Albert Morris and the Broken Hill regeneration area: ecologically informed restoration responses to degraded arid landscapes 1936–58

Peter J Ardill

Fourth Edition 2023

Australian Association of Bush Regenerators (AABR)

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Sensitive content notice

This article describes historical events that involved the dispossession and oppression of Aboriginal nations and communities. The article does not display images of deceased Aboriginal persons.

Acknowledgements

The author acknowledges the Aboriginal nations and communities of Australia and pays his respects to their Elders past, present and to come. Many thanks to Tein McDonald, for her support, encouragement and detailed editing input in 2017 and with this fourth edition. Thanks also to Louise Brodie (AABR), Virginia Bear (AABR), Suzanne Pritchard (AABR) and Jane Gye (AABR). The Australian Association of Bush Regenerators (AABR) kindly offered to publish the completed article. Archives Officer at Outback Archives, Broken Hill City Library, Alison Wayman, promptly supplied requested files and documents. The librarians at Broken City Library were also helpful. Barrier Field Naturalists Club made its valuable archive available to researchers, a generous gesture. The staff at the NSW State Archives, Kingswood, NSW provided assistance, files and documents. Trove online research facility at the National Library of Australia was invaluable. Historic photographs courtesy of the Forest History Society Durham NC USA, National Library of Australia (NLA), State Library South Australia (SLSA), Barrier Field Naturalists Club (Outback Archives. Broken Hill City Library, Broken Hill Council. NSW). Impressive Australian botanical resources PlantNET (National Herbarium of NSW, Royal Botanic Garden, Sydney), eFLORA SA (The State Herbarium of South Australia) and Florabase (West Australian Herbarium) were utilised. Publications by Dr Sabine Sauter (2017) and Dr Lilian Pearce (2019) were particularly informative. The hospitality of Broken Hill botanist, Ann Evers and many other Broken Hill residents during my 2016 and 2017 visits was much enjoyed. Environmental repair and conservation colleagues continue to inspire.

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Note to the 2023 edition

When first published in 2017, this article contributed to the existing literature a much needed, referenced narrative that set out the historical background and development of the Broken Hill regeneration area project. Albert Morris's initiation of the project in 1936 and the series of events that culminated in the 1958 completion of the reserves received detailed attention. Derived from previously untapped research sources, a wealth of new information revealed the ecological and conservation contexts of the project: Albert Morris's environmental advocacy in 1923; the revegetation field trials conducted in 1935; Broken Hill field naturalists' correspondence with the state government in 1935; the field naturalists' submissions to the New South Wales Erosion Committee in 1936; the reservoirs regeneration project of 1936. The original article noted that as well as campaigning for solutions to the severe erosion problem confronting their city, the Broken Hill field naturalists advocated for remediation of the rampant erosion that was consuming the regional soils of far western New South Wales.

Margaret Morris's roles as publicist and advocate for the project were documented in the original article, as well as her botanical work. The many contributions made to the project by various Broken Hill field naturalists were recorded. New information, derived from previously untapped archived state government files, revealed the considerable interest shown in the regeneration area by a premier of New South Wales, William McKell, and the involvement of distinguished botanist and Soil Conservation Service researcher, Noel Beadle. Connections between the historical project and subsequent bush regeneration and ecological restoration practices were probed and analysed.

This 2023 revised edition of the article reiterates the narratives, themes and observations recorded in the original article, and in many cases augments them with new material and perspectives derived from additional research. The revised edition emphasises that the regeneration area project, commenced in 1936, was a unique revegetation undertaking, and should not be confused with the Zinc Corporation plantation projects that Albert Morris advised on from 1936, or with any of his other urban landscaping projects. The plantation and landscaping projects were characterised by the planting of trees, in dense clusters. The regeneration area project, as its name quite clearly suggests, was an

exercise in harnessing the evolved capacity of arid zone indigenous vegetation to naturally regenerate when protected from livestock and their grazing; relatively little tree planting was undertaken.

The regeneration area project attracted acclaim at the time of its implementation, and continues to attract acclaim today, because it made use of an ecologically informed revegetation technique, and not simply because a large area of highly degraded arid land was successfully revegetated. The historical documentation and analysis to be presented in this edition demonstrates that in terms of their development, infrastructure and management, and revegetation aspirations, techniques and outcomes, the plantations and the regeneration area project were quite distinct undertakings. To further support this claim, the pre-eminent roles that a stock exclosure concept and the harnessing of natural regeneration played in the regeneration area project are analysed and confirmed in a new, detailed sub-section (Section 7 *Revegetation of the regeneration reserves*).

This revised edition far more deeply acknowledges the Aboriginal nations and communities of the Baaka,[1] their dispossession and experiences of oppression throughout the early decades of settler pastoralism, during the development of the regeneration area project and in the decades that followed. Several social and environmental shortcomings and failings of the regeneration area project are examined.

Definitions and explanations of key concepts are presented in footnotes: stock exclosure; spontaneous and facilitated natural regeneration; indigenous vegetation; local vegetation; soil seed bank and more. The reader is advised to make use of the regeneration area diagram presented in Appendix B. A map of New South Wales is provided in Appendix C.

The regeneration area story will continue to benefit from further research and the presentation of fresh perspectives. My hope is that this article, or short book, will serve as a reliable and informative contribution to that process.

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[1] Also known as the Darling River, western New South Wales, Australia.

1. Introduction

The City of Broken Hill is now completely surrounded by areas specially reserved for regeneration of vegetation (Wetherell 1958)

In a statement released on Wednesday 15 October 1958, the New South Wales Minister for Conservation, Ernest Wetherell, announced the completion of the primary construction phase of the Broken Hill regeneration area project (Wetherell 1958).[2] The chief protagonist of the project, Albert Morris, had died 19 years earlier, on 9 January 1939. Albert had the pleasure of seeing his cherished regeneration area concept become a reality in 1936, and was aware of the enthusiastic, positive appraisals delivered by representatives of community, industry, science and government.

Despite the scale of the problem, Albert Morris and his field naturalist colleagues were determined to remediate eroded lands and reverse ecosystem degradation in western New South Wales. Recovery of indigenous vegetation[3] was identified as the key prerequisite for success. The field naturalists investigated and experimented extensively with environmental repair practices, and by the commencement of 1936 a suitable revegetation technique had been developed.

In August 1936 Albert initiated negotiations with a mining company that culminated in the development of a plan to construct a series of regeneration reserves around the southern and western perimeters of Broken Hill. The fencing of a first set of reserves commenced in September 1936 and was completed by approximately February 1937. Their construction represented the intentional application of a proven, systematic revegetation technique that created conditions for ecosystem recovery.

[2] Primary construction phase: construction of the reserves that resulted in encirclement of the city by 1958. With one exception, these reserves continue to form the contemporary regeneration area. A reserve created in 1936-37 on mining company leasehold was fully developed as a mining site in 1948. Smaller modifications have been made to other reserves.

[3] Indigenous vegetation: the naturally occurring vegetation of a specified locality, region or country. In this article, vegetation and plant species indigenous to the Broken Hill locality are referred to as the local vegetation and local plant species. See section 2 *Broken Hill, sand-drifts and dust* for the local vegetation communities.

These initial regeneration reserves endured and were adjudged a success. Additional reserves were created over the next 21 years. Fully encircling the city, the completed set of reserves is now referred to as the Broken Hill regeneration area.

Approximately 1700 hectares of barren sand and soil were restored to a stable, vegetated condition. The regeneration area project met with ecological and erosion management success because it utilised a stock exclosure concept and harnessed natural regeneration,[4] a revegetation technique deemed viable after careful study, over many years, of the local vegetation communities and ecosystems. Hundreds of thousands of plants naturally regenerated in the reserves; relatively little planting was undertaken. The amenity benefits were substantial.

Albert enjoyed the support of a tremendous array of talented Broken Hill field naturalists. His ideas and plans were ably implemented by mining company administrators. The project exhibited serious faults: Traditional Owners were not acknowledged; engagement with the Broken Hill community was slow to develop.

The exciting scale of the project and the dramatic revegetation outcomes informed the development of state government programs designed to revegetate the millions of eroded hectares that scarred western New South Wales. An ecologically informed environmental repair undertaking of historical significance, the regeneration area project markedly contributed to the transformation of arid zone indigenous vegetation and soil management policies in mid twentieth-century New South Wales and Australia.

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[4] Stock exclosure: the exclusion of a targeted set of animals from a defined area, usually by installing fencing. Natural regeneration: the natural regeneration that occurred throughout the Broken Hill regeneration area is known as spontaneous natural regeneration, the "recruitment of species that occurs without human assistance other than the removal of the original degradation driver" (SERA 2021 p.33). Exclusion by fencing of grazing animals introduced to Australia allowed spontaneous natural regeneration of local vegetation throughout the Broken Hill regeneration area: the naturally distributed seed of local vegetation germinated, and the resultant plants thrived because cattle, sheep and rabbits had been excluded. Also, degraded rootstock, "nearly-dead stumps", exhibited spontaneous natural regeneration (Morris 1938 p.48). Examples of stock exclosure and natural regeneration are presented in the article. Planting of vegetation (local or otherwise) and seed scattering (or direct seeding) are not regarded as natural regeneration.

2. Degraded landscapes: 1830–1936

First Nations communities

From time immemorial a number of Aboriginal nations and communities[5] occupied and carefully managed homelands located on the arid plains and low mountain ranges that embraced the waters of the Baaka,[6] as it is known to people of the Barkantji nation[7] (See Appendix C Map of New South Wales). The Wilyakali community were traditional owners and custodians of homelands situated to the west of the Baaka (OEH 2017 p.15). Their homelands included localities now commonly referred to as Broken Hill[8] and the Barrier Ranges, in far western New South Wales.

Colonial era settlers expanded westward from Sydney township, established in 1788 on the seized homelands of Aboriginal nations and communities.[9] From the 1830s settlers forcibly occupied the Baaka and adjoining regions. The Barkantji nation defended their homelands, and it is highly likely that other nations and communities also resisted (OEH 2017 p.15; Beckett et al. 2008 p.10). Dispossession of the Wilyakali quite likely commenced in the mid-1860s, with the establishment of Mount Gipps pastoral station, near present-day Broken Hill (Beckett et al. 2008 p.10). By approximately 1880 a substantial proportion of the land located to the west of the Baaka had been appropriated by settlers and converted to pastoral properties. Millions of sheep and cattle now grazed the vegetation of the plains.

Pastoralists controlled key water resources. Forced to abandon their traditional lifestyles, Aboriginal communities of the west became increasingly dependent on pastoral stations such as Mount Gipps for food and shelter. Employment could be obtained on stations, but material, health and social hardships were frequent experiences (OEH 2017 p.15;

[5] Aboriginal and Torres Strait Islander peoples are the first peoples of Australia (AIATSIS 2022).
[6] As outlined, also known as the Darling River.
[7] The People of the Baaka.
[8] A major mining centre and city since the mid-1880s.
[9] Subsequently capital of New South Wales.

Beckett et al. 2008 p.11, 14). An exception was Poolamacca station, located approximately fifty kilometres to the north of Broken Hill. Between approximately 1890 and 1910 the station served as a "sanctuary" for an Aboriginal community of more than 200 people; they were the traditional owners of homelands located across the Barrier Ranges and adjoining regions (Beckett et al. 2008 p.14-17).

Severe drought characterised the 1890s. As the drought worsened, Aboriginal peoples of the west were confronted with a decline in employment opportunities. Dependence on financially struggling pastoral stations for essential resources led to an increase in deaths (OEH 2017 p.15; Beckett et al. 2008 p.17). The influenza epidemic of 1919 inflicted a devastating toll on the Aboriginal population; tuberculosis was another rampant disease (OEH 2017 p.15; Beckett et al. 2008 p.17). Although some people and communities remained on stations, worsening environmental and economic conditions in the 1920s resulted in widespread movement to government reserves located near small towns Pooncarie, Milparinka, Tibooburra and White Cliffs (OEH 2017 p.15; Beckett et al. 2008 p.17).

By the 1940s, Aboriginal peoples and communities still lived and worked on pastoral stations, but increasing numbers resided in the township, Wilcannia,[10] or had been forcibly removed from homelands and confined to government reserves located near towns Brewarrina and Menindee[11] (Beckett et al. 2008 p.17-18; OEH 2017 p.15). Authoritarian state government regulation and control of individuals, families and their children continued for many more decades.

Although constantly oppressed by the material and cultural impacts of dispossession, the Aboriginal nations and communities of the Baaka plains and ranges continued to maintain close relationships with traditional lands and waters. After seventeen years of protracted legal effort, in 2015 the Barkantji and the Wilyakali were awarded native title rights to their homelands.

[10] Township located 200 kilometres east of Broken Hill, on the Baaka.
[11] Township located 110 kilometres east of Broken Hill, on the Baaka.

Degrading the land

The well vegetated and stable soils of carefully managed First Nations homelands were rapidly transformed by the influx of settler pastoralists and their sheep and cattle. Significant expanses of far western New South Wales had become so highly degraded by 1890 that the pastoral industry entered a long period of economic depression (Beadle 1948 p.54).

To investigate the causes of the depression, the parliament of New South Wales established the *Royal Commission into the Condition of the Crown Tenants of the Western Division*.[12] The royal commission determined that overstocking, foraging by rabbits and resultant "destruction" of the indigenous vegetation were factors that had significantly contributed to the development of the depression (Beadle 1948 p.54).[13] Also mentioned as contributing factors were the arid climate,[14] frequent dry periods and the severe drought of the 1890s (Beadle 1948 p.54; Bureau of Meteorology). Dry soils delayed natural recovery of vegetation. Loss of vegetation cover resulted in widespread erosion of exposed soils, by wind and by water (Beadle 1948 p.54).

The findings of the royal commission informed the *Western Lands Act 1901* (NSW). Section 18 of the Act imposed new obligations on pastoralists to control rabbits and noxious weeds, protect green timber and conserve indigenous vegetation suitable for consumption by livestock. However, dedicated government and research sector engagement with the remediation of eroded land only commenced in the mid-1930s (see section 4).

Overstocking by pastoralists persisted throughout the early decades of the twentieth

[12] The Western Division is a New South Wales government administrative area comprised of the sparsely populated western to central sectors of New South Wales, excluding urban centres. Administered by a commissioner. This is primarily arid (250 millimetres or less per year of average annual rainfall) and semi-arid (250-350 mm) country. This country is also referred to as rangelands.

[13] Overstocking: the practice of carrying more livestock on a station than the land and its vegetation can sustainably support. Includes inadequate rotation of grazing livestock on a station.

[14] Hot summers with average temperatures exceeding 30° Celsius, and average annual rainfall of approximately 250 millimetres or less (Bureau of Meteorology).

century, with little thought being given to the long-term environmental consequences. Wind and water erosion worsened in western New South Wales. During this period, a group of concerned Broken Hill residents turned conservationists investigated regional overstocking and its impacts, indigenous vegetation loss and how eroded soils and degraded ecosystems might be remediated.

Settler conservationists

Doctor William MacGillivray (1868-1933)[15] was a Broken Hill medical practitioner and distinguished naturalist, with expertise in botany and particularly ornithology (Embury 1933). MacGillivray was disturbed by the degraded indigenous vegetation communities and widespread wind erosion that he encountered on his frequent country trips, and campaigned for the implementation of conservation measures.

Dr MacGillivray observed in 1903 that saltbushes (*Atriplex* spp.) only recovered from grazing when sheep and cattle were excluded from paddocks by fencing (Anon. "Erosion West" *Barrier Miner* p.4, 25 February 1937). He recorded in 1908 that due to the cutting down of Mulga (*Acacia aneura*) and other tree species to provide fodder for hungry livestock, particularly during periods of drought, the indigenous vegetation of western New South Wales was being "sacrificed" for short-term gain (Anon. "Erosion West" *Barrier Miner* p.4, 25 February 1937).

Albert Morris (1886-1939), a Broken Hill mining company senior assayer, was also alarmed by the extent of indigenous vegetation and ecosystem degradation in western New South Wales (Kennedy 1986; Morris, M. 1975: 1-3). In 1920 Albert and his wife, Margaret Morris (1887 -1957), another keen naturalist, joined with Dr W. MacGillivray and other Broken Hill residents to form the Barrier Field Naturalists Club (hereafter the Club).[16]

[15] Dr William MacGillivray's son, medical practitioner Dr Ian MacGillivray, also features in this article.
[16] Traditionally, Albert Morris and Dr. W. MacGillivray are credited with forming the Club. However, in 1933 Margaret Morris recorded that in January 1920 she and Albert discussed the idea of forming a "Naturalists Society in Broken Hill", and that she visited Dr. W. MacGillivray and "talked the matter over with him…"

The Club provided members with an institutional platform from which to study a wide range of environmental, historical and cultural issues.[17] Club President, Dr W. MacGillivray, made it clear in his annual report for 1927 that the conservation of indigenous vegetation and wildlife, overstocking, and the "failure [by pastoralists] to attempt the regeneration of the eaten-out country by protecting it for a period of years so that it may recuperate" were issues that concerned members (Anon. "Field Naturalists Club" *Barrier Miner* p.3, 27 February 1928). Remediation of the eroded soils that encircled Broken Hill was another environmental issue that the Club pursued.

Albert and Margaret Morris: botany, ecology, experimentation, landscaping

Albert Morris developed an interest in nature and plants when he was a child (Morris, M. 1975 p.1). His father Albert Joseph Morris was an

> *enthusiastic botanist…with Albert as his off-sider. Albert, then quite a lad, used to bring in small pieces of geranium and shrubs of all sorts…* (Thorn 1939).

Margaret Morris also developed an interest in nature during her childhood years, and enjoyed the company of Edwin Ashby, a prominent South Australian naturalist (Anon. "Mrs Morris Tells" *Barrier Miner* p.6, 14 July 1949).

Albert and Margaret devoted substantial amounts of time to their home garden and plant nursery, located in Cornish Street, Railway Town, on the wind exposed, western outskirts of Broken Hill (Illustration 1). They grew a wide range of local plant species,[18] and also

(Morris, M. 1933). The Barrier Field Naturalists Club was formed the following month. In 1949 Margaret Morris reiterated her claim that she played an active role, possibly the initial role, in the formation of the Club. "Mrs. Morris said that she had helped to form the club more than 30 years ago" (Anon. "Mrs Morris Tells" *Barrier Miner* p.6 14 July 1949). Quite possibly Margaret resented that her role had been overlooked.

[17] Some Club activities were offensive. See Pearce (2019) p.91 on the Barrier Field Naturalists Club.

[18] As outlined, in this article the terms local species, and local vegetation, refer to the naturally occurring (or indigenous or native) vegetation of the Broken Hill locality. For the local vegetation of Broken Hill see section 2 *Broken Hill, sand-drifts and dust*. Many of the local species of Broken Hill occur naturally in other regions of Australia.

non-local species, including species indigenous to other regions of Australia, and species from overseas. They developed seed collection, plant identification, plant propagation and nursery management skills (Jones 2016 p.45).

Albert was particularly keen to cultivate a garden that was adapted to the demanding arid conditions of Broken Hill. “He came to the conclusion that local species grown from seed collected in the district withstood [arid] conditions better than any others” (Morris, M. 1975 p.2).

Illustration 1. Margaret and Albert Morris (undated) Source: Barrier Field Naturalists Club Outback Archives Broken Hill City Library

Another environmental challenge was posed by the powerful, mobile “sand-drifts”[19] that formed when soils stripped of vegetation were exposed to regular southerly and westerly

[19] As they were referred to in Broken Hill and by Albert Morris (Morris 1938 pp. 43, 44, 46).

winds. Drifts threatened the Morris's home and neighbourhood, schools, roads, fences and other residential areas (Morris, M. 1939a. p.13). Seeking effective ways to stabilise wind-blown sand, Albert conducted home garden experiments "and studied drift and what happened under different conditions" (Morris, M. 1939a. p.13). He evaluated the soil binding capabilities of various plant species, and concluded that local species, Old Man Saltbush (*Atriplex nummularia*), when planted, grew well in conditions of deep sand, or "drift" (Morris, M. 1939a. p.13).[20]

From approximately 1920 Albert and Margaret taught themselves the principles of botany, making good use of the limited botanical resources that were available. They utilised "Botanical Gardens"[21] and "Floras"[22] (Anon. "Twenty Years of Botanical Study" *Barrier Miner* p.1, 13 April 1939; Morris, M. 1975 p.2). Albert and Margaret would have regularly referred to John M. Black's publication, *Flora of South Australia* (Anon. "90 Years Old" *Barrier Daily Truth* p.2, 30 April 1945).[23] Only a small number of reference books that dealt with New South Wales indigenous vegetation had been published by the 1930s, and they often contained little information about arid zone vegetation (Jones 2016 p.45). Botanical maps for western New South Wales did not become available until the 1930s (Jones 2016 p.45). Distinguished botanist, plant ecologist, soil conservation researcher and academic, Noel Beadle,[24] maintained that botanist and plant ecologist, Marjorie Collins, in 1923, was the first researcher to produce "reliable information on the ecology of any area of the western part of the State…" (Beadle 1948, p.15; Collins, M. 1923, 1924).

