sheep and poultry, as well as draught horses and hacks, and sheep dogs were also bred onsite. From the time it opened, the farm and its animals would become popular for news items and photograph opportunities for the local newspapers as well, generating public interest even beyond the local farmers.

BRED BY MINISTER

The Minister for Transport (Mr. Brunker) is interested in breeding sheep dogs. These handfuls of fluffy sheep dogs were bred by him at the McGarvie Animal Husbandry Farm at St. Marys.

Figure 23: News article showcasing puppy Sheep Dogs bred at McGarvie Smith Farm (Source: *Newcastle Sun*, 31 August 1938)

A Lift For Newly-Born Lambs

This is one way of getting a lift. Two newly-born lambs astride a horse at the McGarvie Smith Animal Husbandry Farm at St. Marys don't appear to be particularly comfortable. Veterinary science students receive practical training in the management of dairy cattle and sheep at the farm.

Figure 24: News article featuring one of the students at McGarvie Smith Farm with newly born lambs (Source: *The Sun*, 30 August 1938)

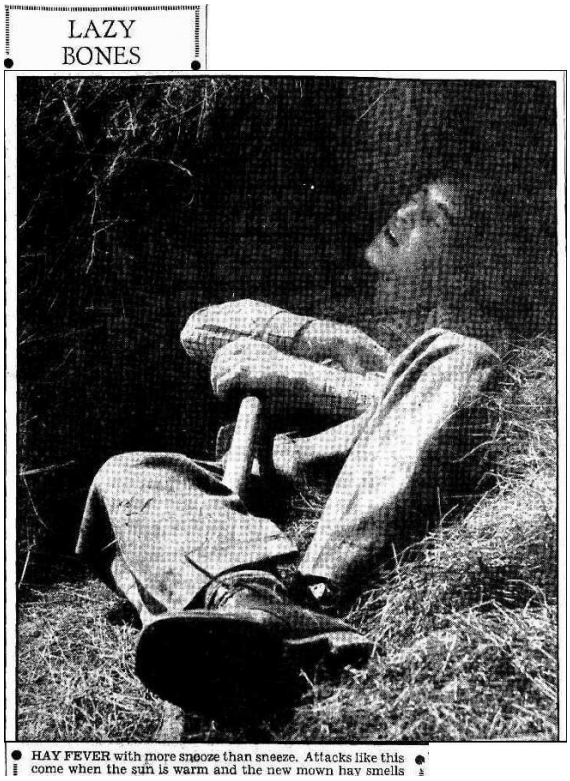

Figure 25: One of the students captured in the local paper (Source: *Daily Telegraph*, 9 August 1938)

At the time when McGarvie Smith Farm was opened, farmers and stockowners not just in Sydney but nationally '…were all becoming seized with the great necessity for scientific research and for large numbers of trained men'.[90] The veterinarians trained there would become pivotal to farmers and stockowners, providing guidance in the adoption of modern and scientific methods in production and protection against losses from disease and pests, on ways to improve quality and to reduce costs of production.

Although the Cumberland Plain area was the oldest farmed region in Australia, the variability of the rainfall and the difficult nature of the soil had prevented the establishment of improved pastures on a permanent basis. The 1950s saw a growing interest in the potential of water harvesting for using in spray irrigation for improving pastures and therefore production, particularly of dairy cattle. One of the most interesting and successful systems in Australia was developed by Geddes. The project was responding to the repeated failure of pasture improvement in the Cumberland area because of the unreliable rainfall, owing to its location within a rain shadow:

> The land form here is gently undulating, the intractable clay soil has a low absorption capacity and heavy rains provide a considerable run-off…Although the annual rainfall for the district is about 25 in. its distribution is so uneven and unreliable that pasture improvement had been unsuccessful.[91]

[90] *Sydney Morning Herald*, 9 September 1938, p. 7.
[91] *Farmer and Settler*, 30 September 1955, p. 14.

The unreliable rainfall compounded by the extreme and regular occurrences of both drought and floods on top of the large amounts of water being lost to run-off, meant farm dams were inadequate on their own to solve these problems. Water was desperately needed. Harvesting water would not only alleviate the effects of inadequate rainfall on pasture production, but also resolve other problems that had been building up in the post-war period such as expansion of pastures and higher intensity of stocking on many properties leading to increased vulnerability to feed shortages during unfavourable seasons.

Geddes water harvesting project commenced in earnest at McGarvie Smith Farm in the early 1950s:

> Water harvesting may strike a body blow at our major agricultural problem – the great variability of the Australian rainfall. It may be the salvation of many millions of acres of what we now call poor country. [92]

This system of water harvesting was ideally suited to areas such as western Sydney because of the undulating landscape – rather than the system of flood irrigation. It basically worked as a self-contained irrigation system, by collecting the run-off from the farm, road drainage and any storm water that penetrated the boundary fence that is then collected and stored in a series of dams. The surplus water from heavy falls and floods could also be collected in the dams. In effect, running the farm as a 'watershed'. The water is then pumped using spray irrigation pipes and applied to the crops or pastures during dry periods. Spray irrigation, which replicated rainfall, enabled maximum use of a limited supply, even though it was susceptible to wind and involved high intensity of labour in moving spray lines around. [93]

The topography of McGarvie Smith Farm was ideally suited to water harvesting using the natural gullies through the undulating landscape that would allow dams to be excavated and built in a stairway fashion. Between 1952 and 1955 four large dams were constructed, a reticulation system installed, tanks and drinking troughs erected.[94]

In 1955 a delegation of 15 Indian farmers came to Australia as part of a 6 month visit under the Colombo Plan. The purpose of this visit was to study farm methods in Australia. One of the highlights was their visit to McGarvie Smith Farm where Geddes showed them the innovative irrigation/water-harvesting project.

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[92] Geddes, H. J. as quoted in *Farmer and Settler* (NSW), 2 April 1954, p. 5.
[93] *Farmer and Settler* (NSW), 2 April 1954, p. 5.
[94] *Farmer and Settler*, 14 July 1938 p. 10 and 15 September 1938 p. 14.

Figure 26: Geddes showing visiting Indian farmers to McGarvie Smith Farm 1955 studying farm methods under the Colombo Plan (Source: CSIRO held at National Archives of Australia, A1501:A250/2)

Figure 27: Geddes showing the Indian farmers his spray irrigation piping method, 1955 (Source: CSIRO held at National Archives of Australia, A1501:A250/3)

One of the most innovative elements of the water harvesting project at McGarvie Smith Farm was what was known as the **Turkey Nest Dam** or Turkey Nest Tank or ring tank, built in 1954. They were called turkey nests because turkey nests were built on the ground and sometimes out in open fields. The idea of the Turkey Nest was to build it on flat land on the side of a stream, creek or storm water channel that ran during storms so that the dam could be filled by pumping water into it during storm water runoff or in the peak of a flood. Although dams are good for undulating country, on flat land the turkey nest was a more economical form of water storage. It was even effective in places where there is a creek that runs for only a few days each year. [95] It is formed by excavating below ground then partly building a wall above ground level. The Turkey Nest Dam at McGarvie Smith Farm had a diameter of 150 yards – a circumference of just over a quarter of a mile – was seven feet deep with walls 40 feet wide at the bottom and 8 feet wide at the top. It had a storage capacity of 8 million gallons.

The Turkey Nest Dam at McGarvie Smith Farm resulted in increased total water storage capacity on the farm which could now potentially store 60,000,000 gallons of water. The Turkey Nest Dam attracted much attention in the local press:

> The giant "turkey nest" may be the answer to the problem of economic storage on flat country, and may have particular application in the sheep districts. The "turkey nest" is a giant saucer-like tank built partly above ground and partly excavated".[96]

Figure 28: Geddes Turkey Nest Dam at McGarvie-Smith Farm, 1964 (Source: Geddes, *UNSW Water-Harvesting Project*, research article, 1/12/1964, University Animal Husbandry Farms, Camden, NSW)

[95] *Sydney Morning Herald*, 19 February 1954, p. 16.
[96] *Sydney Morning Herald*, 4 June 1954, p. 6.

Several years of experimentation was carried out to gain a representative series of seasons with results exceeding expectations. It was proven that what were essentially poor soils could give a yield comparable with good dairy pastures found in New Zealand. [97] The success of the work being carried out at McGarvie Smith Farm in turn stimulated the surrounding farms to build dams for irrigation. This was also spurred on by the improvements in spray equipment available, reducing labour and cost making it more practical for farmers generally to use. The post-war years saw the innovation of lightweight aluminium piping to replace heavy galvanised pipes and technology for coupling, valves and nozzles as well as more mobile mechanisms for shifting the location of spray pipes.

Field Days arranged by the Australian Irrigation Development Association (AIDA) were at the farm with more than 1000 visitors attending. During these events, Geddes would give visitors a tour explaining the procedures and the results of his irrigation. The major part of the field day was to demonstrate to visitors the construction of the Turkey Nest Dam. Visitors came locally and from all over Albury, Little Billabong, Glen Inness, Cowra and Cudal. The AIDA were very supportive and enthusiastic about the advances made by Geddes, their President, Mr Beale, declaring that '…no man since William Farrer has done more for Australian agriculture'.[98]

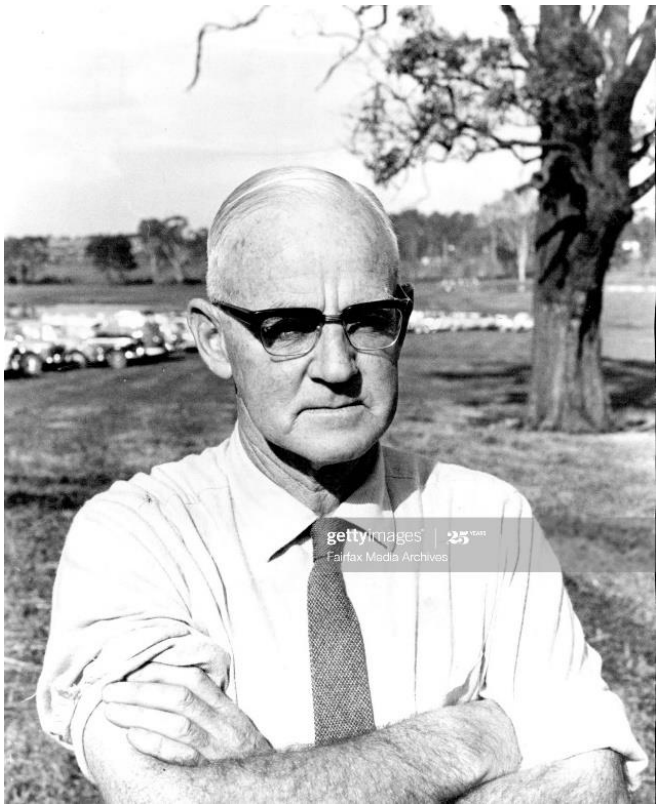

Figure 29: Geddes at the Field Day, 15 June 1963 (Source: Fairfax Media Archives)

[97] *Farmer and Settler* (NSW), 2 April 1954, p. 5.
[98] *Nepean Times*, 30 June 1955, p. 3.

Among the various animals at the McGarvie Smith farm, one of the most well-known and most pampered was the pony," **Twinkle**". It was given to Geddes children by the veteran horse-trainer, Kell Jeffrey, not long before Jeffery passed away, knowing that '…he would be well looked after along with the funds to feed him'.[99] Twinkle also had a special significance to Geddes who had learnt from Jeffrey '…the more humane horse-breaking methods' when he was a student at Hawksbury College and which he applied at McGarvie Smith Farm. [100]

McGarvie Smith Farm's pioneering research, experiments and successes attracted students from all parts of the Commonwealth and New Zealand. The water harvesting scheme, in particular, received worldwide interest. Visiting American agricultural expert Professor W E Pederson was also generous in his praise, saying that what Geddes was doing with water harvest and planned irrigation '…excelled any similar project in the USA'.[101] Pederson went on to propose a similar demonstration farm to be established at the University of Minnesota. Not long after the water harvesting project had been completed, a party of Indian farmers who were on a six month visit to Australia to study farm methods visited the McGarvie Smith Farm during which Geddes gave them a practical demonstration of the irrigation system.

The synergy and ongoing collaboration between CSIR and Sydney University was exemplified by the McGarvie Smith Farm and the McMaster Field Station. Starting with the original arrangement for acquisition of land between the two parties, the construction and layout of the McGarvie Smith farm and buildings was assisted by Dr Kelley, the first officer in charge of McMaster's farm, the McMaster flocks were made available to the students at McGarvie Smith for instruction on sheep and wool, and Geddes gave his expertise to the McMaster's station on irrigation.

By the 1980s Sydney University had acquired a number of other properties in the region for its farms and work had been winding down at McGarvie Smith Farm, which by 1983 had been declared surplus to needs.

Today Kemps Creek is an active rural and research area in Western Sydney with the University of Sydney and Western Sydney using the area for research purposes.

[99] *Land*, 18 June 1954, p. 5.
[100] *Land*, 18 June 1954, p. 5.
[101] *Nepean Times*, 30 June 1955, p. 3.

Figure 30: McGarvie Smith Farm in 2020 (Source: S Graham TfNSW)

Figure 31: McGarvie Smith Farm in 2020 (Source: S Graham TfNSW)

Figure 32: McGarvie Smith Farm in 2020 (Source: S Graham TfNSW)

Figure 33: The abandoned dairy, McGarvie Smith Farm 2020 (Source: S Graham TfNSW)

Other Agricultural Research Stations

There have been other agricultural research stations and similar facilities located in NSW that, along with McMaster Field Station and McGarvie Smith Farm, have contributed to veterinary research, agricultural, pastoral and animal husbandry groups, the use of pioneering methods and practices and made contributions to the development of all aspects of farming in Australia.

As well as McGarvie Smith Farm, **Sydney University** had other farming stations in NSW including J. B. Pye, Coates Park and Wolverton Farms in the Bringelly area, and Westwood Farm, Corstorphine Farm, May Farm, Mount Hunter Farm, Karalee, and Lansdowne in the Camden-Cobbity area. The University's farms have been used for a wide range of teaching, research and economic purposes, including broad scale cattle grazing, intensive food production, education and training, cutting edge research, and also provided student accommodation so that students could live and experience their training first hand and under real conditions. While the Sydney University farms were set up for different purposes, all of them, including McGarvie Smith Farm, have contributed to the development and innovation of Australia's agricultural and pastoral industries.[102]

McMaster Field Station was a relatively unique undertaking as there were few other **CSIRO** owned farms established in NSW. One comparable station was Prospect Hill in Prospect. This was established by CSIRO in the early 1950s around 15 years after McMaster Field Station, the land having been acquired by the Commonwealth in 1946. but. Prospect Hill was the only other station that also undertook research on livestock similar to McMasters operated for a similar period of time as McMasters under CSIRO. Its main area of research was on sheep. Prospect Hill is important for its contribution to research and is significant to employees who have worked at the research facility over 40 years.[103]

The other organisation that has been instrumental in setting up research and advisory stations across NSW from the late nineteenth century was the **Department of Agriculture.** Many of the Department of Agriculture experimental farms – listed as follows - were established relatively early compared to McGarvie Smith Farm. While McGarvie Smith Farm focused specifically on veterinary training for Sydney University students, the experimental farms and research stations had a variety of functions. However, taken together, these stations have all played an important role in the development and introduction of new agricultural technologies as well as in training and research in agriculture, pastoralism and farming in Australia.[104]

> **Bathurst Experiment Farm** (1890s)**:** The farm and farm school was established in the late 1890s. Its remit was to undertake research on breeding and selection of improved varieties of farm crops and the raising of stud stock and made major contributions to the development and introduction of new technologies into NSW Agriculture.

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[102] Appendix J *Non Aboriginal Heritage Assessment Report, M12 Motorway Environmental Impact Statement,* for TfNSW Roads and Maritime Services, October 2019, p. 71.
[103] Appendix J *Non Aboriginal Heritage Assessment Report, M12 Motorway Environmental Impact Statement,* for TfNSW Roads and Maritime Services, October 2019, p. 98.
[104] Appendix J *Non Aboriginal Heritage Assessment Report, M12 Motorway Environmental Impact Statement,* for TfNSW Roads and Maritime Services, October 2019, pp. 71-73.

Condobolin Agricultural Research and Advisory Station (1912)**:** This was set up as a demonstration farm to assess the potential for cropping in the region and study and breed Merino sheep. In the 1920s experimental work expanded to hay, grain, fertiliser, seeding rates and cultivation trials. In the 1970s research began on sheep and beef cattle, then later feral goats which had become a significant pest in agricultural regions. The station has operated for over 90 years and been instrumental in the introduction of significant technological and cultural change to agricultural industries of Central Wheat Belt NSW.

Cowra Agricultural Research and Advisory Station (1903): This farm was established initially to research wheat growing then later used to evaluate breeds and crosses of sheep. It was also a practical agricultural training centre with accommodation onsite. It gained particular recognition as the location where the 'Dreadnought Farm Scheme' was developed and also as the location for the Women's Land Army during World War Two, both significant in the history of NSW.

Glen Innes Agricultural Research and Advisory Station: Located in the Northern Tablelands of NSW, Glen Innes was used for education and training in advancement and efficiency of agricultural production ranging from fruit and vegetables, broadacre crops, pastures and livestock. The research and advisory station played an instrumental role in developing advanced technologies and introduction of improved genetic material to increase agricultural productivity.

Grafton Agricultural Research and Advisory Station (1910)**:** This farm was pivotal in advancing technologies and in the introduction of new genetic material to increase the productivity of dairy cattle, beef cattle, pigs, maize and tropical pastures. The station was a practical agricultural training centre. It is also socially significant to the local Clarence Valley farming community, former staff and Dreadnought scheme boys.

Wagga Wagga Agricultural Institute (1892)**:** The institute functioned for over a 100 year period, providing first class laboratory and field facilities for research and instrumental in the development of new plant varieties. In 1948 the Wagga Agriculture College was established at the institute and included extension, veterinary and regulatory staff.

Wollongbar Agricultural Institute (1894)**:** This farm advanced technologies and introduced new genetic material to increase productivity and was a practical agricultural training centre.

Another facility worth noting is the **Grantham Poultry Research Station** operated by the **NSW Government**. Grantham station was one of six of the leading poultry research stations in the world and presumed to be the only such station established in NSW. The station was constructed between 1897 and 1939 and commenced its experimental phase from 1917. In the 1950s additional land was acquired as the station expanded and became internationally known.

The use of the farm declined in the 1980s. After 1991 the site was subdivided, and the farm area was sold for housing resulting in the demolition of many of its farming infrastructure.[105]

Communication

Communication both local and further afield has developed from early road-based mail services from the early days of settlement through to the development of the telephone and telegraph toward the end of the nineteenth century. For example, communication between workers on the Upper Nepean Scheme was facilitated by a telephone line constructed along the Canal's length in the 1880s-90s. For the local community, post and telegraph offices were established which not only provided mail services but also held the telegraphs and telephone exchanges. Post offices such as Cecil Park Post Office opened up all through the nineteenth and early twentieth century at most of the settlements and townsites in the area.

Figure 34: Cecil Hills Post Office c1950 (Source: National Archives of Australia)

Mr Flood, the head teacher at the Cecil Park School was the first post master at the Cecil Park Post Office and the tradition of the head teacher taking on the postmaster duties continued with his successors until the school closed in the 1940s, as it was a convenient arrangement with the school and post office being on the same site. The post office continued to operate until 1963 after which it was demolished along with the school buildings.[106]

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[105] Appendix J *Non Aboriginal Heritage Assessment Report, M12 Motorway Environmental Impact Statement,* for TfNSW Roads and Maritime Services, October 2019, p. 100.

[106] Jacobs-Arcadis Joint Venture, 'Former Cecil Park Historical Complex, Historical Archaeological Assessment, Research Design and Test Excavation Report', 2019, p. 14, Annexure B of Appendix J *Non Aboriginal Heritage Assessment Report, M12 Motorway Environmental Impact Statement*, for TfNSW Roads and Maritime Services, October 2019.

3.5 Looking Beyond

Observing the galaxy

Creation and innovation

Taking to the air

Observing the galaxy

Astronomy

Astronomy is a fascinating subject, capturing the imagination of human beings since time immemorial. One of the most powerful of many arguments for supporting astronomy is that it encourages our sense of wonder. [107]

Aboriginal people have used songlines and the heavens on their journeys across the continent for tens of thousands of years, using the stars as navigation, as calendars and as stories. Aboriginal astronomy is not so much a science but is social-cultural astronomy, a belief system.

The constellations visible above Western Sydney have been a navigation tool for the local Aboriginal community for an estimated 40,000 years.[108] They looked to the celestial bodies that appear in the Australian night sky, and although it was the same celestial body they were looking at because of the different language groups they can have different interpretations and different names across different parts of Australia. However, what is common to all is the connection to astronomy for cultural uses such as for finding food, marking the different seasons and guiding them on when to conduct particular ceremonies. As well as in the sky, on the ground Aboriginal stone arrangements or configurations are also sometimes connected with astronomy. Arrangements can represent solstitial alignment thereby forming a tangible astronomical connection to the changing positions of the sun and demonstrating a robust knowledge held by Aboriginal people of the sun's movement both daily and yearly.[109]

So too, the Europeans who arrived in Australia were also keen to understand and explore the celestial wonders especially the unknown southern skies, having observed for the most part only the northern hemisphere skies until now. Even before landing on Australian soil, astronomical observations were a critical part of navigation for maritime explorations around the globe, including the early Dutch, French and British explorations of Australia. Before accurate clocks were available, lunar tables were used to determine positions at sea. These tables of solar-system predictions depended on knowledge of the distance to the Sun and this could be measured by observing the transit of Venus across the Sun from several different locations.[110]

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[107] Ekers, Ron, Professor, Director Australian Telescope National Facility, CSIRO, 'Achievements and Challenges for Australian Science – Radio Astronomy', Distinguished Lecture Series, Curtin University WA, 1993.

[108] Balarinji, 'M12 Aboriginal Cultural Interpretation Project', Body of Story, 2018, p. 11.

[109] Norris, Ray 'Wurdi Youang Australia' in ICOMOS Heritage Sites of Astronomy and Archeoastronomy in the Context of the UNESCO World Heritage Convention A Thematic Study, June 2010, pp. 76-79.

[110] Ekers, Ron, Professor, Director Australia Telescope National Facility, CSIRO, 'Achievements and Challenges for Australian Science - Radio Astronomy' Distinguished Lecture Series, Curtin University WA, 1993.

However, Aboriginal astronomy differed from the dominant western culture which looked to light in the night sky as guidance and enlightenment, whereas Aboriginal people looked to the darkness. Within the darkness is what are called dark constellations as represented by the Emu in the Sky which is one of Australia's most well-known of these dark constellations in the Milky Way.