Albert and Margaret's botanical knowledge benefited from a range of collaborations. They participated in the Barrier Field Naturalist Club's regular botanical excursions. Quite likely the talented Dr W. MacGillivray was a good source of botanical and ecological

[20] Albert regarded the "drift sand" as "mostly good top soil" (Morris, M. 1939a p.13).
[21] Centres of professional botanical study. Possibly the Royal Botanic Garden Sydney and the Botanic Gardens of South Australia were particularly utilised by Albert and Margaret. Professional botanists quite likely learnt a lot from Albert and Margaret.
[22] Botanical reference books.
[23] Black was an authority on the botany of South Australia, a state with a boundary close to Broken Hill. The various volumes of his book were published between 1922 and 1929.
[24] Noel Beadle ((1914-1988): Soil Conservation Service researcher between 1939 and 1946. Appointed Lecturer in Botany, University of Sydney, in 1946. Appointed Foundation Professor of Botany, University of New England, New South Wales, in 1954.

information. Albert became recognised as an authority on arid zone vegetation. By the 1920s he was engaging in correspondence with prominent Australian and international botanists, including South Australian botanists John M. Black and Professor Theodore G. Osborn (Morris, M. 1939a. p.13; Anon. "90 Years Old" *Barrier Daily Truth* p.2, 30 April 1945; Morris, A. 1921b. p.39). Marjorie Collins and Albert shared botanical field experiences and discussion (Ardill 2022 p.38). His 1923 publication, *The Flora Between the River Darling and Broken Hill,* was regarded by Beadle as a valuable contribution to the study of western New South Wales botany and ecology (Beadle 1948, p.15; Morris, A. 1923). Albert developed an herbarium of over 7000 plant specimens, comprised of plants indigenous to Australia and also specimens from overseas.[25]

Throughout the 1920s and 1930s, Albert prepared notes and articles and delivered public lectures on botany, plant ecology and erosion. Influenced from childhood by conventional horticultural practices and then by formal botany, Albert's notes, articles and lectures reveal that by the 1920s he was closely observing the regional ecosystems, their natural biotic and abiotic qualities, ecological functioning, seasonal cycles and modes of self-healing and renewal.

The notes and lectures also record Albert's developing interest in the causes of and possible solutions to the widespread loss of indigenous vegetation occurring west of the Baaka, and the resultant wind erosion.[26] Overstocking and its impacts, seed viability and dispersal, seed bank quality, climate, capacity for natural regeneration, soil quality, and plant species' succession and adaptability were all considerations that he successfully brought to bear on the development of the first regeneration reserves in 1936.

An undated set of notes, based on a Club field trip to Mootwingee (now Mutawintji National Park and a place of significance for Aboriginal communities), reveal Albert's opinion on the origins of the sand-drifts that formed in dry seasons: the problem arose

[25] The herbarium was undoubtedly collected and prepared with considerable input from Margaret Morris. The majority of the specimens are now housed in the State Herbarium of South Australia. The Royal Botanic Gardens Sydney and other Australian botanical institutions also hold specimens. Margaret Morris beautifully hand coloured a number of Albert's plant specimen photographic slides, and they may be viewed at Outback Archives, Broken Hill City Library.

[26] Wind and water erosion had become serious problems in many regions of New South Wales and Australia.

from loss of indigenous vegetation and soil cover caused by pastoralist's overstocking (Morris, A. n.d. 3, p.15). He noted the ability of the indigenous vegetation to recover in good seasons, after periods of drought.

In a season when the rainfall is above the average, the country was soon carpeted with a good growth of vegetation and many spots could be classed as a garden of flowers, equal to anything to be seen elsewhere (Morris, A. n.d. 3, p.15).

On the field trip to Mootwingee, Albert observed that Spear Grass (*Stipa scabra* syn. *Austostipa scabra*) and other indigenous grass species with a perennial rootstock recovered rapidly after rain and provided valuable soil cover. He believed that Old Man Saltbush was not as common as it used to be, due to overstocking and the grazing of rabbits. The weeds Mexican Poppy (*Argemone mexicana*), Night Lily (*Datura metel*) and Patterson's Curse (*Echium plantagineum*) did not escape his attention: "a fairly formidable array of nuisances" (Morris, A. n.d. 3, p.15, pp.18-19, p.20). The ecological roles of indigenous plants were recorded.

The roly poly (Salsola kali L.) must not be forgotten… they block quantities of drift sand. While rolling, they deposit their seeds, a good method of seed distribution (Morris, A. n.d. 3, p.20). [27]

A 1921 Club lecture presented by Albert, *Wattles*, provided extensive information on the seed vitality and propagation of indigenous Australian plant genus, *Acacia*. For example, the local wattle species, Mulga,[28] could be propagated from seed that was decades old (Morris, A. 1921a. p.124).

On a visit to Cockburn, located fifty kilometres to the west of Broken Hill, Albert observed the scarcity of small plants, and attributed this to unchecked grazing by rabbits, goats and livestock. However, he noted that when grazing livestock were excluded by fencing, the germination of naturally occurring, soil-stored seed[29] resulted in dense groves of

[27] *Salsola kali L.* syn. *Salsola australis*
[28] Also indigenous to other dry regions of Australia.
[29] Soil-stored seed: seed stored in a soil seed bank (also called a seed bed). Soil seed bank (or bed): soil containing (or storing) plant seed. The seed awaits suitable germination conditions, usually moisture, heat.

indigenous vegetation: “inside the rabbit and stock proof enclosure of the railway annual plants flourish in great profusion” (Morris, A. 1921b. p.33).[30]

Albert’s important 1923 publication, *Flora Between the River Darling and Broken Hill*, illustrates his interest in the emerging science, ecology.[31] Albert presented a detailed description of the various local plant communities, and their relationships with soil, climate, hydrology and aspect. The soil binding role of grasses was noted. Fungi, ferns, lichens, mistletoe and herb species were listed (Morris, A. 1923 pp.7-13).

Albert’s 1929 lecture, *How To Grow Gum Trees*, “stressed the fact that nothing can be better for planting than local trees…”, as they required very little water (Morris, A. 1929 p.135). The indigenous Australian tree species, “beautiful Murray red gum…”, or River Red Gum (*Eucalyptus rostrata* syn*. E. camaldulensis*), a local species, was particularly recommended for propagation and planting, as it grew well in a variety of environmental conditions (Morris, A. 1929 p.135).[32]

A 1936 Club lecture presented by Albert was titled *Ecology*.

In studying the plants in the field, we do not only study each plant as an individual, but its relation to others and their effect upon each other (Anon. “Our Plant Life” *Barrier Miner* p.4, 26 June 1936).

Explaining the ways in which plant communities differed in their species’ composition, density and structure, due to variations in aspect, elevation, soil quality and availability of moisture, Albert delivered the practical lesson to be learnt from these observations.

[30] An example of spontaneous natural regeneration.
[31] From approximately 1920, or even earlier, arid zone plant ecology was pioneered in Australia by Professor T G Osborn, Adelaide University, South Australia (Robin 2007 p.104-106). See next sub-section.
[32] By “local trees”, Albert would have been referring to local species, those that occurred naturally in the Broken Hill locality, such as River Red Gum, and quite possibly also to species that did not grow locally and occurred naturally in the arid and semi-arid west of New South Wales and similar regions of South Australia.

Men are to be sent abroad to obtain plants to combat erosion. We need to be very careful before introducing fresh plants – our own did the work well, before the advent of white men, and could do it again, if given a chance. The effect of alien plants upon vegetation needs to be studied seriously because of the possibility of adding to our troubles (Anon. "Our Plant Life" *Barrier Miner* p.4, 26 June 1936).

As well as pursuing his interests in botany, ecology and the management of erosion, Albert took on the task of enhancing the neglected amenity of Broken Hill, and developed urban landscaping projects. At the request of the Broken Hill Hospital management, in 1929 he and Margaret established a plantation of 800 trees[33] in the grounds of the hospital. The trees were propagated in the Morris's home nursery, and the species selected were suited to the soil and other environmental conditions of the site.[34] Broken Hill High School teacher and Assistant Secretary of the Barrier Field Naturalists Club, Thistle Yolette Harris, also worked on the project (Anon. "Trees for Hospital" *Barrier Miner*, p.2, 15 April 1929). Local schools and streets benefited from Albert and Margaret's landscaping work. By approximately 1930, Albert was recognised in Broken Hill, and further afield, as an authority on dry climate urban landscaping (Anon. "Planting Street Trees" *Barrier Miner* p.2, 28 July 1930; Ardill 2018).

This combination of home experimentation, formal botanical study, observation of natural ecosystems and urban landscaping work equipped Albert and Margaret with skills in botany, ecology, project management, soil conservation and environmental advocacy. These skills inspired and informed their future regeneration projects. Thistle Harris also graduated to further botanical and conservation exploits (Webb 2012).[35]

Professor T G Osborn and the Koonamore research reserve

[33] No longer in existence.
[34] Possibly species "of the Western District of New South Wales" (Anon. "Trees for Hospital" *Barrier Miner*, p.2, 15 April 1929).
[35] Better known as Thistle Stead AM, distinguished Australian botanist and conservationist. She married scientist and conservationist, David Stead, in 1951.

The Broken Hill conservationists' ideas on the revegetation of arid lands were quite likely influenced by some form of exposure to the work of botanist and plant ecologist, Professor Theodore G. Osborn (1887-1973). Commencing in 1926, Osborn conducted pioneering plant ecology research at the University of Adelaide's Koonamore Vegetation Reserve research facility, located approximately 320 kilometres to the north of Adelaide, on 400 hectares of eroded pastoral country (Robin 2007 pp.104-106). His work addressed the impacts of rabbits and overstocking on arid zone indigenous vegetation (Anon. 2016; Robertson 1988; Robin 2007, pp.105-106).

Osborn was particularly interested in the effects of overstocking on saltbushes and bluebushes (*Maireana* spp.), important livestock fodder plants that sheltered and stabilised soils. His research focused on "the return of the saltbush in denuded areas" and the conditions under which this occurred (Anon. "Grazing Problems" *Observer* p.5, 3 August 1929). Osborn believed that utilising a stock exclosure concept and harnessing natural regeneration displayed potential as a way of restoring saltbushes and bluebushes to degraded pastoral lands (Anon. "Grazing Problems" *Observer* p.5, 3 August 1929; Robin 2007 p.105).

There is a reasonable likelihood that Albert Morris was quite well informed about Osborn's research at Koonamore Reserve. Some years before the opening of the research facility, Albert had developed a correspondence relationship with Osborn when seeking plant identification advice from him (Morris, A. 1921b. p.39). Albert would have been interested in the subjects being investigated at the Reserve, and possibly the congenial Osborn forwarded details about the university's new research venture. The research facility is located approximately 200 kilometres to the south-west of Broken Hill, so maybe Albert and possibly Margaret Morris and Dr W. MacGillivray visited in a motor vehicle or by train, and had an opportunity to discuss shared botanical and ecological interests with Osborn and his research team.[36] Interestingly, on at least two occasions Albert collected plant specimens on sites quite near the Koonamore Reserve: Boolcoomatta pastoral station in 1926, and Koonamore pastoral station some time prior to October 1927 (Morris, A. n.d. 2 p.84; Black 1927 p.381).

[36] A visit is unconfirmed. The Koonamore research facility was operational in 2022.

Doctor W. MacGillivray was definitely aware by early 1928 of the Koonamore work and its scope, via the journal of the Council of Scientific and Industrial Research (hereafter C.S.I.R.)[37] (Anon. "The Dying Saltbush" *Barrier Miner* p.2, 3 January 1928). MacGillivray had continued to take an interest in the degradation of the regional ecosystems, and their remediation. Interviewed by the Broken Hill newspaper, *Barrier Miner*, in 1927, a year of extremely low rainfall,[38] he commented on the disappearance of Mulga and other indigenous tree and shrub species from the parched landscape, as starving sheep and rabbits destroyed any new growth that appeared. He advocated for the application of a stock exclosure concept to degraded country, and the harnessing of natural regeneration as a revegetation technique.

"Great blocks of land should be fenced off with rabbit-proof fences, and the rabbits inside that area, killed off, in order that the plants would be able to reproduce. A number of areas such as this could be introduced and the effect would soon be noticed. In any area protected from stock, the scrub soon comes into its own. A case in point is the South racecourse [Broken Hill], *where the scrub has increased prolifically since the stock has been kept away"* (Anon. "Rehabilitation Needed" *Barrier Miner* p.2, 26 September 1927).

Albert Morris would certainly have been aware of the broad character of the research that was being undertaken at Koonamore Reserve, and that it overlapped with his interest in restoring indigenous vegetation to overgrazed, eroded land. The Broken Hill conservationists would have been fortified to know that an academic researcher was also interested in this subject. Although not confirmed, quite possibly Osborn's research benefited from contact with Albert, as the latter was a skilled botanist, and had observed stock exclosure and its beneficial effect on the natural regeneration of local plant species since at least 1921.

Osborn's research had important implications for the remediation of eroded pastoral lands and their subsequent management, but he was not an erosion researcher, and was

[37] Australian federal government agency that conducted a wide range of scientific research.
[38] Barely 100 millimetres, or approximately 40% of the average annual rainfall of 260 millimetres (Bureau of Meteorology).

not conducting research into the management of sand-drifts and other specific erosion problems. As outlined, government sponsored research of this kind does not appear to have commenced in Australia until the mid-1930s (see section 4). However, Osborn did publicise his interest in the application of the Koonamore research findings to broad-scale revegetation projects (Anon. "Grazing Problems" *Observer* p.5, 3 August 1929).

From approximately 1930, a number of South Australian pastoralists were successfully applying a stock exclosure concept and harnessing natural regeneration to restore indigenous vegetation and remediate erosion on their stations. Quite possibly the first of their kind to be conducted in Australia, there is a high likelihood that the projects were inspired by Osborn's Koonamore research (Ardill 2022, pp.10-11).

Stock exclosure involved the fencing of vegetatively degraded sites to exclude livestock and rabbits. This protective measure encouraged natural regeneration: growth to maturity of seedlings produced by germination of naturally distributed indigenous plant seed.[39] Overgrazed rootstock of indigenous plants would also have naturally regenerated. By 1936, this revegetation technique was successfully stabilising sand-drifts, of an unspecified size and extent, on South Australian pastoral stations (Ardill, 2022, p.20).

Additionally, and due to the influence of Koonamore and C.S.I.R. researcher, Terrence Paltridge, stock exclosure and furrowing techniques were being used on South Australian stations to manage scalds and their hardened surfaces (Ardill 2022, p.27).[40] By 1935 furrowing had encouraged natural regeneration of indigenous grasses on previously bare ground.[41]

[39] As outlined, also referred to as spontaneous natural regeneration. Wind plays a prominent role in distributing the seed of many plant species. See section 7 *Revegetation of the regeneration reserves*.
[40] Scald: severely wind eroded land stripped of topsoil, largely or completely denuded of indigenous vegetation and resistant to moisture penetration. Natural regeneration severely compromised or impossible without active remediation.
[41] The practice of furrowing to encourage natural regeneration can be categorised as facilitated natural regeneration: "the approach and practice of fostering natural regeneration (in situ) and recolonisation after actively removing ecological impediments and reinstating appropriate abiotic and biotic states…" (SERA 2021 pp.30-31). The furrowing of scalds amends abiotic conditions by creating sheltering rows of broken ground, or furrows, where seed, moisture and plant litter can collect, enabling germination of naturally distributed seed and healthy growth of seedlings. Note: where seed is scattered in furrows by humans (direct seeding), resultant plant recruitment is not considered to be natural regeneration.

For the first time in the history of salt-bush grazing there is concrete evidence to show that drift can be stopped and the country re-vegetated… (Paltridge in Ardill, 2022 pp. 27-28).

The stock exclosure and natural regeneration work conducted by pastoralists in South Australia was extensively reported in the *Barrier Miner* on 26 August 1936, and Albert Morris would certainly have read the article (Anon. "Erosion of Soil" *Barrier Miner* p.4, 26 August 1936). Quite possibly, he had already read of the work in the occasional brief reports that appeared in Adelaide's newspapers from approximately 1933, but this is unconfirmed.

Conservation values

Albert and Margaret Morris's environmental studies and interests were not confined to the theoretical and technical aspects of botany, plant ecology and erosion management. They deeply admired the natural landforms of the arid west, and their striking aesthetic qualities. After a September 1921 trip to Mount Robe, Albert recorded that the panorama was wonderful: "beautiful vistas of blue hills stretch away as far as the eye can see" (Morris, A. 1921c. p.26). In a 1924 lecture he referred to "the beauty we have at our own door…the scenery of our own district has a beauty of its own" (Morris, A. 1924. p.129).

As well as unique plant species and distinctive plains and ranges, the arid landscapes of western New South Wales were home to a diverse range of indigenous animal species. Albert's interest in these species developed into a deep concern for their conservation.

Let me add a plea that all possible measures be exerted to preserve for future generations the wonderful plants, birds and animals it is our privilege to see now, because Australia is unique as regards these things (Morris, A. n.d.3 p.22).

Albert recognised the threats that Australia's indigenous plant and animal species faced from the pastoral industry and introduced animal species, such as sheep and rabbits, and

expressed his concern about the low level of conservation management being exercised in Australia. Writing in 1923, he lamented the disappearance of mile-long flocks of Harlequin Pigeons (*Phaps histrionic*) from the plains, their habitat and food supply destroyed by sheep, and noted the devastating impact of foxes on the Bush Curlew (*Burhinus grallarius*) and Black Swan (*Cygnus atratus*) (Morris, A. "The Flora between the River Darling and Broken Hill" 1923 p.64 cited pp.35-37 in Environment NSW [2002]). Treatment of the majestic Wedge-tailed Eagle (*Aquila audax*) was another source of distress. This "largest and finest of our raptorial birds kills a few lambs … and in consequence is poisoned, trapped, and shot by the man on the land" (Morris, A. "The Flora between the River Darling and Broken Hill" 1923 p.64 cited p.35 in Environment NSW [2002]). Margaret Morris publicised the need to conserve avifauna habitat (Anon. "Regeneration Areas" *Barrier Miner* p.7, 30 September 1939).

Albert formed ideas on why indigenous animal species were being driven to extinction, and how recovery of vegetation could help to reverse this process.

Some of the smaller marsupial mice are to be found by a zealous researcher, but will, before long, be gone forever. The causes of extinction of these species are to be found in the destruction of all natural shelter in the shape of underscrub and herbage by overstocking the country with sheep, followed by the rabbit invasion and later, domestic cats and foxes (Morris, A. in "The Flora between the River Darling and Broken Hill" 1923 pp.62-63 cited p.35 in Environment NSW [2002]).

As a young man, Albert became interested in the indigenous vegetation of far west New South Wales. By the early 1920s he was acquiring considerable skills as a botanist, and was learning about ecology. Throughout the 1920s he developed informed perspectives on the features and conservation of the arid ecosystems: an appreciation of their biodiversity, functioning and intrinsic beauty; alarm at the degrading impacts of overstocking and introduced animal species; concern about the adverse amenity outcomes of vegetation stripping around Broken Hill; interest in reversing the damage caused by wind erosion. Albert also perceived the need for field naturalists to publicise the dire long-term ecological implications of overstocking, and engage in environmental advocacy.

Albert dated his interest in the establishment of a Broken Hill regeneration area to the early 1920s (Morris, A. 1938 p.46). Field notes from that period reveal his awareness that arid zone vegetation had capacity to naturally regenerate, given the presence of topsoil, naturally distributed seed, rain and protection from stock (Morris, A. 1921b. p.33). An emerging interest in ecology had alerted Albert to the vital role played by vegetation in stabilising the regional soils (Morris, A. 1923 pp.7-13).

However, a range of practical restoration issues required further investigation before a regeneration scheme could be effectively implemented: loss of indigenous vegetation and reduced natural distribution of seed; depletion of soil seed-banks; uneven natural distribution of seed; climatic uncertainty and its influence on plant regeneration; the challenge of remediating scalds and large sand-drifts. Field trials, commenced in 1935, and observations of eroded and non-eroded land proved to be effective means of exploring these issues.