Aboriginal Elders, researchers, astrophysicists, communicators and students now share their knowledge Aboriginal astronomy and Aboriginal knowledge of the stars and constellations has been valuable in substantiating and winning land rights. Indigenous Aboriginal Astronomy is now being incorporated in some school curriculums and tertiary courses including postgraduate studies in Aboriginal Astronomy & Education.[111] Just outside of the study area in Abbotsbury, astronomy nights are held, led by Aboriginal Astronomers who takes visitors on a journey through the night sky from an Indigenous perspective, telling star stories and revealing how Aboriginal Australians used the sky for their culture and astronomy.

Creation and innovation

Fleurs Radio Station

Astronomy, perhaps the oldest of all the Sciences**,** is the study and measurement of the physical properties of extra-terrestrial objects such as planets, stars, galaxies and the universe as a whole. All heavenly objects emit or reflect light (or electromagnetic radiation). However, there is more than just the visible light coming from these objects. The light from a star is only a very small part of the radiation coming from that star. By only observing the night sky means that astronomers would only be getting a very small part of the picture. For this reason, different types of telescopes have been invented to look at all the different wavelengths of light, based on the principles of collecting, focusing and recording. Radio astronomy is the most accessible form of ground-based astronomy, observing the radio waves aimed at the Earth that make it to the ground. Unlike optical astronomy, which needs a night sky, radio observatories can operate 24 hours a day.

In the early days of radio astronomy, the name radio telescope was given to what were directive antennas that could determine the radio brightness over a particular region of the sky and then produce a radio image of that region. The oldest and mostly widely used form of radio telescope - and in many ways the most universally recognisable type of radio telescope - is the filled-aperture type or the parabolic dish. The advantage of the parabolic dish reflector was that it was simple electrically with its passive reflector and central antenna. However, the physical tilting required in its operations posed mechanical issues which escalated the larger the dish was made.[112] Because radio waves are the longest wavelength of all electromagnetic radiation, they are low energy with very small amounts of power. To overcome this the size of the dish is increased however this in turn makes it more expensive to build. The alternative is to use an

[111] Sydney Mechanics School of Arts and Royal Society of NSW, Talk presented by Dr Ragbir Bhathal, National Science Week, 2019.
[112] Christiansen, W. N., 'Radio Telescopes', School of Electrical Engineering, University of Sydney, *Annual Reviews* provided by the NASA Astrophysics Data System, c1963.

array of telescopes called interferometers, the type of telescopes that were built at Fleur Radio Station and for which Fleurs and its scientists became famous.

After World War Two, the CSIR Division of Radiophysics began setting up a series of field stations and remote radio astronomy testing sites in NSW and all across the country in which initially there was great collaboration and cross fertilisation of staff and ideas. In 1948, the second major field station was established by CSIR at Potts Hill, the first being at Dover Heights during the war. Other field stations in NSW were also set up at Hornsby Valley and Dapto. Then in 1949, in an open farmland area at Badgerys Creek near Wallacia, a remote interferometry testing site was set up by a team of scientists, led by Bernie Mills who was based at the Potts Hill field station.

In 1953, a new prototype radio telescope was built and tested at Potts Hill by Mills in association with Alec Little and Kevin Sheridan. The Mills Cross prototype was an interferometer type radio telescope, comprised of two lines of dipoles or strip antennas – also called arms. While the this was not new technology, Mills came up with the innovative design to lay the two arms as a horizontal crossed-shape array. The energy received in each arm would be collected separately and the two outputs correlated or multiplied into two-antenna interferometry. The new prototype met all expectations '…and cleared the path for the construction of a full scale "Mills Cross".

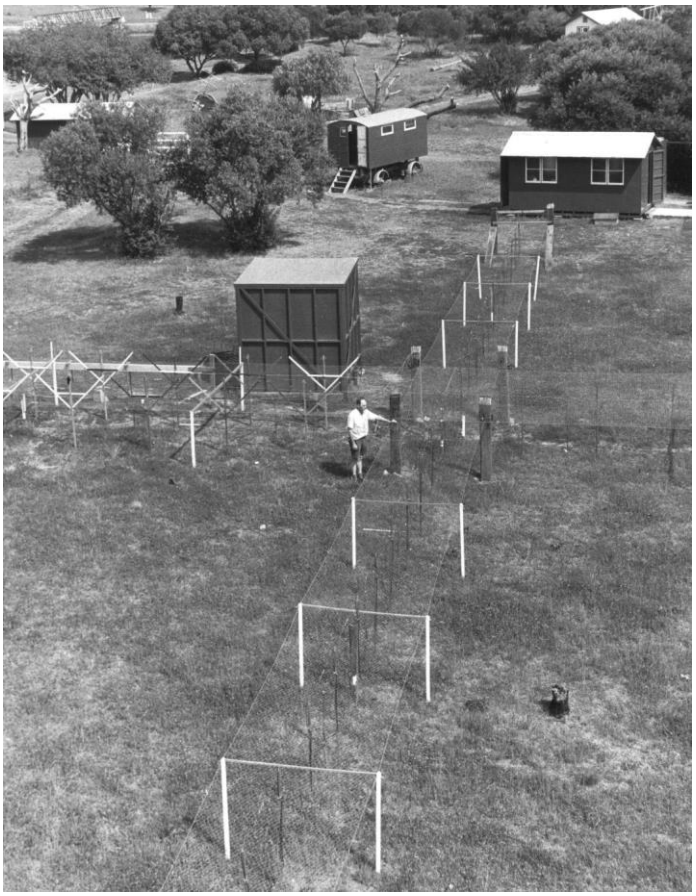

Figure 35: View of part of the first prototype of the Mills Cross at Potts Hill (Source: ATNF Historic Photographic Archive 3171-3

The chosen location was land that was originally part of the historic “Fleurs Estate” from which the Fleurs Radio Station would take its name, as did the Fleur Aerodrome which had been constructed there during World War Two. The flat land next to a disused airstrip at the aerodrome was ideally suited for the **Mills Cross**. Fleurs Radio Station was established by CSIR in 1954.

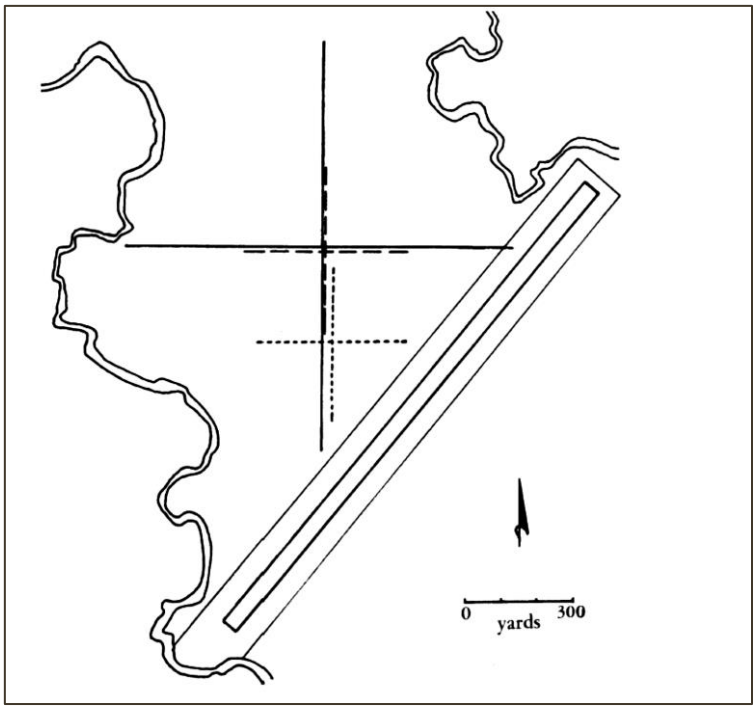

Figure 36: Plan of the Fleurs Field Station, showing the former Fleurs Aerodrome strip between Kemps Creek (on the east) and South Creek and the three cross-shaped radio telescopes that would be built there: Mills Cross indicated by dashes, Shain Cross by solid lines, Chris Cross by dots (Source: Wayne Orchiston[113])

The Mills Cross comprised two north-south and east-west arrays each measuring 450 m long with 250 dipoles. Bernie Mills built this with the assistance of Eric Hill and Bruce Slee. Between 1954 and 1957, Mills used the Mills Cross to observe the celestial sphere, to carry out detailed surveys of the sky and recorded and catalogued sources of discrete radio emission (or bursts), associated with galactic and extragalactic objects. The results were published in the *Australian Journal of Physics*. However international controversy arose when Mill’s surveys and results did not correlate with those derived from the team in Cambridge, England. However, after some years, problems with the Cambridge survey were identified and the results of the Mills Cross were fully accepted as correct.[114]

[113] Orchiston, W, M. George, B Slee and R Wielebinski, ‘The History of Early Low Frequency Radio Astronomy in Australia, 1: The CSIRO Division of Radiophysics, in *Journal of Astronomical History and Heritage*, 18(1) 2015, p. 8.

[114] CSIRO, ‘The flowering of Fleurs: an interesting interlude in Australian radio astronomy’ in CSIRO Newsletter June 2002.

During Mills' period at Fleurs there were many new discoveries that would change the viewpoint of the astronomer including '…the eruptive solar corona, radio galaxies, the structure of the Milky Way, quasars, black holes, pulsars, dark matter and the relic radiation from the big bang'.[115] A legacy of the MSH survey remains in the celestial catalogues, where, despite more than one rationalisation of object names since the 1950s, some MSH prefixes on identifiers reveal that they were first recorded on the Mills Cross antenna.[116]

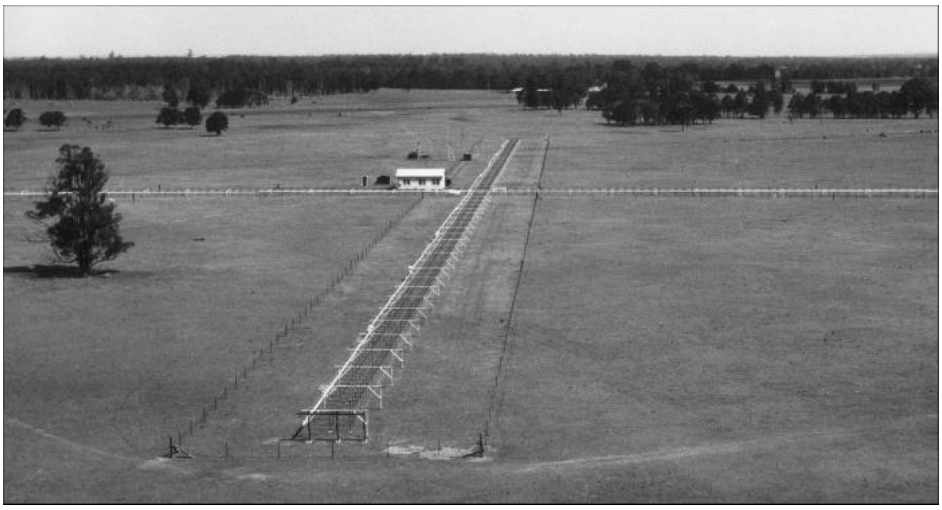

Figure 37: The recently completed Mills Cross and receiver hut, 1954 (Source: ATNF Historic Photographic Archive 3476-3)

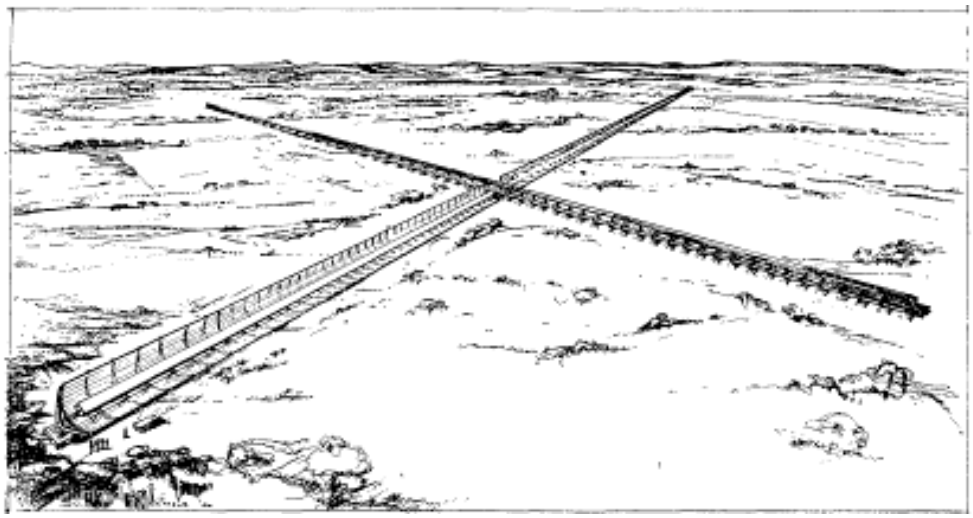

Figure 38: The Mills Cross as drawn by W N (Chris) Christiansen (Source: Annual Review of Astronomy and Astrophysics, Vol 1, P. 1, 1963)

[115] Frater, R. H., and W M Goss and H W Wendt, 'Bernard Yarnton Mills 1920-2011, in *Historical Records of Australian Science*, Vol 24, No. 2, December 2013, p. 2.

[116] Gorman, Alice, 'A Heritage Survey of the Fleurs Radiotelescope Field Site, Badgerys Creek, NSW', 2018, p. 17, being Annexure A of Appendix J *Non Aboriginal Heritage Assessment Report, M12 Motorway Environmental Impact Statement*, for TfNSW Roads and Maritime Services, October 2019.

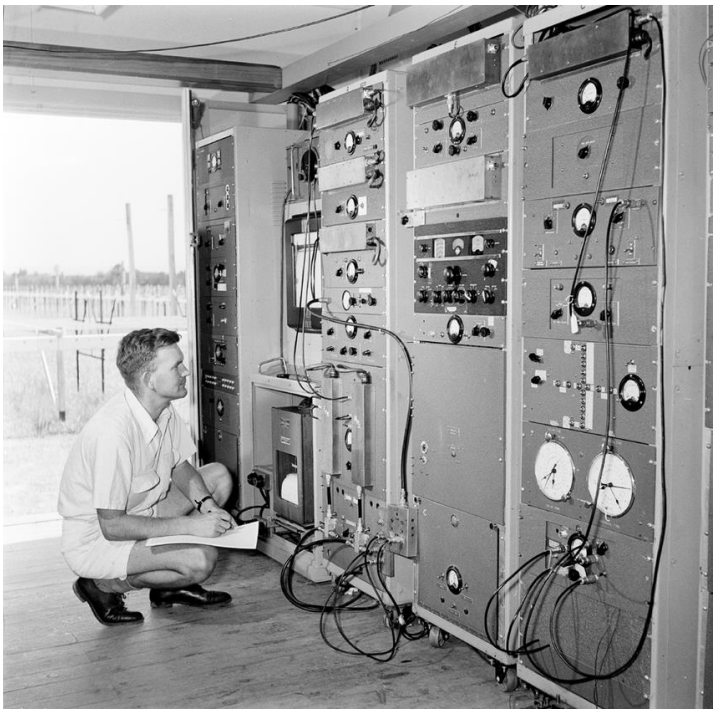

Figure 39: Bruce Slee examining the Mills Cross pen recorders and receiver, 1955 (Source: ATNF Historic Photographic Archive 3868-10)

Figure 40: View looking south along the N-S arm of the Shain Cross. To the left is part of the south arm of the Mills Cross (Source: CASS RAIA: B3868-19[117])

[117] Orchiston, W, M. George, B Slee and R Wielebinski, 'The History of Early Low Frequency Radio Astronomy in Australia, 1: The CSIRO Division of Radiophysics, *Journal of Astronomical History and Heritage*, 18(1) 2015, p. 9.

The next cross-type array at Fleurs was designed by Alex Shain, who had built the major dipole aerial array telescope at Hornsby Field Station. Shain moved from Hornsby to Fleurs in 1955 to take advantage of the larger and flatter site in order to further develop his research and telescope design. The **Shain Cross**, built alongside the Mills Cross, carried out surveys of the galactic plane and monitored decametric burst emission from Jupiter. Although the Shain Cross was much simpler than the Mills Cross, its simplicity was deceptive, and it proved to work perfectly. Sadly, however, Shain died of cancer in 1960 aged just 38.[118]

In 1956, noted scientist, Wilbur Norman (Chris) Christiansen, who had been based at Potts Hill, relocated to join Mills at Fleurs. Similar to Shain, Christiansen was attracted to the space available at Fleurs where he could finally build his new and innovative cross-type array radio telescope.[119] The **Chris Cross**, completed in 1957, had arm lengths measuring 320m each consisting of 32 x 6m diameter paraboloids. The Chris Cross was a success for Christiansen and his team at Fleurs, producing daily two-dimensional high-resolution radio maps of the Sun.[120] It was also used to investigate major solar bursts and solar microwave transients.

Figure 41: The Chris Cross at Fleurs, 1964-1980 (Source: National Archives of Australia, B942 Research [6])

[118] CSIRO, 'The flowering of Fleurs: an interesting interlude in Australian radio astronomy' in CSIRO newsletter June 2002, www.atnf.csiro.au/news/newsletter/jun02/Flowering_of_Fluers.htm 1/

[119] Wendt, Harry, *The Contribution of the Division of Radiophysics Potts Hill & Murraybank Field Stations to International Radio Astronomy*, PhD Thesis, James Cook University, 2008, pp. 41-42.

[120] Davies, R. D., "A history of the Potts Hill radio astronomy field station", in Journal of Astronomical History and Heritage (ISSN 1440-2807), Vol. 8, No. 2, 2005, p. 90.

There was also a mobile field laboratory wagon used at Fleurs, given the name 'Flo'. However, the station staff would sometimes need to call upon the help of local farmers and their tractor on the occasions when the wagon would be stuck in the mud.[121]

Fleurs was CSIRO's leading radio astronomy field station in Australia. However, the late 1950s started to see considerable upheaval in the Division of Radiophysics with competition rising between scientists for the right to construct large new radio telescopes. In the end, the Radio Telescope at Parkes and Radioheliograph at Culgoora were given priority over the further development of the telescopes at Fleurs. As a result, Mills moved to the University of Sydney. However, this proved a fortuitous for Mills as in just a few short years he went on to build a much larger cross-type telescope at the Molonglo Synthesis Telescope, near Canberra. This telescope was later upgraded and renamed the Molongolo Observational Synthesis Telescope (MOST) and is still in operation today with a sensitivity as good as the best radio telescopes in the world.

In 1960, Christiansen also left Fleurs to take up a Chair at the University of Sydney. Christiansen was keen to have a big project to stretch the minds of his postgraduate students. When he found out that the field station at Fleurs was to be virtually 'bull-dozed', he approached CSIRO and requested that it donates Fleurs to the University of Sydney in particular his Chris Cross telescope. Having brokered a deal with CSIRO, in 1963 the School of Engineering at the University of Sydney took over Fleurs, which still had the massive installations of the Mills, Shain and Chris Cross arrays as well as all the associated infrastructure.

The university continued to build on these ground-breaking technologies and owing to the remarkable group of students in Electrical Engineering that Christiansen had established the Fleurs Synthesis Telescope (FST) was developed. The FST, built utilising the infrastructure of the Chris Cross, was used for galactic and extra-galactic astronomical observations in the years 1973-1988. The FST was the highest-resolution radio telescope in the southern hemisphere – the most powerful telescope of its kind in the world. It became an important test-bed for Electrical Engineering PhD students and a significant training ground for numerous scientists who went on to play major roles, not just in radio astronomy but in Australian industry, universities and the CSIRO.

[121] Orchiston, Wayne and Jessica M Chapman and Barnaby Norris, 'The ATNF Historic Photographic Archive: documenting the history of Australian radio astronomy', June 2004, in *Astronomical Instruments and Archives from the Asia-Pacific Region*, Yonsei University Press, Seoul [uploaded onto www.researchgate.net/publications/319184860].

Figure 42: The Fleurs Synthesis Telescope, 18 February 1986 (Source: Fairfax Media Archives, doc6u6s3r7x778mgq|3oy6.jpg)

After the FST was closed in 1988 and much of the equipment was relocated to other stations for continuing research. Fleurs was then used by the Engineering Faculty mainly as a teaching facility. Over the years the remaining Mills and Shain Crosses rapidly deteriorated and the Chris Cross dishes and larger antennas of the FST continued to decay. Fleurs was essentially closed in 1991 and declared surplus in 1996. Since then the land has reverted back to its historic use, currently being agisted for cattle grazing, with most of what was left on site either relocated or demolished leaving only a few remnant clues in the landscape of this once impressive scientific installation. Children started to venture onto the largely abandoned site, with the remnants creating an intriguing and adventurous playground and a soundscape capturing the sounds of the wind, birds and water resonating from the decaying dishes.

Figure 43: A lone cow stands astride one of the last vestiges of a Fleurs telescopes (Source: Extent Heritage, 2020)

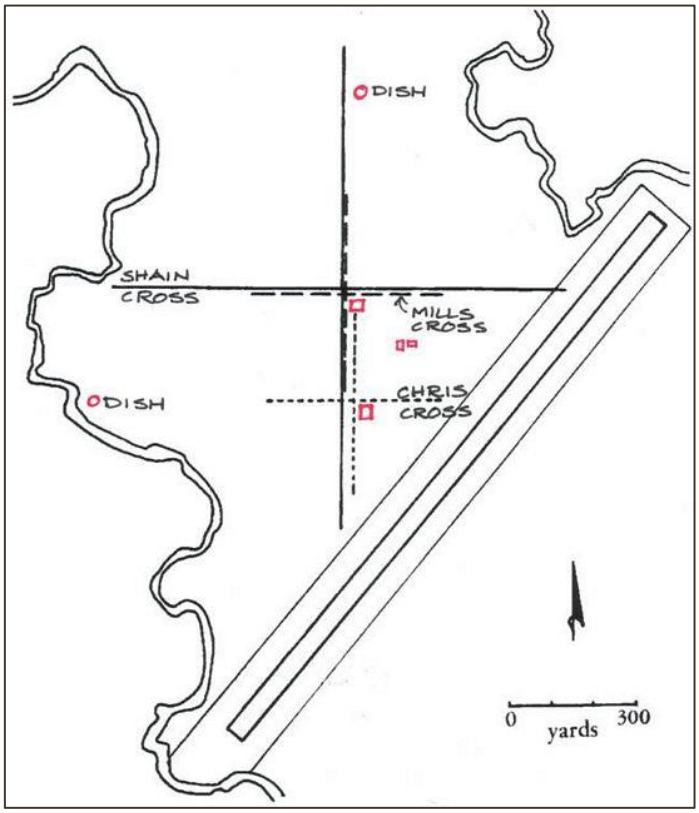

Figure 44: Map of the Fleurs Radio Telescope Site, original plan overlayed with red marking indicating the surviving dishes and buildings in c2008 (Source: annotations by Pamela Hubert, Penrith City Council).