Broken Hill, sand-drift and dust

From time immemorial the Wilyakali community utilised and conserved homelands in localities referred to today as Broken Hill and the Barrier Ranges, far western New South Wales. The local vegetation was largely comprised of Gibber Chenopod Shrublands and Stony Desert Mulga Shrublands (Keith 2004 p.287, p.293). Numerous species of grasses, forbs, saltbushes and bluebushes could be found on plains, and prominent in places were small trees, such as Black Oak (*Casuarina pauper*)[42] and Mulga, the latter often in dense groves; tree, Curly Mallee (*Eucalyptus gillii*) grew on rocky hills and ranges (Keith 2004; Beadle 1948, p.219) (Illustrations 2, 9 and 15).

As discussed, dispossession of the Wilyakali community commenced in the 1860s. Pastoralists seized waterholes and grazed flocks of sheep and cattle. Livestock and feral

[42] Also known as Belah.

animals such as goats and rabbits consumed grasses, forbs, shrubs and Mulga. Compacted by hard-hoofed livestock, exposed soils resisted penetration by rainfall. Very severe wind and water erosion resulted in extensive loss of soil throughout the Barrier Ranges region (Beadle 1948, p.219).

Illustration 2. The Pinnacles near Broken Hill and local vegetation ca.1890[43] *Source: SLSA B73354-5*

The discovery of valuable mineral ores in 1883 led to the establishment of the settlement, Broken Hill, and rapid development of a mining industry (Illustration 3).[44] Broken Hill became an important source of mineral wealth, and a major New South Wales city. The population measured 27,000 people in 1930 (Commonwealth Bureau of Census and Statistics. 1938. p.320).

[43] The Pinnacles area was "devoid of vegetation" by 1936, and probably quite earlier (Anon. "Sand Drift Ravages" *Barrier Miner* p.3, 21 April 1936).

[44] Vast deposits of silver, lead and zinc were mined in Broken Hill.

For many decades, little attention was paid in the city to the immediate and long-term consequences of degrading mining industry practices and their impacts, in particular, timber cutting and resultant soil erosion. No consideration was given to how timber, water, soil and other limited natural resources might be more efficiently managed and conserved. A notable exception was warden, Wyman Brown, who succeeded in protecting "the gums along the creek banks" and "was instrumental in saving some of these magnificent trees" (Morris, M. 1939 p.44).[45]

Illustration 3. Broken Hill and mines 1890 *Source: National Library Australia 8807/51*

Possibly as early as 1890 and certainly by approximately 1900 the city's mining industry, businesses and residents had consumed all readily available timber resources, particularly Mulga; overstocking had destroyed the vegetation of the public common[46]

[45] Quite likely River Red Gum.

[46] Common: non-urban lands dedicated to public use, primarily livestock grazing and recreation. Created as a series of reserves in 1886, 1888 and 1895. Encircling Broken Hill, the common originally consisted of approximately 11,000 hectares; in 2003 it consisted of approximately 8700 hectares (Corkery P/L 2003 p. C-4). See also Pearce (2019) p.97.

(Solomon 1988; Beadle 1948, p.219) (Illustration 4). After rain a sparse cover of grasses and forbs grew on the common but was rapidly eaten by livestock, goats and rabbits (Illustration 17).

Widespread loss of indigenous vegetation around Broken Hill and throughout the far west left soils exposed to regular southerly and westerly winds. Strong winds generated blinding dust storms, particularly during dry periods. Broken Hill's first recorded dust storm occurred in 1886, and buildings, mining industry equipment and public infrastructure were damaged (Solomon 1988) (Illustration 5). Worse was to come.

Illustration 4. Cable Hill adjacent public common Broken Hill 1915 Source: SLSA 280/1/27/108

From the late 1920s until 1946, lengthy periods of below average rainfall were regularly experienced across the arid and semi-arid regions of south-eastern Australia (Bureau of Meteorology). The dry conditions impeded recovery of vegetation. Financially stricken pastoralists overstocked their stations. Additional loss of vegetation led to a widespread deterioration in the dust and erosion problems of Broken Hill and the south-east quarter of the continent, as soils stripped of protective plant cover were ravaged by winds (Anon. "District Erosion Problem" *Barrier Miner* p.5, 30 April 1936; Sauter 2017).

Illustration 5. Broken Hill dust storm approximately 1907 *Source: SLSA B54756/18*

Large sand-drifts comprised of wind-blown sand and topsoil overwhelmed homes in southern and western Broken Hill.

At Railway Town the force of the wind concentrates down a scoured hollow, and during a dust storm, the houses are invaded. Many homes in Wills street have been deserted and pulled down…… Two racecourses have been silted out of existence…… A seven-foot fence around the cemetery has been broken down by the accumulations…. Even middle-aged residents of the town can remember when the commons adjacent to the city were fertile and covered with tree and plant growth. Now the entire surface soil has been scooped away by the wind, leaving a bare, rubbly plain, on which a few thin cows are grazing (Anon. "Sand Drifts" *Sydney Morning Herald* p.13, 22 April 1936).

Australia was not the only continent to be afflicted by serious erosion in the 1930s. North America and parts of Africa experienced widespread wind and water erosion (Sauter 2017 pp.152-155). The governments of affected countries and colonies came under intense pressure to combat the problem and its environmental, social and economic consequences.

Illustration 6. Nebraska shelterbelts 1946[47] *Source: Forest History Society, Durham, NC*

Perhaps the best known of the international attempts to manage wind erosion in the 1930s were those undertaken in the United States of America (hereafter USA). The tree planting projects initiated by the federal government to stabilise vast expanses of eroded land were motivated by a range of considerations, including the need to conserve unique

[47] Full caption: *A 10-row, 1/2-mile-long shelterbelt planted in 1940 on the Dorothy A. Jones farm 1 mile northeast of Goehner, Seward County, Nebraska. In the background, another 1/2-mile shelterbelt also on Dorothy A. Jones farm, planted in 1940 and jogging around farmstead* (Forest History Society n.d.*).*

natural features and beauty spots, and replenish resources required by industries such as tourism and agriculture.

A major project focused on the Great Plains prairies of states North Dakota, South Dakota, Nebraska, Kansas, Oklahoma and Texas. The prairies had been largely cleared of their grasslands and converted to farmland by 1900. A prolonged ca.1930 drought resulted in severe wind erosion of exposed soils and fierce dust storms, or "black blizzards", as they were called (Reed 2017). Homes were lost, families encountered economic ruin and land was destroyed. Responding, in 1935 President of the USA, Franklin D. Roosevelt, approved an intensive tree planting program. Known as the "Great Wall of Trees" and featuring a range of both local and introduced species, approximately 217 million trees were planted in dense groves made up of multiple rows, with the intention of sheltering exposed soils and farms (Reed 2017; McKee 2018). Each expanse of trees was referred to as a shelterbelt (Illustration 6).

Concluded in 1942, the program is believed to have benefited farmers, and habitat for wildlife was created (McKee 2018; Reed 2017). However, whether groves of trees should be established throughout former indigenous grasslands was debated at the time by foresters (Karle, S. in Reed 2017). Quite possibly it was better agricultural practices, including the planting of grasses, that most contributed to improved wind erosion management on the plains (Karle, S. in Reed 2017).[48]

The shelterbelt project was funded by Roosevelt's "New Deal" program (Reed 2017). The program was designed to stimulate the economy of the USA and relieve the high unemployment generated by the international Great Depression. In addition to the Great Plains shelterbelt project, a series of New Deal tree planting and environmental infrastructure projects saw the Civilian Conservation Corp plant three billion trees across the USA between 1933 and 1942. Although some of the tree planting projects did pursue conservation objectives, many of the projects were commercially focused and paid little attention to environmental considerations (Neatrour 2015).

[48] Also see Sauter (2017) p.199 on shelterbelts.

The media coverage of the devastating social and economic impacts brought about by the Great Plains erosion crisis in the USA made a deep impression on Australian scientists, conservationists and society (Sauter 2017 pp.229-231). Albert Morris and his field naturalist colleagues were aware of the wind erosion problems and tree planting programs in the USA. However, the erosion management strategy that they devised had its origins in observations of the regional and local ecosystems. The strategy targeted the revival of indigenous vegetation. To achieve this, the Broken Hill conservationists utilised a revegetation technique that featured the application of a stock exclosure concept and the harnessing of natural regeneration. As the historical documentation to be presented readily reveals, tree planting played quite a minor role in the revegetation process.

The New South Wales Erosion Committee at Broken Hill: 1935–1936

Responding to the deteriorating erosion situation that afflicted much of New South Wales, in 1933 the state government of Premier, Bertram Stevens, established the New South Wales Erosion Committee. The Committee was authorised to tour the state, take evidence on regional vegetation and soil conditions and report back to the government with recommendations on how wind and water erosion might be managed.

Campaign Begins: First Shots Fired in War on Erosion.

*The departmental committee on erosion, which is in touch with similar bodies and bureaus in other parts of the world, is investigating all aspects of the erosion problem (*Anon. “Campaign Begins” *Farmer and Settler* Sydney p.3, 8 March 1934*).*

a. Environmental advocacy: December 1935

On 2 December 1935 New South Wales Government Minister for Forests, Roy Vincent, announced that the Erosion Committee would travel to Broken Hill in 1936 to inspect

local and regional erosion and receive submissions from interested parties (Anon. "Erosion Danger" *Sydney Morning Herald* p.8, 3 December 1935). Barrier Field Naturalists Club members Albert Morris, medical practitioner Dr Ian MacGillivray[49] and Edmund Burnett Dow were keen to meet the Committee.

There is a strong likelihood that Vincent's announcement represented a response to earlier conservation advocacy undertaken by the Club. "The Field Naturalists Club has been the prime mover in drawing attention to the [eroded] state of the district" (Anon. "Soil Erosion Problem" *Barrier Miner* p.1, December 4 1935).

Prior to Vincent's announcement, in approximately October 1935 the Club had written to his ministerial colleague, the New South Wales Minister for Lands, and advised him of the Club's preferred regional and local erosion management strategies (Barrier Field Naturalists Club. n.d.; Anon. "Soil Erosion Problem" *Barrier Miner* p.1, 4 December 1935). The strategies had been prepared by a Club sub-committee comprised of Albert Morris, Dr I. MacGillivray and Edmund Dow (Barrier Field Naturalists Club. n.d.). The Pastoralists Association of the West Darling was supportive of the strategies.

To manage the regional erosion problem, the Club's erosion management strategies called for the protection of dead wood, as well as "green" trees, those alive.

For some months the Barrier Field Naturalists' Club has been considering the advisability of protesting to the Government about the wholesale cutting of timber in certain areas west of the Darling, and after deliberating, wish to suggest that the existing laws be rigorously enforced to prevent further cutting of green timber, especially mulga.

The interior is subject to strong persistent winds, and the destruction of the timber and the removal of dead wood lying upon the ground make it possible for the sand to drift and thus destroy the economic value of the land from a pastoral point of view, and if unchecked will in a very short time render very large areas quite useless (Anon.

[49] As mentioned, Dr I. MacGillivray, a talented naturalist, was the son of Doctor W. MacGillivray.

"Reducing the Dust Nuisance" *Barrier Miner* p.3, 7 December 1935; Barrier Field Naturalists Club. n.d.).

As well as checking sand-drifts and acting as a soil stabiliser, dead wood also served as a collector of moisture and wind-blown indigenous plant seed. These vital ecological roles encouraged natural regeneration, or, as Albert Morris explained, dead wood "would block the sand and be a place for small plants to spring up" (Anon. "Soil Erosion Problem" *Barrier Miner* p.1, 4 December 1935).

To manage local erosion, the Club advocated for the fencing of Broken Hill's degraded perimeters, essentially a large portion of the public common, to allow natural regeneration of the local vegetation. The proposed fenced area extended over nearly 2000 hectares.[50]

We believe the sand menace around Broken Hill could in time be somewhat checked if an area, say a mile wide was fenced to prevent access of stock, and natural regeneration would result, which could be assisted by our society by scattering native seeds, such as various kinds of salt bush, shrubs and trees indigenous to this part of the country. The worst areas near the town are on the south, west and north-west side (Anon. "Reducing the Dust Nuisance" *Barrier Miner* p.3, 7 December 1935; Barrier Field Naturalists Club. n.d.).

The Club's proposal evinced confidence that natural regeneration of local vegetation would occur around the degraded perimeters of Broken Hill, once livestock had been excluded by fencing.[51] However, the Club's prediction of how effectively the local "sand

[50] As proposed by the Club, the fenced area was to be one-mile-wide by approximately 7.5 miles long (as it extended along the south, west and north-west of the city), which is 1940 hectares (4800 acres).

[51] The Barrier Miner article in which the Club's erosion remediation proposals were reported referred to the Club "being guided" by a "shelter belt project" implemented in the USA and involving the planting of millions of shrubs and trees (Anon. "Reducing the Dust Nuisance" *Barrier Miner* p.3, 7 December 1935). The article's description of the shelterbelt project matched the Great Plains shelterbelt project initiated by President Roosevelt in 1935 (Illustration 6). According to the article, the USA shelterbelt project "involved a strip of land a thousand miles wide..." designed to protect the country "from winds and erosion of the surface soil, regenerate the grass…" (Anon. "Reducing the Dust Nuisance" *Barrier Miner* p.3, 7 December 1935). Quite likely, it was these latter aspects of the Great Plains shelterbelt project that interested Albert Morris: the effectiveness of vegetation in reducing wind erosion, and the regeneration of grasses. No suggestion was made in the Barrier Miner article (7 December 1935) or by the Club and its sub-committee that shelterbelts

menace" would be managed, following revegetation of the common, was more cautiously worded: "in time" the sand would be "somewhat checked".

Club Secretary, Albert Morris, suggested that small scale planting of shrubs and trees could also be undertaken within the proposed fenced area. Possibly he believed that the planting of sand-drift tolerant species, such as Old Man Saltbush, was the only way to stabilise large drifts. Planting schemes might also encourage community participation in the project.

> *The suggestion of the club was that an area on the common say a mile wide should be fenced so that stock could not get in and that it be allowed to regerminate. Interested persons could plant saltbush and trees and native shrubs in the area to try and stop the sand moving into the town. After all, it is the vegetation which holds the sand* (Anon. "Soil Erosion Problem" *Barrier Miner* p.1, 4 December 1935).

With the visit of the Erosion Committee announced, Albert Morris revealed in the *Barrier Miner* that he would forward to Minister Vincent details of the Club's regional timber conservation initiatives and local revegetation proposals for the perimeters of Broken Hill. Albert also informed the editor of the *Barrier Miner* and the Broken Hill community that Club members would have some important suggestions on erosion management to offer the Committee when it visited the city (Anon. "Soil Erosion Problem" *Barrier Miner* p.1, 4 December 1935).

b. Submissions to the New South Wales Erosion Committee: April 1936

The members of the Erosion Committee arrived in Broken Hill on 21 April 1936 and returned to Sydney on 28 April 1936. They spent a busy week touring the city and regions, inspecting field examples of overstocking, loss of vegetation, wind erosion,

should be established around Broken Hill to revegetate bare soils and manage erosion. Note that the Great Plains shelterbelt localities featured deep, rich soils supportive of intensive agriculture. Rainfall exceeded that of arid Broken Hill.

attempts at erosion remediation and also relatively undegraded areas.[52] They met with representatives of Broken Hill Council, the Pastoralists Association, regional public officials and administrators, commercial and community groups, residents and pastoralists.

In their formal submissions Albert Morris, Dr I. MacGillivray and Edmund Dow were keen to address regional vegetation and erosion issues, as well as the local Broken Hill problems. Reflecting this regional interest, MacGillivray accompanied the committee members on one of their arduous inspection tours, a circuit of approximately 600 kilometres on unsealed roads that took in the township of Wentworth on the Murray River, south of Broken Hill (Anon. "Erosion Can Be Checked" *Barrier Miner* p.1, 23 April 1936).

Edmund Dow attributed the cause of much of the regional erosion to the destruction of indigenous vegetation by overstocking in good seasons (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936). Soils stripped of vegetation were exposed to wind and water erosion. Also, due to regular dry periods the vegetation was often slow to recover from overstocking, and this slow recovery left soils exposed to the wind for long periods of time.[53] He emphasised that vegetation loss was leading to the siltation of the local watercourses. Dow urged pastoralists to preserve existing indigenous vegetation, to allow natural regeneration during "good seasons" (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936). Possibly driven by the rapidly mounting need for a response to the deteriorating erosion situation, Dow described the New Deal tree planting projects in the USA, underway since 1933.[54] However, the newspaper report suggests that Dow did not provide details about how or where a tree planting program might be conducted in Australia, or locally (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936).

[52] Towards "Mootwingee" (Mutawintji National Park), there were "few signs of scalding, sand drift and erosion" (Anon. "Erosion Can be Checked" *Barrier Miner* p1. 23 April 1936).

[53] In a 1938 newspaper article Dow acknowledged the heavy toll that settler overstocking had taken on the country, to the point where it was "hard to visualise it in its virgin state before the advent of the pastoralists" (Dow, E.B. 1938).

[54] Dow did not discuss the rainfall totals of the regions in which the USA "New Deal" tree planting projects were conducted. Quite likely, they were higher than those of arid Broken Hill, as was the case with the 1935 Great Plains shelterbelt project.

Doctor Ian MacGillivray utilised climate data and pastoral industry stocking rate records to demonstrate that the indigenous vegetation of western New South Wales had been decimated by overstocking, and also by rabbits. As recently as 1927 and 1929, two years of very low rainfall, "stock was kept on the country until practically every vestige of feed had been eaten out" (Anon. "District Erosion Problem" *Barrier Miner* p.5, 30 April 1936).

MacGillivray favoured natural regeneration as an effective means of restoring indigenous vegetation. Planting might assist with specific erosion problems. He offered detailed advice on how moderately wind eroded land and more serious problems like large sand-drifts and hardened areas of clay (scalds) could be remediated.

Reafforestation [sic] [planting trees] … *is out of the question on an extensive scale except possibly in special areas as in the immediate neighbourhood of Broken Hill, to try and stop the drift that is rapidly invading the southern areas of the town.*

The country would produce a great deal of natural reafforestation [sic] [natural regeneration] *provided that it was rested from sheep and rabbits during good seasons. Ploughing or scarifying the bare areas of clayey ground to form a bed for the seeds to germinate would greatly help in certain localities.*

The one outstanding remedy that can be carried out is the prevention of the cutting of green timber and the prevention of the removal of dead timber. No new timber is growing and it is necessary to immediately conserve all that is left. In some areas the dead timber lying on the ground is helping to arrest the drift as well as forming a protection for seedlings (Anon. "District Erosion Problem" *Barrier Miner* p.5, 30 April 1936).

To support these measures, MacGillivray advocated for the appointment of a forestry officer, and called for government action to control stocking rates on stations.

MacGillivray had observed dead timber on the ground controlling the drift of soil and sand, and was confident about the effectiveness of dead timber as a soil stabiliser.

Possibly he was less confident that reforestation,[55] "to try and stop the drift…", would prove to be completely effective: he did not refer to local reforestation field trials, and some sand-drifts in south Broken Hill were capable of destroying houses (Anon. "Sand Drift Ravages" *Barrier Miner* p.3, 21 April 1936).

MacGillivray revealed that overstocking and loss of vegetation had resulted in the destruction of valuable soil seed beds (or seed banks). "The loss of the seed beds is due, on the one hand, to the drifting of the country, and, on the other, to the eating of the seeds by the sheep and rabbits" (Anon. "District Erosion Problem" *Barrier Miner* p.5, 30 April 1936). In areas where seed beds had been degraded or destroyed, capacity for natural regeneration was likely to be limited, or virtually non-existent.[56]

Albert Morris's submission focused on specific revegetation techniques. He described three techniques that would encourage natural regeneration and vegetation recovery on pastoral stations, and improve soil cover.

> *It is suggested that each station fence a small area (preferably of several acres) to prevent access of stock, situated in a central portion of the run, where native fodder plants can grow undisturbed. This would provide a plentiful supply of seed, which would blow into surrounding areas, and would help after rain falls to cover the ground quickly. This project could be helped by seed scattering and by judicious planting at the right times, with local plants of all classes. Many of the fodder plants have seeds which are distributed by wind, such as most species of saltbush, grass etc Wind swept regions, hardened into claypans, can be ploughed at right angles to the prevailing wind of the particular district. The ridges thus set up will block drift sand containing seeds, and after rain good germination results. If stock be kept off for a period, the otherwise useless area can be brought again into production…*(Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936). [57]

[55] Planting of trees.
[56] Seed naturally distributed after the destruction of the seed beds, such as grass seed blown by wind, had potential to contribute to natural regeneration.
[57] "Several acres" would have meant approximately 3 acres or 1.2 hectares.