Taking to the air

Fleurs Aerodrome was an integral part of the RAAF defence of Australia and the larger US military strategy in the Asia-Pacific. Fleurs Aerodrome was one of only two parent operational aerodromes in the Greater Sydney region, and had the largest number of satellite airfields of any of the operational aerodromes.

Construction of the Fleurs Aerodrome started in 1942 and was completed by 1945 as one of several aerodromes/airfields during World War Two. It was built by the RAAF's Airfield Construction Squadrons (ACS) for the United States Navy Fleet Air Arm *(USN FAA)* as a land base for its carrier aircraft but this did not eventuate.[122] The presence of the US Navy in Sydney was as a result of its success in the South-West Pacific Area campaign, and Australia needed the assistance of the US with its extensive defence assets. Initially the plan was to construct three runways, and although Runways Nos.1 and 3 were completed only one was used, and No. 2 Runway was abandoned. An existing farmhouse was used for accommodation and some outbuildings were also retained and utilised and eight camouflaged hideouts for aircraft were built. Fleurs was classed as a parent aerodrome with satellite aerodromes at Bringelly, Ravenswood and Wallgrove forming part of Sydney's air defence and aircraft dispersal system.

As well as Fleurs, another major aerodrome was established near to the study area at Hoxton Park, Liverpool.[123]

Figure 45: Fleurs Aerodrome under construction June 1942. (Sources: SLNSW Government Printing Office 1 – 23755)

[122] Horne, John, *Come Fly With Me: Blacktown City's Aviation History from 1911 Until the Present*, entry into Mayoral History Prize, Blacktown City Council, 2018, p. 83.
[123] Liverpool City Council, *Liverpool Heritage Strategy*, draft, 2019-2023.

Fleurs Aerodrome was initially home to the 41st Pursuit Squadron 35th Fighter Group USAAF, but was later downgraded to serve as an Emergency Landing Ground.

In the early 1950s, the Fleurs Aerodrome was closed when the Fleurs Radio Telescope was installed

As early as 1969, Fleurs was considered as a site of the second airport for Sydney but this did not eventuate. In 1986 plans were finally announced for a second major airport at Sydney and the then '…remote and isolated hamlet of Badgerys Creek, some 50 kilometres from the city' was considered the best place to locate it'.[124] Today, the Fleurs airfield is popular with gliding clubs with three sections of the former airstrip still extant.

Figure 46: Fleurs Aerodrome showing the farmhouse and outbuildings in lower r-h corner, 1955 (Source: portal.spatial.nsw)

[124] Hills, Ben, "The Invisible Airport", in *Sydney Morning Herald,* 10 February 2001.

3.6 External Influences

Influences and responses

Government policy

A global community

War and conflict

The main developments captured by this Theme are particularly associated with advances in science and technology in connection to agriculture, astronomy, transport and communication, as well as defence in relation to the first and second World Wars. The associated infrastructure that was built took advantage of lands that had been gradually acquired by the Commonwealth Government.

The Second World War brought further changes to the area when a network of aerodromes was established across New South Wales to assist in training and defence. With its wide expanses of flat land, Western Sydney was ideally suited to accommodate many of these aerodromes, represented by the construction of Fleurs Aerodrome.

After the Second World War, air travel would take an even further leap with the advent of the space race and the endeavours to put humans on the moon. CSIRO's research into space science had its beginnings around 1944 in radar research to aid the war effort that would lead to engagement in space research and finding an important role in furthering international radio astronomy.

Other technological and industrial advances would emerge after the Second War. There was a significant increase in private car ownership and use of cars and trucks as the main form of transportation. Then came the expansion of air travel, now not just for the purposes of defence, but also into the domestic and tourism market. With its ready access to population and industry at Sydney, development of a new Western Sydney International Airport and surrounding Aerotropolis precincts, initially flagged in the 1980s and which has now commenced. This has triggered the planning and development of new motorways and major road links such as the M12 and Outer Sydney Orbital and the Sydney Metro-Western Sydney International Airport line from St Marys to the Aerotropolis Core. With the first runway set to open at the Western Sydney International Airport in 2026, the cultural landscape will once again experience a period of major transformation over the coming decades.

Influences and responses

Tourism

The economic boom of the 1880s in NSW saw the emergence of people with increased leisure time and money to spend – leading to a new tourist industry. The construction of the railway also made the area available to people from the city, and the Cumberland Plains with the backdrop of the Blue Mountains, numerous waterways, and its picturesque undulating landscape became attractive for excursions and holidays:

> The great houses became less the centre of viable commercial enterprises but country estates of leisure, personal interests and hobbies.[125]

With tourism becoming a viable business, some of the large houses were converted into guest houses and boarding houses. The healthy environment of the Cumberland Plains offered relief and respite to those living in the increasingly industrialised, polluted and noisy metropolis. Areas such as Mulgoa were particularly popular holiday destinations for those who lived in the inner suburbs of Sydney

Crop disease and the next economic depression of the 1890s caused by over-speculation in transport and infrastructure and drop in markets - especially primary production - ended this period of prosperity. Although the guesthouses were still relatively steady sources of income for more years to come, these too had dropped off by the by the time World War Two struck in the 1940s.

Subdivision

After World War One, the *Soldier Settlement Act 1919* was introduced for the purpose of stimulating settlement in particularly for those returned servicemen. Under the scheme, large areas of land, in particular historic large estates could be subdivided into small farming blocks. Although two large sections of James Badgery's Exeter Farm were set aside as part of the scheme in 1920 and 1923 the subdivision did not progress and the property was eventually reconsolidated.

Following World War Two the region returned to primarily agricultural activities however with a slightly different approach and outcome. The introduction of the *County of Cumberland Planning Scheme* created a green belt that would encircle Sydney. The Scheme required that subdivisions could not be smaller than 5 acres. During the early 1950s, many of these new 5 acre lots were taken up by migrant families who mainly set up poultry farms and market-gardens as the main agricultural enterprises. A number of lots were also taken up as 'hobby farms' resulting in suburbs such as Kemps Creek, Bringelly and Badgerys Creek becoming characterised as dormitory suburbs. Following the building boom of the 1960s and increased demand for housing, further intensification of settlement occurred as post-war migrants came to Australia to take advantage of this period of economic growth and an increase demand for labour.[126]

[125] Thorp, Wendy, 'The Penrith Heritage Study: the Historical Archaeology Component', August 1983, p. 18.

[126] Gwyther, G., 'From Cowpastures to pigs' heads: The development and character of Western Sydney', *Sydney Journal* 1(3), December 2008.

Government policy

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Within the study area, a number of establishments were set up by the Council for Scientific and Industrial Research (CSIR) which later became the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the name by which it is known today.

The CSIRO has evolved and grown significantly since it first emerged as the Advisory Council of Science and Industry in 1916 when it set up the first "national laboratory". It was no coincidence that the increased interest and engagement in science occurred in the midst of World War One. Developments in Europe, including the apparent technological superiority of Germany in agricultural and industrial domains and the development of the Department of Scientific and Industrial Research (DSIR) in Britain in 1915 appear to have fuelled Australian Prime Minister, William (Billy) Hughes' recognition that science was going to be the foundation of the fledging nation's national security and industrial and economic success.[127]

The conference from which the ACSI was established was chaired by Prime Minster Hughes and involved State Ministers of Agriculture, representatives of State universities and industry representatives. The ACSI's remit was to invest in research projects and commissioned investigations on matters of science relevant to industry development and securing good and productive agricultural land in Australia. By the end of the war, the proposal was put forward to establish the ACSI under an Act of Federal Parliament as the Institute for Science and Industry. Tragically, its first Director, Dr Francis Gellatly, died in the Influenza Outbreak of 1919 (more commonly called the Spanish Flu) whilst on duty travelling around the States to garner support for the proposed Institute. However, it had already gained momentum enough to continue. In 1920, the Act was passed and the Institute was formed.

In 1926 the *Council for Scientific and Industrial Research Act* was passed and the Institute was again reorganised and rebranded as the Council for Scientific and Industrial Research (CSIR):

> The object of the Government is, not to create a great new centralised institute of research, but, for the benefit of both the primary and secondary industries, to bring about co-operation between existing agencies and to enlist the aid of the pure scientist, the universities, and every other agency at present handling scientific questions.[128]

The CSIR, however, like all its predecessor, struggled for funding and a clear mandate as the fledgling Commonwealth Government was still contesting its role with the States in the wake of Federation and as war and economic challenges shaped the young nation.[129] Funding steadily increased and a new direction was emerging.

In 1938, the functions of the CSIR came under the *Science and Industry Research Act 1920-1937* extending its scope to include secondary industries. Initially the focus of CSIR and its predecessor organisations was only primary industries. However, Australia had been observing

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[127] *The Argus*, 1 January 1916.
[128] Quoted from Prime Minister S. M. Bruce in 2nd Reading 1926 CSIR Act cited in CSIRO online CSIROpedia.
[129] CSIRO, online CSIROpedia.

the United States, as opposed to the United Kingdom, which was at this time leading the world in drawing upon science as the key to industrial development: American industries were co-operating with the universities, with problems sent to the universities to be investigated by pure scientists, and therefore science being applied to the solution of industrial problems.[130]

CSIR's role was now to initiate, assist and carry out research in connection with, or for the promotion of, primary and secondary industries in Australia its reach extending to farming, mining and manufacturing, including the training of research workers, the making of grants in aid of pure research and the establishment of a bureau of information relating to scientific and technical matters. New committees were set up such as the Secondary Industries Testing and Research Committee which oversaw the area of standards testing and research. It also played a pivotal role in the defence of Australia during World War Two conducting research to assist the Australian Defence Forces in areas such as radar.

A National Standards Laboratory and Aeronautical and Engine Testing Research Laboratory were set up, divided into three sections – Metrology, Electrotechnology and Physics. The University of Sydney provided a site within its grounds for the Standards Laboratory where there were also a large number of engineering industries. Field and research stations and laboratories were being set up in every State. CSIR also expanded its information services to provide and disseminate technical literature on science and industry and agriculture, and articles about the experiments carried out at its stations and the results were regularly published in journals such as *The Australian Journal of Agricultural Research* and the *Australian Journal of Physics.* Contributions to CSIR journals came from many different departments, as well as statutory organisations, cooperatives and not-for-profit groups around the country and from all over the globe. Not just for academics, the research, publications and services were important in that they were accessible to everyone and provided information on many areas ranging from soil, viticulture, irrigation, weeds, pests, fertilizer, animal feed, disease, wool, cotton, bacteria, food transport, fishing, mining, metallurgy, radio research, forest products and irrigation.

In 1949, CSIR ceased all defence work for the military and was renamed the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the name by which it is known today. In later years its activities again expanded to include tertiary industry, thereby covering almost all facets of industry including the environment, human nutrition, conservation, urban and rural planning and water.

A global community

CSIRO and Agriculture

In relation to the agricultural development of Australia, The CSIR Division of Animal Nutrition was one of the first Divisions in CSIR established in 1927, followed by the Division of Animal Health in 1930. In 1936 these two divisions merged to form the Division of Animal Health

[130] CSIRO, online CSIROpedia.

& Nutrition. In August 1944 the Division of Animal Health and Nutrition was split into the Division of Animal Health and Production and the Division of Biochemistry and General Nutrition.

Regardless of all its departmental manifestations, through the CSIRO, as well as the Department of Agriculture and other various organisations interested in farming, the traditional insularity and suspicion of anything new that was often felt by farmers was significantly eased. No longer content with "hit or miss" farming', pasture improvement was seen as imperative to ensure that graziers and farmers were to survive into the future on a profitable basis. By the 1950s, research and interchange of ideas that were freely shared by CSIRO were now helping many Australian farmers. Farming was becoming more scientific and there was growing awareness of '…getting the best out of the good earth without killing the earth so that it will cease to produce'.[131] Farmers could attend lectures to learn the advice of the experts who have been brought to Australia, they could listen to radio programs (through the ABC), read journal articles as well as exchange ideas with other farmers. This new interest and engagement in agricultural science was not just limited to farmers. When W. E. Petersen, professor of animal husbandry at Minnesota University was brought out to Australia, visiting many country centres – including McGarvie Smith Farm – he made a number of broadcasts providing both advice and inspiration that even people from non-farming backgrounds listened in to and learnt something.

CSIRO and Astronomy

Many of the key factors that have influenced Australia's success in astronomy can be linked to its geographic location. Rather than its isolation in the Southern Hemisphere being an impediment, it has had a strong effect on the scientific culture that has evolved here. Its isolation meant it was free from much radio interference and light pollution, and the impressive Milky Way - the centre of which passes overhead – and the two dwarf galaxies that orbit the Milky Way, the Magellanic Clouds, are only visible from the southern celestial hemisphere. In many ways, isolation has made Australians more innovative and willing to improvise compared to European or North American counterparts. The early development of radio telescopes in Australia is an obvious example.[132]

Radio waves from space were first detected by engineer Karl Guthe Jansky in 1932 at Bell Telephone Laboratories, New Jersey. The first purpose-built radio telescope was a parabolic dish constructed by radio amateur Grote Reber in Illinois in 1937. The sky survey he conducted with his telescope is often considered the beginning of the field of radio astronomy.[133]

Although radio emissions from the cosmos were discovered in the 1930s, it wasn't until World War Two that interest in this area of research accelerated with the development of radar. In 1939, following a secret Cabinet meeting of the Australian Federal Government, of which no records were kept, the CSIR Radiophysics Laboratory was established in the grounds of the University of Sydney. Its specific purpose was to support military forces in the Pacific area

[131] *Argus*, 15 September 1955, p. 26.
[132] Ekers, Ron, Professor, Director Australia Telescope National Facility, CSIRO, 'Achievements and Challenges for Australian Science - Radio Astronomy' Distinguished Lecture Series, Curtin University WA, 1993.
[133] Christiansen, W. N. Radio Telescopes *Annual Review of Astronomy and Astrophysics*, vol. 1, p.1, 1963.

'…with research into the basic principles of radar and developing new systems for the wartime conditions in the Pacific'.[134] In May 1940, the CSIR Radiophysics Laboratory was granted divisional status. One of the first achievements of the Division was the development of a shore defence radar system that was installed in 1940 at Dover Heights at the entrance to Sydney Harbour. The CSIRO radio astronomy group also developed the aircraft landing system called "Interscan".

The expertise and experience gained by the Division of Radiophysics team at the University of Sydney during the war years put the CSIR into a strong position to embark on further research in space science and the team was kept together. Once the war ended, the Division turned its attention to two main areas: radio astronomy and cloud physics.

The radio telescopes developed in these post-war years could probe the most distant reaches of the universe and make solar observations never made before. They could capture moving pictures of the Sun, locate sources of radio emission caused by stars that had exploded thousands of years earlier, explore the Milky Way and even reveal new galaxies outside the Milky Way.

By the 1950s, Australia, along with the United Kingdom and the Netherlands, was playing a leading role in the development of radio astronomy, cementing its reputation as a world centre for astronomy and with its scientists, such as Bernie Mills, John Bolton, Paul Wild, Taffy Bowen and Chris Christiansen dominating the world of astronomy for the next decade. [135]

CSIR's Fleurs Radio Station in Badgerys Creek, established in 1954, with its innovative cross-type telescopes - the Mills Cross, Shain Cross and the Chris Cross – would become the leading radio astronomy field station in Australia. These telescopes enabled the radiation from a source in space to be imaged or the position of the source accurately determined resulting in the first detailed basic radio data for the southern sky.[136] Although the important cosmological results produced by the Mills Cross were greatly under-rated at first, because of the intense rivalry between the Australians and the more influential group in Cambridge, England, the Molongolo Observational Synthesis Telescope (MOST) that came out of the Mills Cross is still regarded as the best radio telescope in the world.[137] The research and discoveries of the Australian radio astronomers also led to important applications in medicine. Christiansen's work that resulted in

[134] Davies, R. D., "A history of the Potts Hill radio astronomy field station", in *Journal of Astronomical History and Heritage* (ISSN 1440-2807), Vol. 8, No. 2, 2005, p. 88.
[135] Ekers, Ron, Professor, Director Australia Telescope National Facility, CSIRO, 'Achievements and Challenges for Australian Science - Radio Astronomy' Distinguished Lecture Series, Curtin University WA, 1993.
[136] Davies, R. D., "A history of the Potts Hill radio astronomy field station", in *Journal of Astronomical History and Heritage* (ISSN 1440-2807), Vol. 8, No. 2, 2005, p. 90.
[137] Ekers, Ron, Professor, Director Australia Telescope National Facility, CSIRO, 'Achievements and Challenges for Australian Science - Radio Astronomy' Distinguished Lecture Series, Curtin University WA, 1993.

the first pictures of the Sun using radio waves was later applied to medical imaging such as CAT scans and NMR imaging. [138]

A number of other related facilities were established in the Western Sydney area in the 1950s, including the Overseas Telecommunication Commissions' Bringelly Radio Receiving Station Complex and the Australian Air Force Radio Receiving Station also at Bringelly.

The success of the cross-type telescopes at Fleurs would also lead to the development of the famous Parkes telescope, completed in 1961, and furthering the knowledge and understanding of solar and non-solar radio astronomy not just in Australia but internationally.[139] The Mills Cross and the Parkes radio telescope were both partly funded by the USA and played an important role in the USA space program but Australia also gained great economic benefit from the research and developments.[140]

During the 1970s, Australia's position in space science started to decline as other countries such as Germany, Japan, The Netherlands, France and, in particular, the USA invested more heavily in astronomy and new areas of astronomy by the space programs in which Australia played an increasingly minor role. Although Australia no longer has a significant space program, its astronomical research still contributes to developments in other countries.[141]

War and conflict

Royal Australian Air Force

The military presence that came with World War Two contributed to development of the overarching study area and brought on further changes to the cultural landscape, with the establishment of munitions factories, bases, service facilities as well as housing and accommodation for the military.[142]

At the end of 1941, Australia came perilously under threat from the Japanese armed forces and a series of events the following year presented real and present danger for the people of Australia. Singapore was captured by the Japanese and large numbers of Australian servicemen located there were taken as prisoners of war. The north of Australia was under attack by Japanese Air Forces especially at the major ports and towns of Darwin, Broome, Derby and Townsville. Australian Territory in Papua New Guinea was invaded by the Japanese.

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[138] Ekers, Ron, Professor, Director Australia Telescope National Facility, CSIRO, 'Achievements and Challenges for Australian Science - Radio Astronomy' Distinguished Lecture Series, Curtin University WA, 1993.

[139] CSIRO, 'The Flowering of Fleurs: an interesting interlude in Australian radio astronomy, in CSIRO newsletter June 2002, www.atnf.csiro.au/news/newsletter/jun02/Flowering_of_Fluers.htm 1/

[140] Ekers, Ron, Professor, Director Australia Telescope National Facility, CSIRO, 'Achievements and Challenges for Australian Science - Radio Astronomy' Distinguished Lecture Series, Curtin University WA, 1993.

[141] Ekers, Ron, Professor, Director Australia Telescope National Facility, CSIRO, 'Achievements and Challenges for Australian Science - Radio Astronomy' Distinguished Lecture Series, Curtin University WA, 1993.

[142] Thorp, Wendy, 'Penrith Heritage Study: the Historical Archaeology Component', August 1983, p. 22.

Japanese submarines began attacking Sydney and coastal shipping. The Battle of the Coral Sea was fought off the north Queensland coast by the American and Australian naval units, and the potential threat of air strikes against centres like Brisbane, Newcastle and Sydney was ever present. In response, the RAAF started constructing dispersal and satellite airfields so that aircraft '…would not be able to be attacked at the one time and all in the one place'.[143]

The Royal Australian Air Force, which had formed in 1921, established a network of aerodromes across New South Wales to assist in training and defence. Western Sydney was ideally suited to accommodate many of these aerodromes with its wide expanses of flat land and ready access to population and industry at Sydney. The need for specialist staff with independent construction capability was increasingly in demand. In 1942, the Airfield Construction Squadrons (ACS) were established as units within the RAAF to address the urgent need for property acquisition and development of facilities. One of these was Fleurs Aerodrome located along Elizabeth Drive with Kemps Creek to the south east and Badgerys Creek to the south west, on what was land comprised in the historic Fleurs Estate. [144]

[143] Horne, John, *Come Fly With Me: Blacktown City's Aviation History from 1911 Until the Present*, entry into Mayoral History Prize, Blacktown City Council, 2018, p. 62.
[144] Wilson, David, *Always First: The RAAF Airfield Construction Squadrons 1942-1974*, Air Power Studies Centre, 1998.

3.7 The Cycle and Milestones of Life

People, places, names

Aboriginal people, places and names in the landscape

There are many references to people, places and names that connect to the Aboriginal cultural heritage of the area. The M12 corridor runs through the land of several Aboriginal groups: the Mulgoa, Cabrogal and Cannemegal of the **Darug** (also D'harawal, Dharug, Daruk, Thurrawal, Dhurrawal) language group. The Darug language group are to the east and south of the area, and the Gandangara language group are located to the west and southwest.[145]

The word Darug is the local language word for yam. The main local totems of the Darug people include the **Mulgoa/mulgo** (Black Swan) **Yurangai** (Black Duck) **Wuban-Burumin** (Flying Fox), and **Wuban-marli** (Possum). Another important animal is the Emu in connection to the **Emu in the Sky** (sky being "**Buurah**") constellation. The emu **Baiame**, his wife **Mariong**, and their son **Dharamulan**. Dharamalan was also known as Dharramulluan 'The One Leg'. [146]

In relation to individual Aboriginal people who lived at the time of the early colonisation of NSW, that have some connection to the M12 study area, there was **Pemulwuy** (c. 1750 - 1802) who was a prominent Aboriginal figure. He was from the Botany Bay area, north of the Georges River, from the Bediagal or 'woods tribe' although he was recorded at places throughout Darug country and spoke a dialect of the Darug language. **Barangaroo**, a Cammeraygal woman, was also a key figure in the local Aboriginal community at the time of European colonisation. Barangaroo's second husband was Bennelong, after whom Bennelong Point - the site of the Sydney Opera House - is named. A new urban renewal project located on a former container terminal on the edge of Sydney Harbour has been named Barangaroo. In relation to the M12 study area, Barangaroo was the name the Buffier family gave their estate which is today connected to McGarvie Smith Farm, McMaster Field Station and also Fleurs Radio Telescope Site and Fleurs Aerodrome.