Albert's proposal to establish fenced blocks of indigenous vegetation on pastoral stations and encourage natural regeneration quite likely reflected an intention to improve vegetation density on non-eroded land and prevent erosion from developing. He may have also aspired to the revegetation of land that was already eroded, in an attempt to limit soil loss.

Aware that indigenous vegetation and seed beds had been lost on overstocked stations, Albert supported planting of appropriate species and seed scattering within protected fenced areas, to re-establish vegetation. In time, natural distribution of seed would improve, creating opportunities for recovery of vegetation and seed beds on stations.[58] Of course, Albert knew that restoring vegetation would enhance indigenous animal species' habitat.

Albert's advocacy for ploughing (or furrowing), to "block drift sand containing seeds", encourage natural regeneration and remediate scalds was supported by two field trials (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936).

> *Mr Langford of K Tank* [a pastoral property located 25 kilometres to the east of Broken Hill] *ploughed an area of such ground* [a hardened claypan, or scald] *in February 1935. Very little rain fell until about January 1, 1936, and none has fallen since* [as at 5 April 1936]*. Quite a good growth has resulted, and is now still in a flourishing condition due to the fact that the broken soil with depressions, held the water, which previously always ran off* (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936). [59]

The ploughed area consisted of approximately 400 acres (160 hectares), and had previously been "absolutely destitute of plant life" (Anon. "Soil Erosion" *Sydney Morning Herald* p.7, 24 April 1936). Mr Brougham, of Yalcowinna pastoral property, had conducted a similar trial (Anon. "Soil Erosion" *Sydney Morning Herald* p.7. 24 April 1936).

[58] As outlined, seed scattering (or direct seeding or assisted seed dispersal) and planting involve human agency and resultant recovery of vegetation is not categorised as natural regeneration.
[59] Broken Hill recorded 47 millimetres of rain in January 1936, a very good total, and rainfall records strongly suggest that a similar amount fell throughout the immediate region (Bureau of Meteorology).

Albert elaborated on the ecological role of the colonising herbs, saltbushes (annual and short-lived perennial species) and bluebushes (annual and perennial species) that naturally regenerated in the ploughed area (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936).[60] Crucially, they sheltered emerging perennial plants.

> *The condition of all these* [colonising] *plants was healthy and they had seeded freely, the ground under the plants being thick with ripe seeds. The following season would be plentiful with these early colonisers, and would shelter the young plants of shrubs, such as old man salt bush, cassias, wattles, and the like…* (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936). [61]

Although not specifically stated, there is a strong likelihood that grazing livestock had been excluded from the ploughed area by fencing, to encourage natural regeneration. Albert supported the planting of trees in the ploughed area, once smaller indigenous plants were well established (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936).

Albert quite possibly played a prominent role in planning and monitoring the two field trials, although this is not stated in the historical documentation. Throughout the trials he carefully recorded his observations and climatic, weed and botanical data, and was apparently responsible for reporting these observations and data to the Erosion Committee. The land management techniques and concepts tested were similar to those that Albert had been investigating for at least 15 years: stock exclosure; natural regeneration; utilising seed natural dispersal, seed viability and soil seed banks; plant succession; weed management. Station owners Langford and Brougham were also keen participants in the trials.

[60] The recovery of the colonising plants in the furrowed area was quite probably an example of facilitated natural regeneration. Apparently, the seed from which the colonising plants germinated was naturally distributed. There is no mention of seed scattering by humans. As outlined, recovery of vegetation by furrowing to encourage germination of naturally distributed seed is categorised as facilitated natural regeneration.

[61] Morris planned to hand scatter on the ploughed area the seed of long-lived perennial species such as Old Man Saltbush, as he must have believed that natural distribution of the seed of these species had not occurred, and was not possible.

The ploughing field trials would appear to have been significantly pioneering, as they were believed to be the first of their kind to be undertaken in the region (Anon. "Soil Erosion", *Sydney Morning Herald* p.7, 24 April 1936). The New South Wales Soil Conservation Service, established in 1938, developed a post-Second World War interest in similar experiments: assisted seed dispersal, grazing management, and contour, spiral and checkerboard furrowing (Green 1989; Ardill 2022, pp.48-56) (see analysis of Soil Conservation Service work in section 7).

Rainfall in the arid regions is highly variable, and long periods of below average rainfall and drought are normal events (Bureau of Meteorology). However, good rainfall seasons do occur. Albert knew that naturally occurring soil enrichers would foster root development (and help retain moisture) and assist plants to survive during dry periods. He understood that the occurrence of good seasons had to be anticipated and then fully exploited, as rainfall promoted germination of naturally distributed seed and vigorous plant growth (natural regeneration).

> *The value of the leaves of dead annuals, together with the dead wood of shrubs and trees, must not be overlooked both as sand binders, and enrichers of the soil…*
>
> *The country has a wonderful way of recovering in a good season, and it is in the good seasons that such things as fencing small areas to be kept free from stock to provide seeds, etc., should be done, and thus help the country against the bad years* (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936). [62]

Albert's thoughts on how indigenous vegetation might be restored to the degraded perimeters of Broken Hill and throughout regional western New South Wales were well developed by May 1936, as demonstrated in his submission to the Erosion Committee. To solve the revegetation challenge, he planned to utilise a stock exclosure concept, and harness the ability of arid zone indigenous vegetation to naturally regenerate. Maximum use would be made of residual plants and rootstocks, natural distribution of seed, soil seedbank, litter enriched soil and the good periods of rainfall that did occur, despite the

[62] "Several acres" would have meant approximately 3 acres or 1.2 hectares.

arid climate. To support this primary mode of revegetation, he recommended the use of "seed scattering" and "judicious planting…with local plants of all classes".

The historical documentation reveals that by May 1936, Albert and his conservation colleagues had settled on a specific technique, furrowing (or ploughing), to remediate scalded land. The furrows encouraged natural regeneration. Field trials had revealed that natural regeneration resulted in stabilisation of scalds and their drifting sands. Where naturally distributed seed was not present, planting and seed scattering would be used.

Whether stabilisation of large sand-drifts could be achieved by natural regeneration quite possibly remained an unsettled question. Albert, of course, had conducted home experiments with a range of plant species to test their effectiveness as stabilisers of sand-drifts, and had concluded that Old Man Saltbush, when planted, was best suited to this task. But would plants of Old Man Saltbush naturally regenerate on the large, mobile sand-drifts that had formed in sections of the common highly exposed to wind? A contingency plan was required. As Albert had intimated in December 1935, it might be necessary to plant saltbushes and other appropriate shrubs and trees among the large drifts.

Well informed by botanical and ecological knowledge, comparative studies involving eroded and uneroded expanses of land, observations of degrading processes and scald remediation field trials, the Broken Hill field naturalists had developed a number of revegetation and soil conservation techniques by 1936. They now needed opportunities to apply their ideas to eroded land and actual restoration projects, and Albert Morris wasted no time in creating them.

……

3. Plantation projects: 1936–38

Introduction: plantation planting projects, natural regeneration projects

From 1936, until serious illness incapacitated him in October 1938, Albert Morris, in an honorary capacity, advised on and was closely involved with the concurrent development of four prominent revegetation projects in Broken Hill: two tree plantation projects, that focused on the planting of local and non-local dry climate tolerant tree species in dense clusters on the leasehold of a mining company; two natural regeneration projects (including the Broken Hill regeneration area project), that in contrast to the two plantation projects, targeted the restoration of the local vegetation, by utilising a stock exclosure concept, and harnessing natural regeneration (see section 7: *Revegetation of the regeneration reserves*). This difference in revegetation objectives and techniques markedly distinguished the regeneration projects from the plantation projects. Albert Morris was actively involved in the initiation of the two regeneration projects.

The two tree plantation projects are presented in this section of the article. This presentation contributes to an understanding of how construction of the initial reserves of the Broken Hill regeneration area project came to be approved and financed. Detailed descriptions of the two regeneration projects commence in section 4 of this article.

The two tree plantation projects prioritised the achievement of objectives relating to mining industry amenity; ecological benefits also arose. The first plantation project, Plantation No.1 (the first of the four revegetation projects), involved the dense planting of trees in an irrigated, nine hectares fenced enclosure that was designed to act as a wind-break for a new mine complex (Morris, A. 1938 p.44). The project shared revegetation features with the shelterbelts established from 1935 in the prairie states of the USA. Given his interest in the conservation of local plants and animals, it is highly likely that Albert Morris anticipated that at least some degree of ecological functioning could be recovered on the severely degraded site.

The second of the two tree planting projects (the second of the four revegetation projects), an additional tree plantation, involved landscaping the new mine complex. Development of this plantation appears to have commenced in 1937 (Anon. "Plant Regeneration" p.14, *Barrier Miner* 11 December 1937). Referred to here as Plantation No. 2*,* the work entailed widespread planting of dense groves of trees.[63] The principal objective was to improve amenity on a mining company's leasehold. Quite likely, Albert anticipated that at least some degree of ecological functioning could be recovered on the degraded site.

Planning for the first regeneration project (the third of the four revegetation projects) commenced in May 1936. Referred to in this article as the reservoirs regeneration project, the work involved two separate, elevated sites of public land that covered a total area of approximately thirty hectares and accommodated water storage infrastructure. Quite likely, an aspiration to recover substantial levels of ecological functioning was exercised.[64] Achieving resident and city amenity outcomes was another likely aspiration. Fencing to exclude livestock and rabbits was erected around the sites in 1939, but little else is known about the completed project.

The second regeneration project (the fourth revegetation project) featured the development of a set of fenced regeneration reserves, between September 1936 and February 1937. Primarily located on the public common, the reserves covered an area of approximately 600 hectares. These reserves proved to be the first in a series of fenced reserves that by 1958 encircled Broken Hill and are now referred to as the Broken Hill regeneration area. An aspiration to recover substantial and, quite possibly, full levels of ecological functioning was exercised.[65] A further aspiration was the enhancement of resident and city amenity, by stabilising local sand-drifts and reducing dust. This

[63] There were at least three distinct groves of trees, quite some metres apart. Each grove could be regarded as a single plantation.

[64] Functioning as measured against a comparable reference ecosystem, comprised of actual and/or conceptual components (see SERA 2021 p.4). Albert Morris had made extensive observations of the local ecosystems, including elevated areas.

[65] Functioning as measured against a comparable reference ecosystem, comprised of actual and/or conceptual components (see SERA 2021 p.4). The ecosystems of the local plains and ranges had been closely observed by Albert Morris during field naturalist trips, under a range of seasonal conditions.

regeneration project significantly displayed features of the contemporary environmental repair process, ecological restoration.

Ecological restoration is defined as “the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed” (SERA 2021 p.29). Intention is an important consideration when determining whether a project can be construed as ecological restoration or some other activity: was there an intention to restore some aspect of an evolved ecosystem, such as the indigenous vegetation or animals?[66] As already demonstrated in this article, Albert Morris had a deep interest in the restoration and conservation of the regional and local ecosystems, and their plants and animals.

The remainder of this article outlines the development of the two tree plantations and examines the two regeneration projects in detail. Major emphasis is placed on presenting and analysing the development of the Broken Hill regeneration area project (sections 4, 5, 6 and 7 of this article).

The respective narratives of the planting and regeneration projects are augmented by Appendix A (Chronology) and Appendix B (Diagram of the projects). The reader may find the diagram a particularly helpful interpretive tool.

Plantation No.1: May–September 1936

The 1936–37 Zinc Corporation plantation projects are interesting examples of Albert Morris’s dry climate urban landscaping work. Importantly, a study of the plantations and their development significantly contributes to an accurate understanding of the involved chain of events that presented Albert with an opportunity to initiate a natural regeneration project that he intended would one day encircle Broken Hill.

[66] Dr Tein McDonald, President, Australian Association of Bush Regenerators, provided opinion and discussion notes on the importance of intention in a restoration activity.

On 25 May 1936, the newly appointed manager of the Zinc Corporation, A. J. (Jim) Keast, announced plans for the construction of a new mine and office complex on land located within the Corporation's mining leasehold, towards the south-west outskirts of the city, near Wentworth Road. Demolition of the old mine buildings had already commenced (Anon. "Big Building Plan" *Barrier Miner* p.3, 25 May 1936).

The Zinc Corporation was one of the three large mining companies that operated in Broken Hill.[67] A major and expensive development, the Corporation's proposed mine complex was to be located on a level but highly wind exposed site devoid of vegetation. Quite possibly, wind driven sand-drifts could develop near and within the grounds and buildings of the new complex, and disrupt mining operations.

To manage the potential sand-drift problem and create amenity within the new mine complex, the Corporation had decided to construct a compact, fully fenced and irrigated tree plantation, or shelterbelt, consisting of dense stands of trees, and this plan had been announced on 18 May (Anon. "Sand Drift To Be Stopped" *Barrier Miner* p.1, 18 May 1936). Keast intended that the trees of the plantation would shelter the new mine complex from the strong southerly and westerly winds that prevailed in Broken Hill.[68] The plantation was called Plantation No.1 (extant) (Illustration 7). Work on the protective fence that would enclose Plantation No.1 had commenced before the 18 May announcement (Anon. "Sand Drift To Be Stopped" *Barrier Miner* p.1, 18 May 1936).

The tree species to be planted would be similar to those used for landscaping the grounds of the Broken Hill Hospital in 1929 (Anon. "Sand Drift To Be Stopped" *Barrier Miner* p.1, 18 May 1936). Intended to act as a soil stabiliser, saltbushes would also be planted within the plantation enclosure (Morris, A. 1938, p.46).

The managerially adroit Keast purchased the rails of the disused Tarrawingee Railway, with the intention of using them in the construction of the mine complex and plantation.

[67] The other mining companies were North Broken Hill Limited and Broken Hill South Limited.

[68] Alternative solutions to the sand-drift problem had been considered. In particular, "huge slime dumps" were proposed, but apparently Keast preferred a more attractive solution (Morris, M. 1939c, p.44; Anon. "Tree Belt" *Sun* p.19, 29 April 1936). Also, the sand could be cleared manually (Morris, A. 1938 p.44). The threat of sand-drifts was not going to prevent construction of the new mine complex.

Work on taking up the rails was to commence on 26 May (Anon. “Tarrawingee Railway” *Barrier Miner* p.3, 25 May 1936). The rails also proved to be useful as fencing material in the construction of the reservoirs regeneration project and some reserves of the Broken Hill regeneration area. Still functional today, the rails solidly enclose Plantation No.1 and regeneration reserves of the Broken Hill regeneration area (Illustrations 8, 12, 13).

Illustration 7. Plantation No.1 and 1936 mine complex 2017 *Source: P Ardill*

Albert Morris was well informed about the proposed Zinc Corporation plantation: on 9 May he had met with Keast and Maurice Mawby, a mining company metallurgist and member of the Barrier Field Naturalists Club (Anon. “Plant Regeneration” *Barrier Miner* p.14, 11 December 1937). They knew of Albert’s expertise with urban landscaping, and after advising that development of a substantial tree plantation was feasible, he agreed to help with the project. Albert also perceived, and explained to Keast and Mawby, that in a fenced enclosure, as was planned for Plantation No.1, natural regeneration of local plant

species would occur: naturally distributed seed stored in the soil of the enclosure, and also seed recently distributed by wind, water and animals would germinate after adequate rain, and the resultant seedlings would thrive, because they were protected from livestock and rabbits by fencing (Anon. “Plant Regeneration” *Barrier Miner* p.14, 11 December 1937; Morris, A. 1938 pp.43-44).

Illustration 8. Plantation No.1 rail post and mesh fence and 1936 mine complex 2017
Source: P. Ardill

Throughout 1936 construction work on the new mine complex continued. Consisting of approximately 22 acres (nine hectares), Plantation No.1 was situated adjacent to the south-west boundary of the mine complex and its buildings (Illustrations 7 and 8). As outlined, fencing of the Plantation No.1 site had commenced by May 18 (Anon. “Sand Drift To Be Stopped” *Barrier Miner* p.1, 18 May 1936). Approximately 1.5 kilometres of fencing was required to enclose the plantation, so the work is likely to have been

completed in three to four weeks, by early to mid-June.[69] The fence around the plantation was galvanised iron on three sides with a rabbit-proof mesh fence on the mine complex side (Illustration 8) (Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937). A plant nursery was established (Illustration 11). The plantation would be irrigated with water supplied via gravitational feed from an elevated tank that was regularly recharged with mine complex waste-water sourced from change room showers and septic tanks (Morris, A. 1938 p.45; Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937).

Plantation No.1 and Plantation No.2: winter 1936–37

As Albert Morris had predicted in May to mine manager, A. J. Keast, and Maurice Mawby, throughout the winter of 1936 natural regeneration of local vegetation occurred within the Plantation No.1 enclosure. The bare soil was soon covered in vegetation. Grasses regenerated, including Spear Grass (*Stipa scabra* syn*. Austrostipa scabra*); "Sida[70] of several kinds and other native plants were plentiful" (Morris A., 1938 p.45-46). Margaret Morris reported that in addition to grasses, "Cassias"[71] and "many other native plants" regenerated in the enclosure (Morris, M. 1939).

A start to planting within the Plantation No.1 enclosure was scheduled for spring 1936. Seeds were collected, to use in the nursery propagation of trees and shrubs. Additionally, 1600 River Red Gum trees that had naturally regenerated within the grounds of the Umberumberka reservoir, at nearby Silverton, were transplanted into tin containers and raised in the nursery (Morris, A. 1938 p.45).

Commencing in early October 1936, one thousand nursery propagated Old Man Saltbush plants were planted, "three feet apart", within the plantation enclosure (Morris, A. 1938

[69] An estimate based on how long it took to fence the first series of regeneration reserves (November 1936-February 1937). The Tarrawingee rail posts became available from May 26.
[70] *Sida*: herbs and small shrub species (some perennial). See Pidgeon, Ashby (1940) p.126.
[71] *Cassia*: shrub and small tree species. See Pidgeon, Ashby (1940) p.126. Genus has been extensively revised since the 1930s.

p.45-46). Irrigation channels were ploughed by a camel team, and planting holes were dug for approximately 3000 trees (Morris, A. 1938 pp.45-47).

On approximately 12 January 1937, planting of the nursery raised River Red Gum trees commenced, and planting of further trees and shrubs continued for quite a few months (Morris, A. 1938 pp.45-47). “Fifteen different kinds” of trees were planted in Plantation No.1 (Morris, A. 1938 p.47). Morris utilised “seeds from plants growing under arid conditions” (Morris A. 1938 pp.45). Primarily, but not exclusively, indigenous Australian species were used, both local species and species that did not grow locally (Anon. n.d. 1; Anon. n.d. 2).[72] At least one species introduced to Australia from overseas was used. Further planting of trees continued in succeeding years. Much of Plantation No.1 is still visible. An orchard and vegetable gardens were established.[73]

The plantation appears to have quickly met its prime objective of revegetating and stabilising the drifting sands on the site. Additionally, Albert Morris is likely to have aspired to recovery of some degree of ecological functioning on the site, by restoring layers of vegetation. He had anticipated that natural regeneration of local grasses and shrubs would occur. Local species, Old Man Saltbush and River Red Gum, as well as tree, Curly Mallee, and shrubs such as Turpentine Bush (*Eremophila sturtii*) and other local species were planted (Anon. n.d. 1; Keith p. 293). Certainly, habitat for birds would have been created by the natural regeneration of grasses and shrubs and planting of trees within the plantation enclosure.

However, in the Broken Hill locality clusters of River Red Gum are more typically associated with watercourses, rather than the plain on which Plantation No.1 was located (Illustration 9). The completed plantation was a compact, layered vegetation community of groundcovers, shrubs and trees with a relatively dense canopy (Illustrations 7, 10), a community that is not typical of the local plains, with their prominent shrub vegetation and sparse tree canopy (Illustrations 2, 9, 16).

[72] Possibly, non-local species were planted for their aesthetic qualities. There may have been community or mining company pressure to beautify, by using certain attractive species that naturally occurred in more distant regions of Australia, and not locally. Possibly, Albert liked to use these attractive species, or hoped that their use would boost support for his landscaping work.

[73] No longer in existence.

Also, numerous indigenous Australian plant species that did not grow locally were planted in Plantation No.1, including species endemic to Western Australia: Gimlet (*Eucalyptus salubris*), Silver Gimlet (*Eucalyptus campaspe*) and Brown Mallett (*Eucalyptus astringens*) (Anon. n.d.1). The planting of local species would have been far more ecologically appropriate.

Illustration 9. The Pinnacles near Broken Hill, local tree species possibly River Red Gum on intermittent watercourse, well vegetated plain ca.1890 Source: SLSA B-73354-6

A tree species introduced to Australia and used in the plantations proved to be a particularly unfortunate selection.