Some of the place names in the area have also been dual named to recognise the traditional owners. For example, South Creek was dual named as ***Wianamatta*** on 28 March 2003 by the Geographical Names Board of New South Wales. *Wianamatta* is an Aboriginal word of the Darug language, meaning 'mother place'. This is also the name given to the shale found in the area.[147]

[145] Information sourced from Balarinji, 'M12 Aboriginal Cultural Interpretation Project', 2018.
[146] Information sourced from Balarinji, 'M12 Aboriginal Cultural Interpretation Project', 2018.
[147] Information sourced from www.gnb.nsw.gov.au/place_naming/placename_search

Sir Frederick D McMaster (McMaster Field Station)

I believe the great lesson of life is to spend money on something that will outlast you [F D McMaster].[148]

Figure 47: Sir F D McMaster (Source: CSIRO)

Sir Frederick D McMaster was born in Sydney in 1873 and educated at Sydney Grammar School. He was a noted pastoralist, sheepbreeder and studmaster, his main interest being the breeding of Merino sheep, and set up the F D McMaster Pty Ltd pastoral company. His family estate was *Dalkeith Station* at Cassilis where he lived with his wife, daughter (Thelma) and son (Ian).

As well as his successful business ventures, McMaster was also a prominent philanthropist and supporter of Royal Agricultural Society cattle and sheep shows. Following an appeal for support by the NSW Government for scientific research into the problems being experienced by pastoralists, McMaster donated £20,000 which made possible the building of the McMaster Animal Health Laboratory at Sydney University which he opened in 1931. In 1932 he provided further assistance by making available a large area of his property, *Hinchin* in Liverpool for a temporary field station for Sydney University to allow for the improved experience for the students of an actual farm setting which would also improve the types and results of experiments undertaken. As a result of his benefaction, when the university was finally able to establish its own research station, they named it the F D McMaster Field Station which opened in 1938.

McMaster also supported many other public causes. During the depression he gave 500 Merino rams to the Government that could be given to settlers experiencing hard time so they could maintain the standard of their flocks. In 1934 he was created a Knight Bachelor for his public services.

[148] *Sydney Morning Herald*, 3 December 1954, p. 18.

McMaster was also on the NSW State Committee of CSIR. He was interested in scientific research and carried out experiments at his own farm. Just before he died he donated £52,800 to CSIRO for research into animal health and production which was used to build a new wing at the McMaster Animal Health Laboratory at Sydney University – named after his son Ian who was killed in the war at El Alamein in 1942.[149] McMaster also bequeathed shares of McMaster Pty Ltd to the Laboratory to create scholarships and fellowships for research. His contributions and the work done by the Laboratory '…made the name of McMaster known in the field of agricultural science all over the world'.[150] McMaster died in 1954 at his home *Dalkeith* from pneumonia. He was aged 81.

Dr R B Kelley (McMaster Field Station)

Figure 48: Dr Kelley (Source: *Queensland Country Life* 14 February 1946)

Dr Ralph Bodkin Kelley (1890-1970) was the first appointed Officer in Charge of McMaster Station. He was born in Melbourne and attended Melbourne University. He joined the CSIR division of animal health and production in 1931. At the time of his appointment at McMasters, Kelley, animal geneticist, veterinary scientist and published author, was already well known to stock breeders in Australia and overseas. He remained at McMasters until 1953. The following year, in 1954, Kelley was awarded on OBE for his research into cattle.

[149] *Land*, 3 December 1954, p. 8.
[150] *Sydney Morning Herald*, 3 December 1954, p. 18.

John McGarvie Smith (McGarvie Smith Farm)

Who was McGarvie Smith?

THE name of McGarvie Smith is famous throughout the world for the discovery of an effective vaccine to prevent Anthrax.

When he died, the secret of his method of making Anthrax Vaccine was given to the State of New South Wales, and the McGarvie Smith Institute was incorporated under Act of Parliament to carry on his work.

This Institute, true to the ideals of McGarvie Smith, is dedicated to the promotion of veterinary research and among its many recent developments is a highly effective vaccine against Blackleg. All its profits are devoted to research, and substantial grants of money, totalling over £80,000 in all, have been made to organisations such as the Sydney University Veterinary School, Glenfield Research Station, the Shannon Vale Nutrition Station and the McGarvie Smith Animal Husbandry Farm at Badgery's Creek.

Figure 49: An advertisement for Grazcos Cooperative Limited featuring a potted history of John McGarvie Smith (Source: *Central Queensland Herald*, 27 January 1955)

Born 1844 at Paddington, Sydney, McGarvie Smith was apprenticed to a watchmaker at the age of 13. He studied chemistry at the University of Sydney, and in his spare time - and later while travelling in Europe and America - he became interested in bacteriology.

McGarvie Smith discovered a vaccine for anthrax in sheep and cattle that gave protection by a single inoculation, and kept indefinitely, thus allowing its export. The vaccine practically stamped out anthrax and saved Australia millions of pounds. McGarvie Smith kept the formula a secret. During World War One his health failed, and it was feared he might die without disclosing the formula. The Government negotiated with him for the formula only a few months before his death in 1918.

When he died the secret of his method of making anthrax vaccine was given to the State of New South Wales and the McGarvie Smith Institute was incorporated under an Act of Parliament. The McGarvie Smith Institute, controlled by a Government board and pastoralists of New South Wales, was established to manufacture and distribute the vaccine and dedicated to the promotion of veterinary research.[151] All profits were donated to research and grants made to Sydney University Vet School, Glenfield Research Station, Shannon Vale Nutrition Station and the McGarvie Smith Animal Husbandry Farm.

[151] *Australian Women's Weekly*, 27 December 1967, p. 22.

Mr Hector J Geddes, M.Sc (Ag.) (McGarvie Smith Farm)

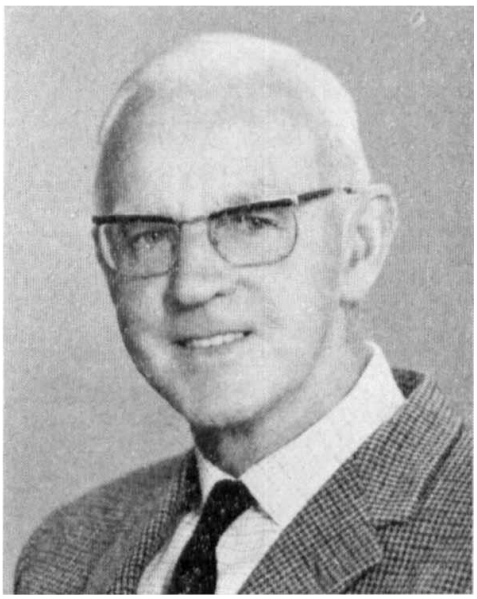

Figure 50: H J Geddes on his retirement in 1973 (Source: Australian Veterinary Journal, Vol 49, November 1973)

Hector Geddes was the Officer in charge, senior lecturer in Animal Husbandry at McGarvie Smith Farm. Geddes, recognised as one of the foremost men of his line in Australia, also travelled around the country to give lectures and talks on harvesting water, during which he would show films and slides of the work being done at McGarvie Smith Farm. Overseas experts who met him or read about his ideas '…considered him about the greatest authority on water harvesting to be found anywhere in the world'.[152]

Mr. Geddes was born and graduated in New Zealand. After being a lecturer in Field Husbandry at Lincoln Agricultural College for a few years, he migrated to Tasmania in 1933 as District Agricultural Officer. He later spent a few years in Melbourne as an agricultural journalist. He was appointed Senior Lecturer in Animal Husbandry in the University of Sydney, and Officer-in-Charge of the McGarvie Smith Animal Husbandry Farm in 1940. In 1954 he was made Director of University Farms, when the University acquired two additional farms in the Camden district.[153]

Geddes retired on 31 August 1973 after working for the University for 33 years. A farewell dinner was held in his honour sponsored by the Faculties of Veterinary Science and Agriculture.

[152] *Argus*, 15 September 1955, p. 26.
[153] Beverley Times, 20 January 1961, p. 6.

Wilbur Norman ('Chris') Christiansen (Chris Cross, Fleurs Radio Telescope Station)

When radio telescopes were revolutionary technology, he not only designed and operated them, he even started building them with his bare hands.[154]

Figure 51: W N Christiansen in 1957 (Source: National Archives of Australia, No. A1200, L23589)

Wilbur Norman Christiansen was born in Melbourne, 9 August 1913 and educated at the University of Melbourne. He held several positions as a physicist, research engineer and principal research officer. He joined CSIRO Division of Radiophysics in 1948 as a senior principal research officer where he came up with the idea for a telescope to study a new science: mapping the sun.

After leaving CSIRO, he was professor and head of the Department of Electrical Engineering at University of Sydney from 1960 to 1978.

Christiansen was an innovative and influential radio astronomer who achieved a distinguished career in science and engineering, spanning almost five decades, were his inventiveness and his commitment to, and success with, large-scale projects. These projects were the outcome of his innovative skill as physicist and engineer. Christiansen forged many strong international links and friendships in the field of astronomy, serving as Vice-President of the International Astronomical Union, as President and Honorary Life President of the International Union of Radio Science (URSI) and Foreign Secretary of the Australian Academy of Science.

[154] *Sydney Morning Herald*, 24 May 2007.

Bernard Yarnton Mills (Mills Cross, Fleurs Radio Telescope Station)

His absolute integrity as a scientist and friend remains an example that all of us can strive to emulate.[155]

Figure 52: Bernie Mills with a drawing of his Mills Cross (Source: Historical Records of Australian Science, Vol 24 No. 2 December 2013, p. 1)

Bernard (Bernie) Yarnton Mills was born in Manly, Sydney on 8 August 1920, only child of Ellice and Sylphide Mills. He went to school at Kings School in Paramatta then went on to study physics and engineering at the University of Sydney in 1937 when he was just 16. In 1942, Mills married Russian born medical student Lerida Karmalsky and they had three children. After Lerida died in 1969, he remarried Crys Lewis.

In 1943, Mills joined CSIRO. He is remembered in both Australia and internationally as an influential pioneer in twentieth-century radio astronomy. His contributions with the 'Mills Cross' at the CSIRO Division of Radiophysics and later at the University of Sydney's School of Physics and the development of the Molonglo Observatory Synthesis Telescope (MOST) were widely recognised as astronomy evolved in the years 1948-1985 and radio astronomy changed the viewpoint of the astronomer as a host of new objects were discovered. He was also fondly remembered by his students for his caring and kind nature. Mills died in 2011.[156]

[155] Frater, R. H., and W M Goss and H W Wendt, 'Bernard Yarnton Mills 1920-2011, in *Historical Records of Australian Science*, Vol 24, No. 2, December 2013, p. 24.
[156] Frater, R. H., and W M Goss and H W Wendt, 'Bernard Yarnton Mills 1920-2011, in *Historical Records of Australian Science*, Vol 24, No. 2, December 2013, p. 1.

Charles Alexander (Alex) Shain (Shains Cross, Fleurs Radio Telescope Station)

Alex Shain was a wonderful colleague in the laboratory, imaginative, well balanced, exceedingly unselfish, and a real friend to all.[157]

Figure 53: Shain in 1952 (Source: Wikipedia)

Alex Shain was born on 6 February 1922 in Melbourne, Victoria. Shain was a pioneer of low frequency radio astronomy in Australia. In 1940, Shain went to Melbourne University to study physics. Having won a scholarship, he spent his final year, 1942, in residence at Trinity College and graduated with a Bachelor of Science.

During World War Two, Shain joined the Second Australian Imperial Force (the volunteer personnel of the Australian Army) During the war he worked on the Division's radar program but was discharged on medical grounds in 1943. After this, Shain went on to champion "low frequency" radio astronomy in Australia, joining the CSIR Division of Radiophysics. Shain was first based at Hornsby Valley field station where he and Charlie Higgins completed a 9.15 MHz sky survey.

After the closure of Hornsby in 1955, Shain moved to the Fleurs Radio Station. Here, he explored the source of Jovian emissions and oversaw the construction of the Shain Cross, a large-scale cross-type radio telescope.

After only a short illness, Shain died of cancer in Sydney on 11 February 1960, aged only 38. He was married with three children.

[157] Pawsey, Joe Lade, 'Charles Alexander Shain', obituary notice, *Quarterly Journal of the Radio Astronomical Society*, Vol. 1, 1960, p. 244.

The Buffier family (McMaster Field Station/McGarvie Smith Farm)

Figure 54: Mr Norman Buffier (right) at the Randwick Races, 1933 (Source: National Library of Australia 160398004-1)

Daniel Buffier was born in Concord, NSW, 1859. His ancestors were wine-makers in France before moving to Bremen in West Germany. Later they migrated to Australia, buying 3000 acres of land in St Mary's in 1880 which would become their "Barangaroo Estate".[158] He was well-known for his association with the cattle industry in NSW, Queensland and Victoria and also as a race-horse owner which his son, Norman, also became very involved in.

Buffier died in 1936. In that same year, knowing that CSIRO was wanting to set up a permanent field station as an extension to its laboratory at Sydney University, his son Norman Buffier offered for sale or lease part of the family's estate. This would be where the F D McMaster Field Station was established.

The laboratory building at McMasters was an original building of the Buffiers and adapted and named the Memorial Laboratory in memory of the late Daniel Buffier. It was formally presented to CSIRO by Mr Norman Buffier on 30th June 1938 at the station's opening. CSIR also transferred half of this property to Sydney University where it set up the McGarvie Smith Farm.

John Blaxland (Luddenham Road)

John Blaxland was the elder brother of the more famous Gregory Blaxland. His property, *Luddenham* which was situated between South Creek and the Nepean River not far from his brother's, was named after the family property in Kent, England. The brothers built a road to connect their respective properties which would be known as Luddenham Road.

The Blaxlands had originally been encouraged to emigrate to NSW by Sir Joseph Banks, who recognised the need for experienced farmers with plenty of capital to invest. The policy developed by Governor Macquarie in his term of office, of granting large land grants to the

[158] Orr, Graham, "The Golden Slipper: a breeders' dream", an interview with Dan Buffier, in *Logans, Racing Articles*, 2005.

wealthy was also designed with this in mind. Initially however, under Governor Bligh the grants of land to the Blaxlands had been much smaller, and both John and Gregory had numerous disagreements with the Governor. They were therefore strong opponents of Bligh at the time of the Rum Rebellion.

The Blaxland property was chiefly used to graze and breed dairy cattle, though grapes and some other crops were grown. The Blaxlands were the first Australians to export wine. John did not live on the property but employed others to oversee and work this land. Among those employed were German and Swiss families brought out to Australia especially to work in the vineyards. Many descendants of these families still live in the area.

The village of Luddenham, straddling this original property, grew with the provision of a school in 1860, a store and the *Thistle Inn*. Those who settled in the area were generally horse or cattle breeders, farmers or orchardists. The area remains rural, despite some recent subdivision and residential development.

Nicholas Bayly Snr (Fleurs Estate)

Born in England in 1769. Lieutenant in the English Army. He came to Sydney as an ensign in the NSW Corps. He later became a Lieutenant in the NSW Corps. His first grant was 116 acres of land in 1799 between Hunter's Hill and Parramatta. In 1806 he was granted 450acres in what became Ashfield which after he sold became known as Dobroyde. By 1814, Bayly built his home at Bayly Park South Creek where he spent considerable time with his family of eight children.

Bayly aligned himself with Macarthur against Governor Bligh and when Bligh was deposed, Bayly was appointed secretary to the Administrator, Colonel Johnstone, however Macarthur opposed all rebel appointments and also disbanded the NSW Corps. Bayly became a cashier at the Bank of NSW. His wife died giving birth to their ninth child in 1820 and Bayly died in 1823. His son Henry took over Bayly Park. Most descendants resided in Paramatta and Liverpool.[159]

In 1826, after Bayly snr's death, part of the estate of Bayly Park was listed for sale by auction which had a house, outhouses and other erections – comprising 2030 acres '…abundantly supplied with excellent water, in the driest seasons; and is equally adapted for cultivation or grazing'. [160]

His son, Nicholas Paget Bayly, was born in 1814 at Bayly Park. Nicholas Paget Bayly would become one of the most successful sheepbreeders and pastoralists in Australia and achieved fame as a producer of wools of super-excellence. Years of careful selection and breeding resulted in the Bayly sheep becoming strong favourites with all breeders.

[159] *Cumberland Argus and Fruitgrowers Advocate*, 15 January 1931.
[160] *Sydney Gazette and NSW Advertiser*, 9 January 1826, p. 3.

Richard (China) Jones (Fleurs Estate)

Richard Jones (1786-1852) was a merchant banker, ship-owner and member of Parliament. Jones purchased Bayly Park in 1824 and renamed the property “Fleurs”. Jones also had a house in Sydney townsite which he called Fleurs (this town estate also known as the Flower of Sydney) which he built in 1827.

Jones was a magistrate, director of the Bank of Australia and a Member of the Legislative Council from 1829-1843. Jones first arrived in the colony in 1809, setting up as a merchant involved in steamship companies and whaling. In 1825, Jones became a pastoralist importing a flock of pure-bred Saxon sheep, introducing this strain into the wool industry of the colony. Fleurs was used by Jones to keep a dairy herd, pigs, poultry and a vineyard. Jones was declared insolvent in the 1842-44 depression and all his estates were sold.

James and Elizabeth Badgery (Badgerys Creek/Exeter Farm)

Figure 55:Elizabeth Badgery (nee Lundie) (Source: Liverpool City Council/Greater Western Library)

James Badgery was born in Devon in c1768. Badgery and his wife Elizabeth immigrated to Australia in 1799, initially leasing land for a mill and establishing a successful bakery in Sydney. In 1803, Badgery was granted 100 acres on the Hawkesbury River, however the 1806 floods forced him to seek property elsewhere.

By 1810, Badgery was granted 640 acres in Liverpool between South Creek and what is now known as Badgerys Creek, north of present-day Elizabeth Drive. Badgery named his farm Exeter Farm after his hometown in England, and here he was successful in grain, cattle, sheep and horses. Over subsequent years Badgery extended the holdings of Exeter Farm, buying up other properties on land south of Elizabeth Drive. The properties were subsequently divided between his family on his death in 1827. These properties were subdivided in the 1880s as the Exeter Farms subdivision. The original Exeter House was demolished by 1980.

As well as his farming and grazing endeavours, Badgery was a racing enthusiast and stud-master of some skill and played a notable role in the early development of the racing industry in NSW, including winning the first official Sydney Cup in 1819 with his horse Rob Roy.[161] Descendants of Badgery are the source of the name Badgerys Creek.

Edward Orpen Moriarty (Upper Canal System)

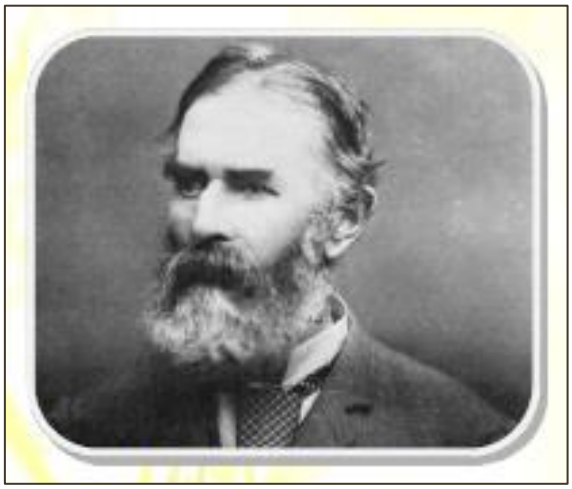

Figure 56: Edward Orpen Moriarty (Source: Engineering Heritage Australia, Port of Clarence Engineering Heritage Marker, www.engineeringheritage.com.au)

Edward Orpen Moriarty was born in Ireland in 1824. He completed his Master of Arts at Dublin University, then forged a career in civil engineering becoming a member of the Institution of Civil Engineering. He came to Australia in 1854, first to NSW then Queensland before returning to Sydney in 1852, starting up a private engineering practice. In 1853 he marred Leila Helen Geary whom he had met in Queensland.

Moriarty went on to have a successful career in the Government, holding held many important positions in the areas of roads and bridges, harbours and ports, rivers and water supply schemes. He designed and constructed Prospect Reservoir for the Public Works Department of NSW during the 1880s and is largely credited for the Upper Nepean Water Supply Scheme.

One of his other significant projects was at the Port of Clarence in NSW, where he initiated the first works in 1862 by constructing short breakwaters and rock training walls at the river entrance. Known as Moriarty's Scheme (1862-1889), part of the north training wall was later called "Moriarty's Wall" in his honour.

Moriarty retired from engineering in 1888 and returned to England, where he died in 1896.

[161] *Sydney Morning Herald*, 8 October 1919.

(Captain) Anthony Fenn Kemp (Kemps Creek)

Born in London c1773, Kemp is remembered as a soldier and merchant. As a young man, he travelled to the United States and France, arriving in Australia in 1795 as part of the NSW Corps. From 1795 to 1797 he served on Norfolk Island being promoted to Lieutenant then Captain. In 1802 he married Elizabeth Riley. Kemp was known for his involvement in the attacks on Governor King's administration and was in the vanguard of those who arrested Governor William Bligh in 1808.

In 1809, Kemp, received an initial grant of 500 acres of land on the eastern side of the creek that would take his name, Kemps Creek, and a further grant of 300 acres named "Mount Vernon". This included Amy Park which subdivided lands south of Elizabeth Drive in the vicinity of the current village of Kemps Creek. In 1816, Kemp moved to Tasmania where he continued his ventures as a grazier and merchant, and also becoming foundation director and later president of the Van Diemen's Land Bank. He died at Sandy Bay in 1868 aged 95 and was buried at St George's Church of England cemetery.[162]

Thomas Wylde (Cecil Park)

In 1817, Thomas Wylde was granted 1,000 acres of land originally known as Macquarie Park on the northern side of Elizabeth Drive and west of Wallgrove Road. Wylde's son, Sir John Wylde, was granted 2000 acres in the Parish of Cabramatta opposite to his father's land, with Elizabeth Drive forming its northern boundary. He named his estate Cecil Hills, from which the suburb Cecil Park - where his father Thomas Wylde's land was located - would take its name. Thomas Wylde died in 1821 and his land interests passed to his son. The Wylde family retained their Cecil Park properties until the late 1800s. After this, the land was subdivided.

William Flood (Cecil Park School and Post Office)

William Flood was the first schoolmaster at Cecil Park School from 1896-1904 and also postmaster of the first post office at Cecil Park.

[162] Kemp, M. C., 'Anthony Fenn Kemp', in *Australian Dictionary of Biography*, Volume Two, London, MUP, 1967; and Kemp, M. C. & T. B. Kemp, 'Captain Anthony Fenn Kemp', *Journal of the Royal Australian Historical Society*, Vol. 51, 1965.

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