The tamarix articulata (Athol-trees) that we brought from Whyalla as cuttings four years ago have made wonderful growth, and have given rise to many thousands of young trees (Morris, M. 1940 p.22).

Listed as "Tamarix Athel" in a Plantation No.1 plant list (Anon. n.d. 2), today this species is usually referred to as Athel Pine (*Tamarix aphylla*). Indigenous to the Mediterranean region and parts of Asia, by 1947 the Zinc Corporation nursery had distributed throughout Australia 190,000 cuttings of the pine, or the "wonder tree" as it was called, to combat soil erosion (Anon. "Field Naturalist Club" *Barrier Miner* p.3, 6 May 1947).[74] The wonder tree is now a Weed of National Significance in Australia.

Plantation No.1 was called Albert Morris Park for many years. Today it is formally known as Zinc Lakes or Twin Lakes Park, after the lakes that were created out of a section of the plantation in 1945, with some loss of trees (Anon. "Beautification at Zinc" *Barrier Miner* p.3, 31 October 1945). Originally erected adjacent to the 1936 mine complex, the Albert Morris Memorial Gates grace the Wentworth Road entrance to the park.

Work started on Plantation No.2 (Illustration 10).

> *In addition to this large plantation* [Plantation No.1], *there was one along the front and back of the cottages both at the South Broken Hill and Railway Town sides of the mine* (Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937).

Fences were erected, and planting within the Zinc Corporation leasehold commenced in approximately February 1937. Several large groves of trees were created. The historical documentation suggests that the mine manager's residence, staff housing, roadways and

[74] Reputedly, the pine was sourced in California and brought to Australia by Australian businessman, Essington Lewis (Anon. "Field Naturalist Club" *Barrier Miner* p.3, 6 May 1947). In approximately 1932 Lewis asked Albert Morris to come to Whyalla, South Australia, for the Broken Hill Proprietary Company (BHP), and investigate the feasibility of local revegetation projects; Morris accepted the invitation (Ardill 2018). This explains Margaret's reference to Whyalla. The pine was used to landscape a "saline flat" on the Zinc Corporation mining leasehold, and was planted in Plantation No.1 (Morris, M. 1939 p.46). As already outlined in this article, by 1936 Albert Morris was firmly advocating for the use of indigenous Australian species, "our own", in erosion management work, and he was weed conscious, so why did he plant the pine in the plantation? (Anon. "Our Plant Life" *Barrier Miner* p.4, 26 June 1936). Keast or Albert Morris may have insisted on planting the pine as an experiment, or as a wind-break for the new mine complex. The weed tendencies of the pine, although obviously emerging, must not have been recognised at the time of its planting in March 1937 (Anon. n.d. 2). Possibly other non-local indigenous Australian species used in the plantation proved to be local weeds, or their use encouraged further ecologically inappropriate planting in arid and semi-arid Australia.

degraded areas within the Zinc Corporation leasehold were landscaped, to beautify and provide cooling shade (Morris, A. 1938 p.47).

Mulga was planted (Anon. n.d. 1). Possibly large quantities were planted across the less utilised sections of the Zinc Corporation leasehold.

Many Mulgas will be grown on the hill around the mine – these hills and plains were densely covered with Mulga prior to the advent of mining operations at Broken Hill (Anon. n.d. p.2).

Illustration 10. Plantation No.2 and a dense cluster of trees 2017 Source: P Ardill

As well as Mulga, quite possibly other local species were used in the Plantation No.2 work. Indigenous Australian species that did not grow locally were also likely to have been used.

> *There are 18 different varieties of gum trees and 13 of wattles, as well as many other kinds of trees and shrubs, such as black oak, myoporum, quandong, pittosporum, bullock bush, beefwood, tea trees, etc., in use in the plantations, as the different soils are best suited to different kinds.*[75] *All the plants used in this work are grown from dry country forms suited to the natural rainfall and from seeds gathered from plants grown under local conditions, by which means the highest resistance to our peculiar conditions is obtained* (Anon. "Plant regeneration" *Barrier Miner* p.14, 11 December 1937).[76]

Much of this work can still be seen. Habitat for birds was created. Possibly other ecological benefits arose. Albert quite probably anticipated that the ecological benefits of the plantations would be enhanced by the completed reservoirs regeneration project.

Additional landscaping and revegetation projects

The Zinc Corporation sponsored a "beautification" project at Broken Hill Cemetery in 1938. New gates were erected and a "sand-bank" was planted with "sand binding bushes and trees…" (Morris, A. 1938 p.49). This work complemented previous efforts by the Barrier Field Naturalists Club to establish the Doctor William MacGillivray Memorial Drive. Penrose Park, Silverton, was landscaped by Albert Morris and the Club (Morris, A. 1938 p.49).[77] Between approximately 1932 and 1937 Albert also worked on landscaping and two stock exclosure and natural regeneration projects in South Australia (Ardill 2018).

Innovative plant propagation and nursery management

[75] Bullock Bush or Rosewood (*Alectryon oleifolius*) is a local Broken Hill species occurring as a tall shrub or small tree, and is indigenous to other arid and semi-arid regions of Australia. Black oak may refer to Belah (*Causarina pauper*), a local species of Broken Hill and indigenous to other arid and semi-arid regions of Australia. The rest of these plant names may refer to any number of indigenous Australian species.

[76] An extremely detailed, seemingly well-informed account of the development of the plantations and 1936–37 regeneration reserves. Quite possibly authored by Albert or Margaret, or both, but this is not confirmed.

[77] Elements of these projects could still be seen in 2017.

Albert and Margaret's propagation of indigenous Australian plant species is noteworthy. Over many years they pioneered the development of propagation procedures that involved identification of local plant species, collection of their seed, germination of seed under nursery conditions and care of seedlings, all intricate processes involving a considerable range of skills;[78] other forms of plant propagation were also developed (Morris, A. n.d. 1). Carried out under arid climatic conditions, the work would have been physically demanding. Albert and Margaret's own home nursery and the two specialist Zinc Corporation nurseries that they helped to run were carefully managed (Illustration 11) (Morris, A. n.d. 1; Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937). These practices are characteristic of contemporary bush regeneration plant stock management technology. Whether Albert and Margaret applied ethical considerations to their seed collection procedures is unknown.

Illustration 11. Likely plant nursery remnant Plantation No.1 2017[79] *Source: P Ardill*

……..

[78] Numerous non-local indigenous species and introduced species were propagated.

[79] See illustration in Webber (1992) p.64

4. The Broken Hill regeneration area: 1936–39

Introduction

From approximately 1920 Albert Morris and his conservation colleagues had studied and trialled revegetation techniques. By 1936 they had settled on a preferred technique, as demonstrated by the Barrier Field Naturalist Club's 1935 letters to the New South Wales government, calling for the fencing of the degraded perimeters of Broken Hill to allow natural regeneration of the indigenous vegetation, and their submissions to the April 1936 hearings of the New South Wales Erosion Committee in Broken Hill. Determined to restore the eroded landscapes of western New South Wales, and keen to demonstrate that a stock exclosure and natural regeneration revegetation technique was an effective means of reversing environmental degradation, by August 1936 Albert was advocating for the development of the Broken Hill regeneration area project. At the same time, he pursued government financial support for a much smaller but still noteworthy regeneration project, the reservoirs regeneration project. Overlooked until reported in the 2017 editions of this article, the reservoirs project is an historically and ecologically significant component of Albert's overall revegetation work.

Albert Morris and the Club initiated the reservoirs regeneration project in May 1936. New South Wales state government approval for the project was granted in September 1937, and the on-site work was executed in April 1939.

The objective was to allow natural regeneration of local vegetation within two small, degraded urban bushland sites, by fencing to exclude livestock. This objective was technically consistent with the fencing and natural regeneration proposal for revegetating the degraded perimeters of Broken Hill recommended by the Club to two New South Wales government ministers in late 1935 (Anon. "Reducing the Dust Nuisance" *Barrier Miner* p.3, 7 December 1935). Although not a part of the Broken Hill regeneration area project, the reservoirs project was initiated only a few months before work commenced

on the first reserves of the regeneration area project, and is presented in this section of the article.

The second and quite the most significant of the two regeneration projects that Albert Morris became associated with in 1936, the construction of the initial regeneration reserves of the Broken Hill regeneration area, was initiated by Albert and received extensive administrative and financial support from the Broken Hill mining industry. The Barrier Field Naturalists Club supported the project; broader community interest also developed. The project was planned by Albert and mining company managers, and approved by Broken Hill Council in August 1936. Fenced regeneration reserves were constructed between September 1936 and February 1937. Additional reserves were constructed between 1937 and 1939, before the outbreak of the Second World War.[80] Most of the reserves were located within the public common; a section of Zinc Corporation mining leasehold hosted one or possibly two reserves.

An intention to effect widespread recovery of the local vegetation by excluding livestock (stock exclosure) and harnessing natural regeneration was evident. This revegetation technique was technically consistent with the stock exclosure and natural regeneration revegetation proposal recommended by the Club to New South Wales Government ministers in late 1935 (Anon. “Reducing the Dust Nuisance” *Barrier Miner* p.3, 7 December 1935). Achieving amenity outcomes for city residents was very important: the stabilisation of sand-drifts, management of local dust, beautification by revegetation.

The development of regeneration reserves between 1936 and 1939 was followed by the construction of three more reserves between 1950 and 1958. The events that led to the construction of the latter reserves and the completion of the regeneration area project in 1958 are presented in section 6 of this article.

The reservoirs regeneration project: May 1936–39

[80] September 1939 to 1945.

On 27 May 1936, a committee meeting of the Barrier Field Naturalists Club, acting on a suggestion from Albert Morris, passed a motion proposed by Mr. Faehrmann to write to the New South Wales government and request the fencing of two water reservoir reserves located in the urban area of Broken Hill, namely Waterworks Hill and Block 10 Hill (see Appendix B).[81] The objective of the project, as stated in the motion was "to keep off stock to enable natural regeneration of plant life..." (Barrier Field Naturalists Club. 1936). The intention was to implement an actual revegetation project, rather than to conduct an experiment. After months of deliberation, in November 1936 the request was refused by New South Wales Minister for Works and Local Government, Eric Spooner (Spooner 1936).

Undeterred, Club secretary Morris raised the reservoirs regeneration project with Spooner again, in April 1937. Indicative of the site's potential for natural regeneration, a list of the local plant species identified on the Block 10 Hill site was supplied to the minister. Some tree planting was suggested, as 1937 had been designated a "special Tree Year" by the state government, to celebrate the "150th anniversary of the State" (Morris, A. 1937a). Spooner was not convinced and refused the request (Spooner, 1937a).

Albert Morris and the Club persevered. He wrote to Spooner for a third time on 15 July 1937, repeating the Club's request: "to enable natural regeneration of the flora thus providing some natural bushland in the heart of the city" (Morris, A. 1937b, p.1). Either convinced by Albert's advocacy or worn down by his persistence, in September 1937 Spooner consented to the Club's proposal (Spooner 1937b).[82]

To be sure that Spooner had fully understood the intricacies of the project, Albert promptly wrote again to confirm that rabbit-proof, one and a half-inch wire netting would be used in the fence. Spooner replied that he would be pleased to check on this detail (Spooner 1937c).

[81] As a guide for the reader, in 2022 Block 10 Hill extended over approximately 17 hectares, and Waterworks Hill covered approximately 10 hectares. The sizes of the proposed 1936 regeneration areas are unknown.
[82] Although unconfirmed, it is quite possible that Spooner had received reports about the emerging success of Albert's concurrent natural regeneration project, the 1936–37 regeneration reserves.

The fencing work was carried out in approximately April 1939 (Brooks 1939; Committee, Barrier Field Naturalists Club 1970). Unfortunately, records of the revegetation outcomes do not appear to be available. Remnants of the rail post fence with its one and a half-inch rabbit-proof wire netting may still be seen on Block 10 Hill, adjoining A. J. Keast Park (Illustration 12).

Illustration 12. Block 10 Hill and rail post fence 2017 *Source: P Ardill*

The reservoirs regeneration project is an historically interesting example of community environmental repair advocacy that successfully attracted financial support from an Australian state government for a project intended to reverse degradation and recover ecological functioning. Unlike earlier attempts by conservationist, Donald MacDonald, to secure local government support for ecologically aspirational natural regeneration projects at Port Phillip Bay, Melbourne,[83] Albert Morris's advocacy proved to be successful. His determination and attention to detail are noteworthy.

[83] Between ca.1900 and ca.1930, Donald MacDonald was an avid advocate for the restoration and conservation of Melbourne's degraded foreshore Coast Teatree (*Leptospermum laevigatum*) vegetation

As well as vegetation recovery, provision of bird habitat would have been a significant ecological objective. Quite likely there was an amenity component to the project: “to provide some natural bushland in the heart of the city” (Morris, A. 1937b, p.1).

Although not confirmed, it is not unreasonable to surmise that Albert intended that the completed reservoirs project would serve as a form of demonstration model, to display the efficacy of a stock exclosure and natural regeneration revegetation technique. A model of this kind would have been an effective means of enlisting government, industry and community support for further revegetation projects, possibly scaled up, that addressed the local and regional erosion problems.

The Broken Hill regeneration area: the regeneration reserves of September 1936–39

As already outlined, Albert Morris initiated the development of a major regeneration project in 1936. This project involved the construction, with net wire fences, of a set of regeneration reserves around the south-west perimeter of Broken Hill, between 1936 and 1937. [84] These reserves proved to be the initial reserves of the Broken Hill regeneration area. Further reserves were created, and by 1939 the western and southern sectors of Broken Hill had been encircled by a number of regeneration reserves, or, as they were also referred to at the time, the regeneration area.

The remainder of this section of the article presents the development of the 1936–39 reserves, in a series of sub-sections. As outlined, the development of the 1950–58 reserves is presented in section 6.[85]

communities, by utilising ecological burning and natural regeneration (Ardill 2021 p.22, 260). For more on McDonald, see section 7.

[84] Regeneration reserve (also referred to in the historical documentation as regeneration paddocks, and regeneration areas): a large area of degraded land strongly fenced with net wire to permanently exclude livestock and rabbits and encourage natural regeneration. Local animal species, such as kangaroos and emus, could access the regeneration reserves. The reserves of 1951, 1953 and 1958 used simpler wire strand fences, that did not exclude rabbits.

[85] As a guide for the reader, the author estimates that the entire 1936-58 regeneration area extended over an area of approximately 1700 hectares. Estimate based on aerial photographs and maps. The 1936–39 set of

a. Announcement of the regeneration reserves project: September 1936

On 7 September 1936, Mr. Fairweather of the Broken Hill Mine Managers Association made a surprise announcement.[86] The Association was managing an "experiment" that would involve the fencing of a degraded strip of land with a rabbit proof fence (Anon. "Sand Drift Problem" *Barrier Miner* p.1, 7 September 1936). The fencing would enclose a half mile wide (0.8 kilometres) and four to five miles long (seven kilometres) set of regeneration reserves, extending from the former South racecourse site to the Silverton Tramway line, around the wind exposed south-west perimeter of the city (See Appendix B - Diagram). Despite rumours that the whole city might eventually be enclosed by fenced reserves, the long-term objectives of the project were not explained.

The stated objective was to exclude rabbits and livestock and allow natural regeneration of local vegetation within the fenced area, to stabilise eroded soils and sand-drifts. Work would commence shortly.

Most of the land to be fenced was located within the public common; a smaller section was on the Zinc Corporation mining leasehold. However, the article reporting Fairweather's announcement made no mention of the common, that a large portion of the common would be fenced, and that the Broken Hill community would be excluded.

The project aspired to the attainment of ecological, social and economic benefits. Albert Morris and his restoration colleagues exercised an intention to recover substantial or quite possibly, full levels of ecological functioning within the proposed fenced area, or regeneration reserves, by restoring indigenous vegetation. Albert and the Club were also intent on securing the conservation of restored ecosystems. Achieving amenity benefits

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regeneration reserves extended over approximately 1000 hectares; in December 1939 Margaret Morris wrote that the 1936-39 set of reserves covered "roughly" 3.5 square miles, or 900 hectares (Morris, M. 1939d p.23). The author estimates that the three 1950-58 reserves extended over approximately 700 hectares. Estimate based on aerial photographs and maps.

[86] The association represented the three major mining companies in the city.

for city residents was important: sand-drift management, dust control and beautification of city perimeters. The economic benefits would be substantial: a hugh reduction in council and state expenditure on sand removal, and large savings on the repair and replacement of damaged and destroyed public and private infrastructure.[87]

Fifteen weeks after the announcement of plans to develop the Zinc Corporation's Plantation No.1 and No.2 tree planting projects, and several weeks before any form of planting had been undertaken in the plantations, all three Broken Hill mining companies had united to manage and fund a stock exclosure and natural regeneration project for the city. This innovative plan entailed confidence that the local vegetation had capacity to naturally regenerate. Who devised the plan, and how did it come to be adopted?

b. The origins and initiation of the regeneration area project: August – September 1936

As described in section 3 of this article, the fencing of Plantation No.1 had been completed by approximately early to mid-June 1936. The plantation enclosure remained in an unplanted condition throughout the winter (June, July, August) of 1936.

However, and as described in section 3, the bare soil within the plantation enclosure was soon covered with local vegetation. Albert Morris recorded the natural regeneration event that he had predicted to Keast and Mawby in May 1936.

> *By this time* ["Early in October"] *the paddock* ["No.1 plantation" or "The Albert Morris Park"] *was showing the effect of keeping stock off, and grasses were showing in all directions. Nine kinds were observed during the first few months...and other native plants were plentiful, and the inside of the paddock was quite green…* (Morris, A. 1938 pp.45-46).

[87] In 1937 the city mayor estimated that the sum of £3000 would be needed to fund complete removal of sand from schools, homes, streets, the cemetery and other infrastructure (Anon. "Drift Sand Removal" *Barrier Miner* p.1, 9 November 1937). As a guide for the reader, and using an inflation measure, this equates to approximately $290,000 in 2021 Australian dollars (RBA 2023).

A total of 100 millimetres of rain had fallen in May, June, July and August 1936 (Bureau of Meteorology). Responding to these favourable conditions, the naturally distributed seed of nine local grass species and other local plant species had germinated within the plantation enclosure, and protected from livestock and other grazing animals, the seedlings had thrived.

Armed with the evidence of natural regeneration that had occurred within the Plantation No.1 enclosure throughout the winter, the enterprising Albert approached mine manager Keast and explained the significance of the vegetation. The regeneration event demonstrated that the seed of local grasses and shrubs had been naturally distributed throughout the plantation enclosure.[88] Accordingly, there was good reason to believe that seed had been distributed in a similar manner throughout the nearby common. Revegetation of the common was possible, despite its barren appearance.

This [regeneration] *demonstrated so clearly what could be done that Mr Keast listened to the dream of my life. "If only we could get an area a mile wide fenced around the town to keep stock and rabbits off, to allow the natural vegetation to come back, we could stop sand drift"* (Morris, A. 1938 p.46).

Respectful of Albert's botanical knowledge, Keast listened and perceived the merits of the proposed project. "After further talks, the manager was convinced of the effect of fencing and what could be expected in years to come" (Morris, A. 1938 p.47). Keast understood that revegetation of the degraded public common was possible, if protective fencing was erected.

These [fenced] *paddocks were called regeneration areas. There was no idea of extensive tree planting here, nor of intensive work of any kind. We were going to let nature do the work.*

[88] Naturally distributed seed is likely to have been stored in the plantation enclosure's soil seed bank for some time, maybe even decades. Also, a proportion of the seed, for example, the seed of some grass species, was likely to have been more recently blown into the enclosure. See section 7 *Revegetation of the regeneration reserves* for a description of seed distribution in the common.

The purpose was to let the land rest, to keep it entirely free from stock which, in a hungry and thirsty land, eats any young growth as soon as it shows itself. It was hoped that by doing this the natural vegetation would come back (Keast 1939a. p.28).[89]

Conceptually, the leap from irrigated tree plantations to naturally resourced regeneration reserves is a big one. To understand, and be confident, that nine types of naturally regenerated grasses were realistic indications that a broad-scale natural regeneration project was a feasible proposition required prior knowledge and experience of natural regeneration as an arid lands ecological process, and of the ecology of the proposed site. It is clear in hindsight that Albert Morris possessed this prerequisite knowledge and experience.

Albert had extensive experience with natural regeneration. As already outlined, in 1921 he had noted annual plants thriving within the stock proof enclosure of the Cockburn railway yards, and from 1935 he had been involved with two field trials that utilised ploughing and natural regeneration to restore indigenous vegetation to hundreds of acres of eroded land. In 1935 he and the Barrier Field Naturalists Club had requested the state government to fence the degraded perimeters of Broken Hill, with the intention of allowing natural regeneration of the local vegetation. Albert and the Club had initiated their reservoirs stock exclosure and natural regeneration project in May 1936.

Experientially, Albert was well equipped to recognise indicators of potential for natural regeneration on a site by germination of naturally distributed seed and growth of seedlings to maturity. His lectures and notes included references to seed stored in topsoil, and natural recovery of vegetation after rain. They suggest that he had a working understanding of how to facilitate and maintain this regrowth, by managing livestock such as cattle, and other introduced animals, particularly rabbits and goats.

Writing in her *Adelaide Chronicle* series of newspaper articles (see section 5), Margaret Morris allotted credit for the regeneration area project to Albert Morris, A. J. Keast and

[89] "Come back" was a term frequently used in the historical documentation. The context in which Keast used it demonstrates that "come back" referred to natural regeneration: "as soon as it shows itself". By "come back" he was clearly not referring to planting activity, or any other form of "intensive" human intervention.

Maurice Mawby, but noted Albert's long-term commitment to the revegetation of wind eroded soils.

> *Years ago* [Albert] *decided that what Broken Hill and other inland towns needed to stop sand drift was a stock and rabbit-proof fenced area around them to allow natural regeneration to take place* (Morris, M. 1939a p.13).

Albert had long maintained that with "protection from stock the country would 'come back'", and referred to his vision of establishing a regeneration area around Broken Hill as the "dream of my life" (Morris, M. 1939c. p.46; Morris, A. 1938 p.46). Keast, unequivocally, gave Albert Morris full credit for the initiation of the regeneration reserves project (Keast 1939 p.3).

The documented evidence reveals that it was Albert Morris who recognised and seized on the opportunity created by the fencing of Plantation No.1 to propose the construction of regeneration reserves for Broken Hill. He initiated the negotiations that led to the development of the project. But he had to do more than just show mine manager Keast some grasses. Albert had to gain Keast's support for the proposed project, by explaining the benefits that would arise for the residents of the city.

Keast was convinced, and senior Zinc Corporation Director, William Robinson, approved the proposal; sizeable funds were allocated to the project (Morris, M. 1939 p.47). The two other Broken Hill mining companies, North Broken Hill Limited and Broken Hill South Limited, were enlisted (Morris, A. 1938 p.47; Morris, M. 1942).[90] Referring to the 1936–37 reserves of the regeneration area project, and the fencing agreement that he came to with Keast and the mining companies in August 1936, Albert Morris outlined the essential infrastructure objective: "We undertook to fence, with iron posts and rabbit-proof netting, a strip half-a-mile wide and about five miles long…" (Morris, A. 1938 p.47).[91]

[90] The three Broken Hill mining companies were financially and managerially connected, and were known as the Collins House Group (Richardson 1988). In Broken Hill the companies were represented by the Mine Managers Association.

[91] Approximately 800 metres by x 8000 metres, which is 640 hectares, or 1580 acres.

Until Albert Morris put forward his regeneration reserves fencing proposal to Keast, the demonstrated interest of the mining company manager and Robinson in erosion control revolved around their corporate responsibilities, namely protection of the new mine complex (Robinson in Webber 1992 pp.55-56).[92] Robinson wanted erosion control projects in place above the mineral deposits of the new mine complex (Mawby 1975). As Albert made clear, Keast and the Zinc Corporation's interest in tree plantations and controlling sand-drift revolved around concern for the mining venture: "How can the new works be protected?" (Morris, A. 1938 p.43). This concern was allayed when Albert Morris assured the mine managers on 9 May 1936 that a tree plantation would definitely protect the new works from sand-drifts. Nevertheless, Keast and Robinson agreed to support Albert Morris's fencing proposal for the common, expend a large sum of money and develop a new, much bigger project, a series of fenced regeneration reserves that would encircle a substantial section of the city. Why did they agree to do this?

Albert and Margaret Morris and their neighbours in Cornish Street, Railway Town, had extensive, first-hand experience with drifting sands and dust: fences, gardens, gates and roads were buried (Morris, M. 1975 p.2). Numerous houses in south and west Broken Hill had been destroyed by sand-drifts and abandoned (Anon. "Sand Drift Ravages" *Barrier Miner* p.3, 21 April 1936). Albert had always wanted to create an area of naturally regenerated vegetation that encircled the city and provided amenity benefits for all (Morris, M. 1939c. pp.44, 46). He and Margaret were concerned for the people and families who had to abandon their homes to sand (Morris, A. 1938 pp.46-47).

The amenity and economic benefits that would accrue to the city from a regeneration project must have been discussed in depth by Albert and Keast, and then with Robinson. Margaret Morris subsequently described the fencing of the common as a "social welfare experiment to protect the most exposed end of town" and a "social service", and acknowledged the "interest and very generous support" that Keast and Robinson extended to the project (Morris, M. 1942 p.1; Morris, M. 1939c. pp.46-47).

[92] Robinson had a qualification in agriculture and some youthful experience with an unsuccessful orchard enterprise, but had no experience in erosion management. He was an industrialist (Richardson 1988).

The fencing of Plantation No.1 was completed by early to mid-June, so Albert must have observed the regenerating grasses and shrubs in June, July and August, "the first few months" after fencing was completed (Morris, A. 1938 p.46). Managerial level discussion of Albert's regeneration reserves proposal took place in approximately mid-August, as the Mine Managers Association successfully applied to Broken Hill Council on 27 August to fence the public common "for purpose of regeneration of local flora" (Broken Hill City Council, 1936).[93] The application made no mention of shrub and tree planting, shelterbelts or irrigation. Following council's approval, Fairweather announced the project on 7 September. Surveying and fencing work commenced shortly afterwards.

Albert's regeneration reserves proposal was not based on some form of revegetation hunch or guesswork developed over the winter of 1936. The ideas that he put to Keast were founded on many years of hard work and study dedicated to the reversal of environmental degradation. Only a person who had supreme confidence in his own extensive knowledge and practical experience of degraded area restoration, stock exclosure and natural regeneration could have displayed the enterprise to propose and secure corporate support and financing for such an ambitious, expensive and innovative project, on the basis of three months of grass growth. Albert must have been confident that extensive natural regeneration of local vegetation would occur within the proposed regeneration reserves.

Albert Morris initiated the Broken Hill regeneration reserves project, in August 1936. The intention was to encourage natural regeneration of local vegetation, by fencing a series of eroded sites and excluding stock. Extensive use would be made of naturally occurring resources: soil, rainfall, seed and wind. The technique was well tested, and a plan to effect ecological restoration and provide sand control amenity was evident.

[93] On 22 August 1936 the South Australian government announced that it was offering rent subsidies to leasehold pastoralists who applied a stock exclosure concept and harnessed natural regeneration to restore indigenous vegetation to fenced areas on their stations (the government had been favourably influenced by the South Australian regeneration projects reported in section 2 of this article). This announcement was reported in the main Adelaide newspaper on 24 August 1936 (Ardill 2022 p.32). The *Barrier Miner* newspaper in Broken Hill reported the South Australian government's announcement, and the stock exclosure and natural regeneration projects being conducted in South Australia, in a substantial article on 26 August 1936, the day before Broken Hill Council approved the regeneration reserves project (Anon. "Erosion of Soil" *Barrier Miner* p.4, 26 August 1936). Possibly the council was favourably influenced by the news from South Australia.

Albert, of course, was an active conservationist. As well as the amenity outcomes that would accrue to the community of Broken Hill, he would have eagerly anticipated the ecological and conservation benefits that would arise from the regeneration reserves project: recovery of the local ecosystems and their ecological functioning; conservation of local plant and animal species; the development of further insights into how the environmental degradation that prevailed throughout western New South Wales might be reversed. The writings, submissions and advocacy of Albert Morris, Edmund Dow, Dr I. MacGillivray and other Club members amply demonstrate their commitment to the achievement of these objectives (Morris, A. "The Flora between the River Darling and Broken Hill" 1923 cited pp.35-37 in Environment NSW [2002]; Anon. "Soil Erosion" *Sydney Morning Herald* p.7. 24 April 1936; Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936). Indeed, the Broken Hill regeneration area project was eventually adopted by state government soil conservation researchers as a model for a western New South Wales erosion management program (see section 7).

c. Concerns, expectations

The regeneration reserves announcement of 7 September 1936 signalled a start to the construction phase of a carefully planned revegetation and soil conservation project. The project was informed by extensive observations of the local vegetation and ecosystems, comparative studies, experiments, field trials and data analysis. Permanent revegetation of degraded arid land was aspired to. To achieve this objective, natural regeneration of the local vegetation was to be encouraged. The scale of the project was ambitious.

In addition to all this work ["the plantations"] *undertaken by the Zinc Corporation, it was early felt that for this work to be really effective, a much more ambitious scheme was necessary, so that the assistance of the South and North mines was sought and obtained as well as the support of the Municipal Council, to enable a belt of land half a mile wide to be fenced outside the town along the south-western edge to keep off stock and rabbits, so that the natural flora could "come back".*

These paddocks were called the Regeneration Areas, and it was hoped that the grass would grow and in turn afford protection to other herbage, which later would be followed by shrubs and in time trees (Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937).

Fairweather's announcement on 7 September referred to the proposed fenced reserves as "experimental" (Anon. "Sand Drift Problem" *Barrier Miner* p.1, 7 September 1936). Certainly, in the 1930s a stock exclosure and natural regeneration revegetation technique was still quite innovative, although not at all unheard of.[94] There was an element of experimentation and even risk for the mining companies that were financing the project. Would local vegetation recover on a degraded site exposed to ongoing wind erosion and arid zone climatic conditions?

From Albert Morris's perspective, the regeneration reserves were not an exercise in revegetation experimentation. In 1935 and 1936 he successfully trialled natural regeneration across 400 acres (160 hectares) of scalded country. The Club had confidently advocated in 1935 for the fencing of the eroded perimeters of Broken Hill. Albert publicly testified to the New South Wales Erosion Committee in April 1936 about the effectiveness of a revegetation technique that utilised a stock exclosure concept, and harnessed natural regeneration. The reservoirs regeneration project was keenly pursued from May 1936. Albert confidently and correctly predicted that natural regeneration would occur within the Plantation No.1 enclosure (Morris, A. 1938 pp.45-46). For Albert, the proposed regeneration reserves of 1936–37, approximately 500-600 hectares in size,[95] were a logical and quite feasible scaling up of the local revegetation effort.

Nevertheless, insistence by the Mine Managers Association on a small fencing trial within the degraded common, a prototype, to further test the stock exclosure and natural regeneration revegetation technique would have been a reasonable, even prudent move. However, they were apparently quite convinced by Albert's explanations of natural

[94] See Ardill (2021) and Ardill (2022): stock exclosure and natural regeneration at Port Philip Bay, Melbourne, 1920s, and in South Australia, 1930s.
[95] Author's estimate derived from aerial photographs and maps.

regeneration and the soundness of the revegetation technique, and a field trial was not requested.

There would have been concerns about the weather, and in particular, rainfall, because of its influence on natural regeneration. The sections of common to be fenced were "sandy wastes", exhibiting little, if any, established vegetation cover (Pidgeon, Ashby 1940 p.123). For the regeneration project to succeed, seed germination and plant growth were required over hundreds of hectares, and for this to happen, rain was needed. In a 1936 research report, University of Adelaide botanist and Koonamore researcher, Professor J. G. Wood, concluded that "climatic conditions", in the form of good rainfall, stimulated "regeneration" of two perennial saltbush species, Bladder Saltbush (*Atriplex vesicaria*) and Bitter Saltbush (*Atriplex stipitatum* syn. *Atriplex stipitata*), and Mulga (Wood 1936 pp.108-109).[96] However, in the nine years that preceded announcement of the regeneration project, 1927 to 1935, rainfall in Broken Hill had averaged only 189 millimetres per year, well below the long-term yearly average of 260 millimetres; rainfall in 1936 was also proving to be below average (Bureau of Meteorology).

Whether Wood's report had been read by Albert Morris is unknown, but he had participated in numerous botanical field trips, and as noted in section 2, he knew that "when the rainfall is above the average, the country was soon carpeted with a good growth of vegetation" (Morris, A. n.d. 3, p.15). Albert was aware that good rainfall was required to stimulate natural regeneration of colonising grasses, herbs and shrubs.[97] A continuation of the below average rainfall patterns that Broken Hill had been experiencing for many years would have concerned project supporters. Natural regeneration within the newly fenced reserves would be impeded if a period of dryness or actual drought set in, creating create serious managerial and community doubts about the project's viability.

The experimental aspect of the project that might have most concerned Keast and the Mine Managers Association, Albert and Margaret Morris, Dr I. MacGillivray and Dow was whether sand-drifts powerful enough to threaten houses could be stabilised. Large sand-

[96] Bladder Saltbush and Bitter Saltbush, as well as Mulga, are local species of Broken Hill.
[97] Following the field trial and January 1936 rains at K Tank station, and the regeneration of colonising species within Plantation No.1.

drifts developed in locations highly exposed to strong southerly winds; westerly winds formed large sand-drifts too (Bureau of Meteorology). In south Broken Hill, some houses had been abandoned to sand by tenants and owners, and sand-drifts in Wills Street, Railway Town, west Broken Hill, also destroyed houses (Anon. “Sand Drift Ravages” *Barrier Miner* p.3, 21 April 1936). In fact, the New South Wales Erosion Committee that visited the city in April 1936 was shown over the south-west urban quarter, “to give a fair idea of the difficulty in Broken Hill” (Anon. “Sand Drift Ravages” *Barrier Miner* p.3, 21 April 1936). If natural regeneration effectively stabilised the sand-drifts of the south-west quarter, including the large drifts, then the same revegetation technique could be confidently applied to the rest of the city perimeters.

> *Although the companies' officials will not comment it is believed that they are carrying out the experiment in the South for the purpose of ascertaining whether the city could not be completely encircled by a fenced in area growing natural herbage which would check the sand drift* (Anon. “Sand Drift Problem” *Barrier Miner* p.1, 7 September 1936).

The historical documentation to be presented reveals that mine manager Keast did closely monitor the regeneration reserves project and the effect of fencing and revegetation on the sand-drift problem.

As discussed in section 3, whether large sand-drifts capable of destroying houses could be stabilised was possibly an unsettled question. Albert had conducted successful home experiments with the planting of Old Man Saltbush, and found that it tolerated the sand-drift conditions in his garden quite well, but the historical documentation does not reveal that prior to September 1936, he had observed natural regeneration of Old Man Saltbush on large sand-drifts, or conducted planting field trials on these drifts. Would plants of Old Man Saltbush and other local vegetation species naturally regenerate on large, mobile sand-drifts?

Although by 1936 it was widely accepted by Australian scientists and administrators that overstocking was a major contributor to the development of wind erosion in arid regions, little formal research had been conducted into how wind eroded land might be

remediated.[98] The Australian government's Council for Scientific and Industrial Research commissioned British biologist, Francis Ratcliffe, in 1935, to study and report on soil erosion in arid South Australia. The Council pessimistically concluded that remediation efforts were unlikely to be successful.

> *In view of the adverse climatic conditions, and the exceedingly low capital value of the land, no great hopes can be held out for the success of remedial measures such as the introduction into the affected areas of soil-binding plants, or the artificial seeding of denuded patches* (CSIR 1936 p.76).

Very little or no research devoted to the remediation of soil erosion had been conducted by state governments. The New South Wales Soil Conservation Service was established in 1938; in 1939 an Advisory Committee on Soil Erosion was established within the South Australian Department for Agriculture. Quite possibly the earliest, concerted attempts made in Australia to remediate arid zone erosion were the stock exclosure, natural regeneration and scald furrowing projects conducted in the 1930s by South Australian pastoralists, as outlined in section 2, and the furrowing field trials conducted in 1935 by Albert Morris, Brougham and Langford.

There is a possibility that by August 1936 Albert Morris had acquired experience in Whyalla, South Australia, with the revegetation of large, infrastructure threatening sand dunes (Ardill 2018).[99] The commencement date of his highly successful Whyalla beach natural regeneration project is unconfirmed, but there is a possibility that it commenced in 1935 (Ardill 2018). If so, then Albert may have been confident that natural regeneration of local vegetation would stabilise the large sand-drifts in Broken Hill. Interestingly, a Sydney *Land* newspaper article of 1946 maintained that the Whyalla regeneration projects preceded the Broken Hill regeneration area project.

> *In asking that the* [Broken Hill] *fenced belt should be established, and that the land in the main should be allowed to regenerate itself, Morris was asking that considerable finance should be expended on a theory he alone was positive would revitalise the land. True, his*

[98] See Sauter (2017) pp.131-152 for an overview of early arid zone erosion research in Australia.
[99] Illustrations reveal that these dunes were many metres high.

theory had worked at Whyalla on a much smaller scale, but would it work on those larger areas, fully exposed, to the dessicating force of the westerlies and southerlies? (Anon. "Trees for Beauty and Utility" *The Land* p.9, 29 March 1946).

Albert Morris would have been quite confident that plants of local colonising species would naturally regenerate within the fenced reserves proposed for Broken Hill. A variety of grasses, including at least one perennial species, herbs, and a range of annual and perennial shrubs had naturally regenerated in the 1935 field trials and within the Plantation No.1 enclosure. These regeneration events had demonstrated to Albert that colonising plants could revegetate bare soils and stabilise drifting sand.

To permanently stabilise the large sand-drifts that developed in areas of high wind exposure and overwhelmed houses, Albert would have believed that establishment of long-lived, perennial shrubs and trees on the drifts was desirable, particularly Old Man Saltbush, and also Mulga. He was likely to have been confident that plants of these species would naturally regenerate from degraded rootstock. With protective colonising plants and sufficient rainfall in place, he may have been confident that plants of local, long-lived perennial shrub and tree species would naturally regenerate from seed and eventually stabilise large sand-drifts, if seed had been naturally distributed throughout the proposed reserves.[100]

Albert may have believed that seed of long-lived perennial species had been naturally distributed in the common (see section 7: *Revegetation of the regeneration reserves* for a discussion of natural seed distribution within the common). In the years prior to its fencing, he may have observed regenerating seedlings of perennial species thriving in the common after rain, only to see them eventually destroyed by livestock. The historical documentation suggests that the Broken Hill field naturalists had some confidence that natural regeneration of perennial species would progressively occur in the fenced reserves.

[100] As revealed in section 2 of this article, Albert believed that colonising plants played a vital role in sheltering perennial species' seedlings (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936). This idea was supported by research, but whether Albert Morris was aware of the research is unknown. University of Adelaide botanist and Koonamore researcher, Professor J. G. Wood, reported in 1936 that coloniser plants and their litter were vital to natural regeneration of Bladder Saltbush, Bitter Saltbush and Mulga (Wood 1936).

> *These paddocks were called the Regeneration Areas, and it was hoped that the grass would grow and in turn afford protection to other herbage, which later would be followed by shrubs and in time trees* (Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937).

As Albert had submitted to the Erosion Committee in April 1936, in eroded areas where a natural supply of seed proved to be limited or completely exhausted, planting and scattering of perennial species' seed were further revegetation options.[101] Planting of saltbushes might be necessary to manage the larger sand-drifts that had formed in extremely wind exposed situations. Furrowing might encourage natural regeneration on scalds; if natural regeneration failed, planting and seed scattering could be used.

In practice, once the reserves were fenced planting, irrigation, seed scattering and furrowing proved to be ancillary revegetation activities. By mid-1937, a few months after fencing, the regeneration reserves were displaying prolific natural regeneration of sand binding perennial grasses. By mid-1939 perennial saltbushes and bluebushes, Mulga and the plants of many other perennial species were naturally regenerating and stabilising sand-drifts. By 1942 plants of approximately 200 local species had naturally regenerated (see section 7 *Revegetation of the regeneration reserves*).

d. Construction of the first set of regeneration reserves: September 1936 – February 1937

The proposed reserves were surveyed, quite probably in mid-September. The first set of regeneration reserves extended from the former South Racecourse site, located on the

[101] The historical documentation does not support a claim that Albert Morris advocated for shrub and tree planting because he believed that mature plants were required on a restoration site to shelter from harsh arid conditions the naturally regenerating seedlings of long-lived, perennial plant species. He knew that colonising species naturally regenerated on degraded sites, and sheltered the seedlings of "old man salt bush, cassias, wattles, and the like…" (Anon. "Erosion Problem West of Darling" *Barrier Miner* p.1, 29 April 1936).

corner of Queen and Jamieson Streets, South Broken Hill, to the Silverton Tramway corridor, near the Broken Hill Cemetery, Barrier Highway (See Appendix B – Diagram).

The North, South and Zinc Corporation mines have also combined efforts in erecting a vermin proof fence from the old South racecourse to the rear of the Cemetery, a stretch some four to five miles long. This will enclose a half-mile stretch of country in which will be grown natural flora. This measure is also being taken to check the sand-drift which is severer on the south of the city. If successful this may be continued to eventually enclose the city with natural herbage, the best means of stopping the dreaded drift of the sand (Anon. "Splendid Outlook" *Barrier Miner* p.9, 12 December, 1936).

Illustration 13. The first regeneration reserve and rail post fence 2017 Source: P Ardill

The fencing work commenced on or before 30 September, at the former racecourse site, and was supervised by "Mr Boland" (Anon. "Sand Drift Menace" *Barrier Miner* p.3, 30

September 1936). By approximately early November the fencing had progressed to the city abattoir (visible in 2017), mid-way to the city cemetery (Anon. “More Trees” *Barrier Miner* p.1, 10 November 1936). So, the first regeneration reserve to be fenced was located between the former South Racecourse site and Wentworth Road (Illustrations 13 and 14).

> *The fencing scheme being carried out by the North, Zinc Corporation, and South mines* [three mining companies] *for the regeneration of natural flora as a protection for the city against the sand-drift problem is being pushed ahead. The fencing of the area to the south-west is almost completed. It is expected that the fence, which has nearly reached the Abattoirs, will be continued to the back of the Cemetery within the next few weeks* (Anon. “More Work Planned About City” *Barrier Miner* p.1, 19 November 1936).

Illustration 14. First regeneration reserve and vegetation 2017 *Source: P Ardill*

By late January 1937 the fencing of the regeneration reserves had nearly been completed: “men are now working behind the Cemetery” (Anon. “Stemming Tide” *Barrier*

Miner p.1, 27 January 1937). A further newspaper account states that the fencing was completed in February 1937: "The fencing of these paddocks [reserves] was only finished last February…" (Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937).

Margaret Morris wrote that five reserves were created (Morris, M. 1939c p.46). A team of workers erected the fences.[102] Conducted in the heat of summer on exposed, sandy plains and involving heavy manual lifting and possibly excavating, the work would have been very demanding.

There must have been some celebrations in the Cornish Street, Railway Town home of Albert and Margaret Morris when the last section of fencing was installed near the cemetery in February 1937. Perhaps a little apprehension was voiced too. Concerns about the weather and rainfall, and whether powerful, mobile sand-drifts could be stabilised may have dominated many conversations. How would the fencing of the once accessible public common be received by the Broken Hill community? The extent of natural distribution of seed in the newly fenced reserves, and the need to apply alternative revegetation strategies in case of seed scarcity would have been further sources of worry.

e. The initial set of regeneration reserves: 1936 or 1937?

Margaret Morris maintained that it was in 1937 (not in 1936) that Albert first spoke to A. J. Keast about establishing a "fenced area", or the regeneration reserves (Morris, M. 1939d). The regeneration reserves were "done in the spring and summer of 1937 and early in 1938" (Anon. "Regeneration Areas" *Barrier Miner* p.7, 30 September 1939; Morris, M. 1939c p.47). "These first areas were fenced just two years ago" i.e., late 1937 (Morris, M. 1939d). Quite likely informed by Margaret, University of Sydney botanists Dr Ilma Pidgeon and Professor Eric Ashby reported that the fencing of the first regeneration reserves was done between July 1937 and February 1938 (Pidgeon, Ashby 1940 p.123)

[102] Also see Webber (1992) pp.48-50.

(see sections 5 and 7 for the plant survey work of Pidgeon and Ashby). However, these accounts of the fencing are incorrect.

Albert must have proposed the regeneration reserves project to Keast in approximately mid-August 1936, as Broken Hill Council approved the project on 27 August 1936 and the formal commencement was announced by Mr Fairweather on 7 September 1936. In a 1938 article Albert recorded that work on the regeneration reserves commenced "almost immediately" after he convinced manager Keast of the merits of the project (Morris, A. 1938 p.47). Historical newspaper reports referred to in the previous sub-section demonstrate that the surveying and fencing work commenced in September 1936 and the fencing continued throughout the spring and summer.

Additionally, Albert Morris reported that on 9 January 1937 "500 saltbushes were planted outside the iron fence [of Plantation No.1] in one of the regeneration paddocks" (Morris, A. 1938 p.47). Albert would only have referred to the planting area for the saltbushes as a "regeneration paddock" if, in fact, it had been fenced, to form a regeneration reserve, or paddock. This report by Albert further confirms that following commencement in September 1936, the fencing of the initial regeneration reserves had advanced to land located between Plantation No.1 and the nearby abattoir by at least the start of 1937.

There are numerous other historical newspaper reports that confirm the 1936 start to the fencing of the regeneration reserves. As mentioned, historical print media reported that the fencing of the first set of regeneration reserves was completed in February 1937 (Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937). An April 1937 newspaper report stated that "The erection of a rabbit-proof fence from the old South racecourse to the Silverton Tramway line behind the Cemetery has been completed… The project was started more than four months ago, and the final touches were completed only recently" (Anon. "Move To Check Drift Sand" *Barrier Miner* p.1, 13 April 1937). On 18 June 1937 the visiting South Australian Erosion Committee was taken on a tour of "the regeneration area sponsored by the Zinc Corporation, South and North mines" (Anon. "Checking Drift" *Barrier Miner* p.3, 18 June 1937).

f. Administration of the regeneration reserves

On 7 October 1936 the Barrier Field Naturalists Club resolved to request the relevant authorities to have the fenced areas on the common (Crown land) declared a sanctuary for indigenous plants and animals (Committee, Barrier Field Naturalists Club 1970. 7 October 1936). The regeneration reserves located on the common were publicly notified as set aside "For Preservation of Native Flora" on 18 June 1937 (*Government Gazette NSW* 18 June 1937 Issue No.84 p.2354).

The Western Lands Commissioner[103] met with representatives of Broken Hill Council and the Mine Managers Association on 28 May 1937 to "discuss provisions to give effective supervision to the companies' regeneration scheme". The parties agreed that the council should be appointed trustee (Anon. "Common Area Regeneration" *Barrier Miner* p.6, 29 May 1937). This agreement was proclaimed on 12 August 1937 (*Government Gazette NSW* 12 August 1937 Issue No. 118 p.3313). Council assumed actual management of the regeneration reserves in mid-1939 (Anon. "Regeneration Areas" *Barrier Miner* p.4 23 June 1939).

Rigorous by-laws governing the management of the regeneration reserves were published on 25 March 1938. Public access to the reserves was forbidden and appointed honorary rangers were empowered to enforce the by-laws. Heavy financial penalties could be imposed for breaches of the by-laws (*Government Gazette NSW*. 25 March 1938 Issue No. 46 p.1279).

Albert Morris, Jack Scougall and Maurice Mawby were appointed honorary rangers, along with three other men (Anon. "Rangers Appointed" *Barrier Miner* p.3, 25 March 1938). Scougall, a mining company employee, had been involved with the tree plantation scheme since its inception; in 1942 he was working as plantation foreman (Anon. "Amazing Productivity" *Barrier Miner* p.5, 25 July 1942). From approximately 1940 he managed the Zinc Corporation nursery for an extended period.

[103] State government appointed administrator of the Western Division.

g. Extending the project: the regeneration reserves of 1937–38

Total rainfall in 1936 was 209 millimetres, well below the Broken Hill (Patton Street) annual average of 260 millimetres (Bureau of Meteorology). However, good falls of rain were recorded during the fencing of the first set of regeneration reserves. The summer of 1 December 1936 to 28 February 1937 recorded 130 millimetres of rain, an amount that substantially exceeded the long-term, average summer rainfall total of 73 millimetres for Broken Hill (Bureau of Meteorology). The final rainfall total for 1937 was a reasonable 242 millimetres (Bureau of Meteorology).

Natural regeneration of indigenous vegetation within the new reserves was abundant. As revealed in section 2, Albert Morris had observed Spear Grass and other local indigenous grass species with a perennial rootstock naturally regenerating after rain (Morris, A. n.d. 3, p.15). He must have anticipated the "good growth" of Spear Grass that occurred within the reserves, after the healthy falls of rain in the summer (Morris, A. 1938, p.48).[104] The new growth was widespread.

> *The fencing of these paddocks* [reserves] *was only finished last February but they are already proving their worth, as the grass is waving about two feet high over a large area, especially in the paddock behind the Cemetery……* (Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937).

Natural regeneration of previously heavily grazed Mulga, *Cassia* spp. and Dead Finish (*Acacia tetragonophylla*) rootstocks also occurred (Morris, A. 1938, p.48).[105]

[104] Spontaneous natural regeneration of Spear Grass rootstock, and quite likely spontaneous natural regeneration of Spear Grass plants from naturally distributed seed.

[105] It is highly likely that colonising herbs and shrubs also naturally regenerated at this time and stabilised soils, but the historical documentation only refers to grasses. The historical documentation suggests that the first formal plant survey was only undertaken in 1939 (see section 7 *Revegetation of the regeneration reserves*).

The newly formed South Australian Soil Erosion Committee visited Broken Hill in June 1937, to view the plantations and regeneration reserves (Anon. "Checking Drift" *Barrier Miner* p.3, 18 June 1937). The committee included Chairperson, W. J. Spafford, a senior South Australian government agriculture administrator, and Dr A. E. V. Richardson, a distinguished Australian agricultural scientist (Ardill 2022 pp.32-34).[106] Albert Morris conducted the committee members on a tour of the plantations, nursery and regeneration reserves. Keast, Dr I. MacGillivray and Dow also met the visiting committee. Spafford and the committee were highly impressed by "the regeneration area" project (Anon. "Checking Drift" *Barrier Miner* p.3, 18 June 1937). They suggested that the reserves be extended around the southern perimeter of Broken Hill, from the former racecourse site to Bonanza Street (airport road), and believed that the entire city should eventually be encircled by reserves (Anon. "Checking Drift" *Barrier Miner* p.3, 18 June 1937).[107]

The "remarkable" natural regeneration occurring in the reserves encouraged Keast and the Mine Managers Association to seriously consider the southern extension suggestion of the Soil Erosion Committee.

The growth of flora in the fenced-in regeneration area, extending from the south side of the old South racecourse to the Silverton Tramway railway crossing near the Cemetery, has been remarkable… it was the undoubted success of this section which had prompted the companies to continue their work (Anon. "Checking Sand Drift" *Barrier Miner* p.1, 3 August 1937).

During August and September 1937 land located between the former racecourse site and Bonanza Street in south Broken Hill was fenced (Anon. "Sand Drift Problem Being Tackled" *Barrier Miner* p.1, 20 August 1937). The Mine Managers Association (the three mining companies) paid for the fencing of this reserve, the sixth to be created.

Confidence was emerging that the sand-drifts located along the city's south-west

[106] Richardson visited separately, due to his busy schedule.
[107] They were quite interested in the plantations too, as an exercise in dry climate revegetation.

perimeter would indeed be stabilised by naturally regenerating vegetation, and that the city's ongoing problems with sand and its impacts on homes, schools, essential infrastructure and the daily routine of residents would be relieved.

A. J. Keast said today that the rain would be of inestimable value in encouraging the growth of the shrubs in the regeneration area. He was pleased with the results attained so far, and expected that the sand drift menace would receive a big check by the project (Anon. "Sand Drift Problem" *Barrier Miner* p.1, 20 August 1937).

Plans were prepared for the extension of the regeneration area around the north-west perimeter of the city (Anon. "Sand Drift Problem Being Tackled" *Barrier Miner* p.1, 20 August 1937). Extending from the cemetery to Silverton Road and then to Kaolin Street – Nine Mile Road (near Zebina Street), work commenced in December 1937, and was scheduled to be completed by early March 1938 (Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937; Anon. "Stemming Tide of Drift Sand" *Barrier Miner* p.1, 15 February 1938). Margaret Morris wrote that this was the seventh reserve to be fenced (Morris, M. 1939c p.46). The Mine Managers Association paid for the work.

By February 1938, Keast was very confident that the sand-drift problem would be successfully managed.

"In all about four miles of the worst section of the city has been enclosed with vermin-proof fence. This will have the effect of encouraging natural flora in that area [Keast said].*"*

…in a few years the growth will have intensified to such an extent that the sand-drift problem which has confronted this city for years will have been overcome (Anon. "Stemming Tide of Drift Sand" *Barrier Miner* p.1, 15 February 1938).

This report suggests that naturally regenerating local vegetation, the "natural flora", was proving to be an effective stabiliser of the larger sand-drifts, but there is no historical documentation available that directly confirms this possibility.

Despite the revegetation successes and newspaper speculation that plans for new reserves were being prepared, the financial supporters of the project made it clear in February 1938 that further extensions would not be considered until the success of the reserves had been proven "beyond doubt" (Anon. "Stemming Tide of Drift Sand" *Barrier Miner* p.1, 15 February 1938). Recent dry months had become a concern, and the ability of freshly regenerated vegetation to survive in these conditions was being carefully monitored (Anon. "Stemming Tide of Drift Sand" *Barrier Miner* p.1, 15 February 1938). Only 30 millimetres of rain had fallen between 1 November 1937 and 30 January 1938, and February was proving to be dry too (Bureau of Meteorology). The first six months of 1938 yielded a total of less than 30 millimetres, and by July little natural regeneration had occurred in the new reserves of the north-west perimeter (Bureau of Meteorology; Morris, A. 1938 p.48).

h. Appreciation of the regeneration reserves and their benefits

As natural regeneration of local vegetation progressed throughout the reserves in 1937, news of the project's impressive revegetation and erosion management outcomes spread beyond Broken Hill. As well as the South Australian Erosion Committee, the New South Wales Erosion Committee, University of Sydney geographer and authority on erosion, Professor MacDonald Holmes,[108] and New South Wales Minister for Mines and Forests, Roy Vincent, had inspected the reserves by the end of 1937 (Anon. "Plant Regeneration Around City of Broken Hill" *Barrier Miner* p.14, 11 December 1937).

Recently appointed New South Wales Soil Conservation Service Director, Sam Clayton, visited Broken Hill and inspected the regeneration reserves in June 1938 (Anon. "Overstocking and Sand Drift" *Barrier Miner* p.2, 22 June 1938). An experienced observer of erosion and its detrimental environmental, social and economic impacts, Clayton had undertaken a state government sponsored international erosion study tour in 1936

[108] Professor Holmes was a member of the New South Wales Erosion Committee and participated in the Committee's April 1936 erosion tour of Broken Hill (Anon. "Sand Drift Ravages" *Barrier Miner* p.3, 21 April 1936). He was regarded as an authority on erosion and soil conservation in Australia. His book, *Soil Erosion in Australia and New Zealand*, was published in 1946 (Walsh 1996).

(Sauter 2017 pp.329-331). As part of the tour, he visited the USA, and was aware of the New Deal tree planting work being undertaken there by the Civilian Conservation Corp, and the plan to plant "a series of wind breaks [shelterbelts] across the prairies from Canada to Mexico…" (Anon. "On The Land" *Sydney Morning Herald* p.9, 28 August 1936; Anon. "On The Land" *Sydney Morning Herald* p.7, 21 January 1937).[109]

Although the dry weather of early 1938 had impeded natural regeneration within the recently fenced north-west reserves, the reserves of the south-west were well vegetated, and Clayton was impressed. He immediately understood the implications of the revegetation outcomes for the management of soil erosion, and proffered much the same stock exclosure and natural regeneration advice to regional pastoralists that Albert Morris had proposed in his April 1936 submission to the New South Wales Erosion Committee.

The regeneration area scheme introduced by the Zinc Corporation, North, and South mines on the outskirts of Broken Hill has, in the opinion of Mr. Clayton, demonstrated in a striking manner how vegetative growth could be maintained in unstocked areas, reducing to a minimum soil erosion in the area encircled. Pastoralists might be well advised to experiment along similar lines on portions of their holdings, and if successful extend the project to give their runs greater safety against soil erosion, and also to provide protection for vegetation (Anon. "Overstocking and Sand Drift" *Barrier Miner* p.2, 22 June 1938).

Appreciation of the reserves and their benefits was developing among the residents of Broken Hill too, and members of a local progress association campaigned for the fencing of wind eroded land in their neighbourhood.

i. Extending the project: the regeneration reserve of December 1938 – March 1939

[109] Clayton was chair of the New South Wales Erosion Committee but missed the April 1936 erosion tour of Broken Hill, due to his international study tour (Sauter 2017 p.330).

A citizen community group keen to improve the amenity of south Broken Hill, the South Progress Association lobbied state Minister for Local Government, Eric Spooner, to fund the development of a regeneration reserve around the south-east perimeter of the city (Morris A., 1938 p.48; Anon. "Regeneration Area Work" *Barrier Miner* p.3, 12 December 1938; Anon. "Excellent Progress" *Barrier Miner* p.1, 24 February 1939). The estimated cost of the fencing was £2000, and a grant for this amount was approved by the state government of Premier, Bertram Stevens. Eroded land between Bonanza Street (airport road) and South rifle range was enclosed between December 1938 and March 1939 (Anon. "Excellent Progress" p.1, *Barrier Miner* 24 February 1939). Broken Hill Council managed the work, using a mix of iron and concrete posts for the fencing.

Although 1938 proved to be a testing, dry year, a four-day burst of wet weather in October produced a substantial 102 millimetres of rainfall, and it is quite likely that prolific natural regeneration of colonising grasses, forbs and shrubs occurred in the more recently fenced reserves (Bureau of Meteorology). The first set of five reserves certainly benefited from the welcome rain.

> *Out beyond the plantation* [as seen from the windows of the Zinc Corporation mine complex] *the country is greening up within the rabbit-proof fences, and there is a definite demarcation at the fence line where sandy waste meets this regeneration area* (Anon. "Amazing Transformation at Zinc Corporation Mine" *Barrier Miner* p.19, 10 December 1938)

By March 1939, regeneration reserves stretched from the north-west of the city, around the western perimeter and then past the airport to the south-east sector, covering an area of approximately 1000 hectares. Margaret Morris reported that the area fenced between 1936 and 1939 was comprised of eight "Regeneration Reserves" (Morris, M. 1939c, p.46).[110] The dimensions of each reserve varied, and were determined by the need to accommodate roads, rail corridors, various minor access routes, a section of Zinc Corporation mining leasehold and facilities such as the cemetery.

[110] Local botanist and Club member May Harding wrote that there were "nine areas", or nine regeneration reserves created between 1936 and 1939 (Harding, M. n.d.). Possibly she counted the section between the cemetery and Kaolin Street – Nine Mile Road as two reserves, as it was divided by the road to Silverton.

The total cost of the first seven reserves, those constructed between 1936 and 1938, was £2500, a very large sum of money. The cost was met by the Mine Managers Association (Morris, M. 1939c, p.46). As mentioned, the £2000 cost of the last reserve to be constructed, in 1938-39, was met by the New South Wales Government (Morris, M. 1939c, p.46).[111]

j. Community engagement, hardship, hostility

The social and economic benefits that arose from the development of the regeneration reserves were quite substantial. By 1938 the all-pervasive sand that had detrimentally affected the work, education and recreation of so many residents was being effectively controlled. Homes, schools, gardens, the cemetery, roads, rail lines and pathways were secured against sand-drift. The strain on the civic budget was eased, as tonnes of sand no longer had to be regularly removed from the urban area.

Sand drift has been lessened as a result of the ground cover… As a proof of this, many blocks of land that had been abandoned and the houses removed from them, have again been built on, and fences that have been cleared of sand have remained clear (Morris, M. 1942).

However, the need to protect the vegetation in the reserves came at a cost to individuals and communities. People who had for many years freely accessed the surrounds of Broken Hill for food and other resources were now excluded from large portions of the common.[112] Entry was controlled by locks and gates; honorary rangers enforced by-laws; punitive financial penalties applied. Individuals and families may have experienced hardship, when welcome supplies of rabbits, mushrooms and firewood could no longer be obtained.

[111] As a guide for the reader, and using an inflation measure, the total expenditure of £4500 equates to approximately $455,000 in 2021 Australian dollars (RBA 2023).
[112] The common is likely to have been used as a camping site by a range of people and communities. See Pearce (2019) p.92.

The historical documentation makes no mention of long established connections between people and common being considered by the Mine Managers Association during the planning stages of the project. There is no evidence of consultation with the community. Fairweather's announcement of the project in September 1936 took the form of directives; remarkably, the common was not mentioned and the public access issue was ignored.[113] The full amenity and economic benefits of the project were not carefully explained (Anon. "Sand Drift Problem" *Barrier Miner* p.1, 7 September 1936). When Albert Morris and his Club colleagues publicly raised the idea of fencing the common and revegetating the city perimeters in December 1935 and April 1936, they set out reasons for doing so, "to try and stop the sand from moving into town", and they welcomed participation by "interested persons" (Anon. "Soil Erosion Problem" *Barrier Miner* p.1, 4 December 1935). But the project managers failed to take advantage of this positive early publicity, by issuing regular updates on the progress of the fencing work, the anticipated community benefits and how the community could become involved.

Existing social tensions in the city may have generated community hostility towards the project. There was a strong tradition of trade union membership and socially progressive political activity in Broken Hill. The Mine Managers Association managed the project and the business orientated state government of premier Bertram Stevens[114] was a prominent supporter. Bitter disputes between the unions and mining companies often flared.[115] As work on fencing the first reserves commenced, an industrial dispute and then a miners' strike erupted, with approximately 3400 workers participating (Anon. "Barrier Strike" *Newcastle Morning Herald and Miners' Advocate* p.13, 2 October 1936).[116] Influenced by industrial and social grievances and inequalities, an indeterminate proportion of the city's population appears to have adopted a hostile attitude towards the regeneration area project, and defied the regulations established to

[113] Webber (1992) p.78 records community concern at being excluded from the common, and resultant vandalism. Keast's management strategy was to ignore this issue and push on with the fencing work.
[114] United Australia Party, a centre-right political party.
[115] A. J. Keast's frank exchanges with union officials during tough industrial negotiations were well reported in the *Barrier MIner*.
[116] Over the dismissal of a mine worker. Had workers traditionally accessed the common for food during strikes, particularly rabbits?

protect regenerating vegetation (Anon. “Regeneration Areas” *Barrier Daily Truth* p.2, 18 July 1942).

Probably all of these factors, resentment, hardship and social tensions, as well as outright criminality, contributed to the vandalism (or sabotage) and theft that became a common occurrence. Shortly after the first reserves were fenced in early 1937, twenty yards of wire netting were removed from the reserve near the cemetery (Anon. “Vandals Responsible” *Barrier Miner* p.2, 16 April 1937). Over the years there were many reported incidents of unauthorised livestock grazing, vegetation harvesting and firewood removal. Flowers and plants were often collected. Fences, gates and their locks were damaged, intrusions by motor vehicles occurred and rubbish was dumped.

The managers and supporters of the regeneration area project did acknowledge, belatedly, it would seem, that broad community support was essential to the success of the venture, especially if the fences were to be maintained.

The success or otherwise of the scheme depends to a great extent on the co-operation of the residents (Anon. “More Vandalism” *Barrier Miner* p.1, 3 March 1938).

[Mr A. J. Keast] *made a plea for the public to respect the work which the mining Companies were doing on its behalf* (Anon. “Vandalism in Regeneration Area” *Barrier Miner* p.3, 15 March 1938).

However, there was an ongoing failure to publicly acknowledge the disadvantages of the project, and respond to public resentment about being excluded from the common.

The social engagement issue continued to fester. Possibly sensing that their involvement was not welcome, in 1939 the Mine Managers Association handed over day to day management of the reserves to Broken Hill Council. A reference to resident’s lack of “civic pride” in the project was insensitive and patronising: by this time residents were actively engaging with the project; managers had ignored the connections established between individuals, families and communities, and the public common.

Mr Fairweather, president of the Mining Managers' Association, had told them [Broken Hill Council officials] *that the companies had provided the regeneration areas for the public, and felt that the sooner they were taken over by the public the sooner there would be developed a sense of civic pride that was so necessary for their preservation* (Anon. "Regeneration Areas" *Barrier Miner* p.4, 23 June 1939).

As well as having their access to vital natural resources abruptly blocked, Wilyakali people and families excluded from the common would have experienced cultural and spiritual hardships.[117] There is no historical documentation that reveals Wilyakali engagement with the regeneration area project being sought or occurring.[118] The historical documentation strongly suggests that managers of the regeneration area project did not publicly acknowledge the ecological knowledge of the Wilyakali community, and their long-standing relationships with the plants, animals and other natural features and places in the common, a part of their homelands.[119]

k. Death of Albert Morris

All projects are subject to setbacks, disruptions and even tragedies, and a devastating

[117] See Pearce (2019) pp.90-93 on the Wilyakali and the regeneration area.

[118] Aboriginal people contributed extensively to settler activities in Australia, but contributions were often not respected and publicly acknowledged by settlers. Settler historical documentation does not record use of Aboriginal traditional knowledge in the regeneration area project, but it is quite possible that knowledge was used, and not publicly recorded and respectfully acknowledged.

[119] Throughout the 1930s many Aboriginal people were campaigning in Australia for recognition of their social and legal rights, and the preservation of cultural heritage (Rowse 2017 pp.169-192). There were settlers who supported these campaigns and acknowledged Aboriginal cultural heritage, including residents of Broken Hill. Edmund Dow (the Club member) delivered at least one public lecture in Broken Hill about the injustices inflicted on Aboriginal peoples, including seizure of land and food resources, and "shootings, poisonings and general ill-treatment…Redress for past wrongs should be made…" (Anon. "The Aborigine: His Place in Society" *Barrier Miner* p.2, 16 March 1936). The Club successfully campaigned in 1926 for the declaration of "Mootwingee" reserve (now Mutawintji National Park), to preserve the Aboriginal art and cultural sites there, and Club members, Dr W. MacGillivray and Albert Morris, were appointed honorary rangers by the state government, a duty they exercised conscientiously (*Government Gazette NSW* 25 February 1927 Issue No. 26 p. 1199; Anon. "Meteorite at Mootwingee" *Barrier Miner* p.2, 22 October 1927). In 1929 they lodged vigorous public complaints against habitual cultural appropriator, A. S. Kenyon, for his theft of Aboriginal art from the Mutawintji cultural area (Anon. "Vandalism at Mootwingee" *Barrier Miner* p.3, 18 November 1929; see Griffiths 1996 p.230).

event that occurred in January 1939 cast a deep shadow over the regeneration area project. Albert Morris became seriously ill in approximately September 1938.[120] He was examined in Broken Hill by a visiting medical specialist, who diagnosed a brain tumour condition. Albert was flown to Adelaide in October 1938, where he received specialist medical treatment and underwent surgery. Margaret Morris and medical attendant Sister E. Elsie Simper also travelled to Adelaide. After a period of post-operation treatment, a still very ill Albert returned to Broken Hill, where he was hospitalised at Warrawee, Sister Simper's private hospital (Simper 1995).[121] Albert died on 9 January 1939, aged 52 (Anon. "Passing of Mr Albert Morris" *Barrier Miner* 9 January 1939).

In a generous tribute published on the day of Albert's death, A. J. Keast unequivocally accorded Albert full credit for the initiation of the "regeneration area" project (Keast 1939 p.3). Margaret Morris described Albert as "one who always worked for the good of all" (Morris, M. 1939b). Although Albert did not live to see the beneficial revegetation effects of the 1939 rains, he was aware of the initial successes of the project, and the wide acclaim that it had attracted by mid-1938. He must have found these tangible vindications of his environmental advocacy and botanical and ecological work enormously pleasing and personally satisfying.

Albert Morris was deeply committed to the conservation of Australia's arid zone ecosystems and their unique plants and animals. There can be no doubt, that in the absence of the Zinc Corporation's Plantation No.1 project and the regeneration lessons that it so fortuitously illustrated, Albert would have proceeded by some other enterprising means to realise his ambitions of revegetating the degraded surrounds of Broken Hill and restoring the eroded landscapes of western New South Wales.

……

[120] 1938 was a difficult year for Albert and Margaret Morris, with illness, dry weather and damage to the reserves creating ongoing worry.

[121] Sister Simper was emphatic in her typed statement describing Albert's illness and death: "The report of Albert Morris's death in the book "The Greening of the Hill" by Horace Webber is wrong" (Simper 1995).

5. War, consolidation, evaluation: 1939–45

Introduction

By mid-1939 the western and southern perimeters of Broken Hill had been relieved of threatening sand-drifts and local raised dust by a series of fenced regeneration reserves and their naturally regenerated local vegetation.[122] Acknowledging these outcomes and endorsing the project, influential Broken Hill newspaper, *Barrier Miner*, commented on the alleviation of the sand-drift threat.

REGENERATION AREA MUST BE PROTECTED

Progress made by natural flora in the regeneration area on the outskirts of Broken Hill since its establishment has been remarkable. Following the bounteous rains last October and subsequent heavy falls this year the growth of grasses shrubs and trees has been even more rapid than before, bringing about a wonderful change in an area that was formerly an expanse of drift sand, a constant annoyance to people living near by (Anon. "Regeneration Area" *Barrier Miner* p.2, 31 May 1939).[123]

Quite possibly, the Mine Managers Association and the state government were interested in funding the development of additional regeneration reserves. Keast had been very pleased with the revegetation outcomes, and addressing the state Legislative Assembly in July 1939, Minister for Mines and Forests, Mr Vincent, described the "regeneration work" as "truly magnificent", and "visualised the day when Broken Hill would be completely surrounded by vegetation" (Anon. "Stemming Tide of Drift Sand" *Barrier Miner* p.1, 15 February 1938; Anon. "Regeneration work" *Barrier Miner* p.4, 19 July 1939).

[122] By 1939 a small number of local and non-local plants had been planted in approximately two reserves (see section 7 *Revegetation of the regeneration reserves*).

[123] Detailed descriptions of how stabilisation of sand-drifts occurred were apparently not recorded. Did vegetation regenerate on the larger drifts and stabilise them? Did natural regeneration account for all stabilisation or was planting also used to stabilise large drifts, and how was this done? See Section 7 *Revegetation of the regeneration reserves.*

However, the historical documentation does not reveal firm proposals or plans to fence the northern and eastern perimeters of the city.

Any thoughts about extending the reserves must have rapidly faded, following the September 1939 outbreak of the Second World War, and the declaration of hostilities between Japan and Australia in December 1941. All available human and material resources were now directed towards the national military effort. Even with the conclusion of war in 1945, many years were to pass before work commenced on the development of more reserves around Broken Hill.

As outlined, Broken Hill Council assumed management responsibility for the regeneration reserves in mid-1939. The Mine Managers Association immediately offered to council a grant of up to £500 to assist with expenses, and in future years contributed sums of money towards maintenance of the reserves (Anon. "Regeneration Areas" *Barrier Miner* p.4, 23 June 1939). Keast and Mawby kept up their interest in the project, and undoubtedly exerted considerable administrative influence. Vandalism and theft were still problems, and a council ranger and appointed honorary rangers continually monitored the reserves (Anon. "Regeneration Areas" *Barrier Miner* p.4, 23 June 1939).[124]

During the war field naturalist, resident and administrative supporters of the regeneration area project consolidated, evaluated and looked to the future. Margaret Morris recognised the need to engage with the Broken Hill community. She promoted the social and environmental values of the regeneration reserves, by recording and publicising their historical development, revegetation and ecological outcomes and amenity benefits. The city emerged as a centre for the study of erosion management, and arid zone vegetation and ecosystems. Drought and dust permeated all of these activities.

Drought and dust: 1939–45

[124] In 1943, for example, 50 honorary rangers were appointed to patrol the regeneration area (Anon. "Regeneration Area" *Barrier Miner* p.2, 11 February 1943).

Throughout the war years Broken Hill experienced frequent, long periods of dry weather and drought. Only 1939 (320 millimetres) and 1942 (246 millimetres) recorded good annual falls of rain. In 1940, a drought year, only 57 millimetres of rain fell, and well below the average annual rainfall was recorded in 1941,1943, 1944, and 1945 (Bureau of Meteorology).

The reserves and their naturally regenerated vegetation had been widely praised in 1939, but the 1940 drought raised concerns in Broken Hill that the desiccated vegetation might completely fail, leaving vast stretches of soil exposed to heat and winds.

The [regeneration] *areas are very dry, and the only prolific growths are those of saltbush and spinifex grass... What grass there is in the area is dry, and native flora scarce. There are very few hops, everlastings and wild daisies, while bare patches of ground are apparent in many sections…The need for rain is apparent, and if there are not substantial falls soon the areas will suffer considerably* (Anon. "Regeneration Areas Suffer" *Barrier Miner* p.4, 26 November 1940).[125]

The plants that had naturally regenerated from seed during the good summer rains of 1936–37 were still only a few years old when the 1940 drought commenced. Would they be able to withstand the prolonged period of dryness that had set in? Seedlings and saplings that had their origins in the generous rainfall of 1939 surely faced a substantial risk of perishing. Margaret Morris directly addressed these questions about the resilience of the vegetation, and a range of other issues relating to the viability of the project.

Margaret Morris, botany, evaluation, research

A. J. Keast was pleased to learn that following Albert's death, Margaret Morris had indicated that she intended to continue her work with the regeneration area project.

[125] "Spinifex grass": quite possibly a colloquial reference to local grass species of the tussock form. "Hops, everlastings and wild daisies": quite possibly colloquial terms for local annual and perennial herb and shrub species with attractive flowers. "Hops" possibly referred to one or more species of genus *Dodonaea*.

We at the Zinc Corporation, offer our sincere sympathy to Mrs Morris, who, I am assured, will carry on the good work of her late husband (Keast 1939 p.3).

Margaret was well equipped to exercise botanical, advocacy and publicity roles in the regeneration area project. She had ample experience with the undertaking of vegetation surveys and plant field work. As her various newspaper articles reveal, she was quite familiar with Albert's experiments and field trials dealing with revegetation and erosion management. The articles also display her affirmative social and environmental values, useful personal attributes during years of war and drought.

During the war years members of the Barrier Field Naturalists Club continued their participation in the regeneration area project, with Clarence Chadwick and May Harding prominent. That Edmund Dow and Dr Ian MacGillivray had moved from Broken Hill by 1940 closed off valuable sources of expertise and support.

a. Botany, research, education

Margaret Morris managed the Zinc Corporation nursery until Jack Scougall took over in the early 1940s (Anon. "Twenty Years" *Barrier Miner* p.1, 13 April 1939).[126] Most importantly, she initiated botanical study of the regeneration reserves by local botanists[127] and contributed to the detailed recording of natural regeneration and plant species by conducting a plant survey in spring 1939 (see section 7 *Revegetation of the regeneration reserves*). Engaging with the official administrators of the reserves, Margaret presented her botanical report to Broken Hill Council in September 1939. The report described the vigorous natural regeneration of local vegetation that was occurring in the reserves, and recommended that a plant survey be conducted on an annual basis. The report formally confirmed to the Broken Hill community and council that fencing of

[126] The nursery supplied plants to the Zinc Corporation and its plantations, to residents, community groups and council for urban landscaping and for the small amount of planting undertaken in several regeneration reserves.

[127] A tradition that continues in the 2020s.

the common was proving to be an effective means of achieving permanent revegetation of the city perimeters and control of sand-drifts, as perennial grasses, shrubs and trees were regenerating (Anon. “Regeneration Areas Show Big Improvement” *Barrier Miner* p.7, 30 September 1939).

The generous 320 millimetres of rain that fell in 1939 certainly pleased Margaret (Bureau of Meteorology). Particularly good falls of rain were recorded in the first six months of the year. Vigorous growth of trees and shrubs was recorded, and species “not seen in these parts for many years” were naturally regenerating (Morris, M. 1939c p. 47).

Margaret also documented the recovery of local avifauna.

Another result of the enclosures was the number of birds that took advantage of the sanctuary… "As well as the ubiquitous crow we saw dotterel, magpie, song-lark and pipit, while the crimson chat and the orange chat made splashes of vivid color as they flitted about" (Anon. “Regeneration Areas” *Barrier Miner* p.7, 30 September 1939).

Unfortunately, Margaret’s plan to conduct annual botanical surveys was disrupted by the dry years of 1940 and 1941. Reasonable rains returned in 1942, and resuming the survey work, Margaret prepared a further botanical report for council and documented spectacular natural regeneration (Bureau of Meteorology; Morris, M. 1942) (see section 7 *Revegetation of the regeneration reserves*).

Margaret also reported the botanical outcomes and history of the project to the Australian scientific community, by preparing an article for the *Australian Journal of Science*. The article was published in 1939 (Morris, M. 1939c). She described the origins of the wind erosion that afflicted the region, the historical evolution of the regeneration area project, the botanical development of the regeneration reserves and the amenity benefits that had accrued to the Broken Hill community. Also in 1939, A. J. Keast publicised the project internationally, with an article in *The Rotarian* (Keast, 1939a). These reports by Margaret and Keast readily complemented Albert’s 1938 article on his revegetation work that was published in the popular and influential Australian geography and travel magazine, *Walkabout* (Morris, A. 1938).

From approximately 1939 the regeneration area was studied by a series of educators, scientists and researchers. They were particularly interested in arid zone natural regeneration and its characteristics, and the implications of the successful stock exclosure technique for the prevention and remediation of wind erosion in western New South Wales.

In 1939, University of Sydney botanists Professor Eric Ashby and Dr Ilma Pidgeon conducted a detailed botanical field study and statistical analysis of the natural regeneration that had occurred within the reserves. Their published report acknowledged Margaret's knowledge of the project and the local vegetation, and the assistance that she provided to the four university students who conducted the field work (Pidgeon, Ashby 1940; Anon "Here To Study" *Barrier Miner* p.3, 21 August 1939) (see section 7 *Revegetation of the regeneration reserves*). Also at this time, state Department of Agriculture agrostologist, Mr Hardy, studied the extensive range of grass species that had naturally regenerated within the regeneration reserves (Anon. "To Study Grass" *Barrier Miner* p.3, 19 August 1939).

Broken Hill residents promoted the educational values of the regeneration reserves. Possibly inspired by the botanical work of Albert Morris, in 1940 a campaign to establish a botany course at Broken Hill Technical College came to a satisfactory conclusion (Anon. "Botany Class Planned" *Barrier Miner* p.2, 6 September 1940). The first teacher was field naturalist and entomologist, Clarence Chadwick. In 1942 Chadwick and his students conducted a plant survey of the regeneration reserves; Margaret Morris also participated (Anon. "Botany Classes" *Barrier Miner* p.4, 13 September 1941; Anon. "Plant Study in Regeneration Area" *Barrier Miner* p.4, 18 August 1942). Chadwick moved from Broken Hill in 1944, and that year presented a "fine collection of local plants" to the college (Anon. "Students Wanted" *Barrier Miner* p.3, 3 March 1947).

May Harding commenced as college botany teacher in 1945. A skilled botanist and field naturalist, she taught botany and art for many years, and promoted interest in the regeneration reserves and the local vegetation and ecosystems.

Miss Harding has conducted a Plant Study circle and has carried out researches on the Broken Hill regeneration areas. The course in Botany offers an opportunity to obtain a good general knowledge of the subject and special information on the interesting local flora (Anon. "Students Wanted" *Barrier Miner* p.3, 3 March 1947). [128]

Harding also contributed to a botanical study conducted within the reserves in 1942 (Harding, M. n.d.) (see section 7 *Revegetation of the regeneration reserves*).[129]

University of Sydney Lecturer, Noel Beadle, and Professor, Eric Ashby, arranged for a large party of botany students to examine the regeneration area in 1946, "to study plant ecology or plant life in relation to its environment" (Anon. "Botany Students From Sydney" *Barrier Miner* p.1, 30 August 1946). The regeneration reserves and plantations were inspected in 1948 by Director of the Inland for Western Australia, Mr Brockman, and various New South Wales Forestry Commission officials, including botanist and plant ecologist, Wilfred De Beuzeville[130] (Anon. "Forestry Officers" *Barrier Miner* p.4, 26 January 1948).

During the war the regeneration area generated substantial interest among researchers engaged with the study of soil erosion and its management. As revealed, between 1939 and 1946 Noel Beadle was employed as a botanist and erosion researcher by the New South Wales Soil Conservation Service. He inspected the reserves in 1940 and 1941, and probably on many other occasions, and they significantly influenced his work (see section 7). During his visits to Broken Hill Beadle would call on Margaret Morris,[131] and it is, of course, highly likely that they discussed the regeneration area and the revegetation and erosion management work conducted prior to and during the project.

[128] Harding utilised J.M. Black's *Flora of South Australia* (volumes published between 1922 and 1929) as her main "flora", or botanical guide (Anon. "What Is the Name of This Plant" *Barrier Daily Truth* p.3, 27 March 1952)

[129] Possibly as part of Chadwick's study.

[130] Pioneering New South Wales rainforest restorationist, Ambrose Crawford, consulted De Beuzeville in 1936 about the selection of appropriate plant species for his project (see section 7 for a description of Crawford's work).

[131] Personal communication to author by email on 13/01/2022 from Dr Barbara Briggs AM PSM, niece of Margaret Morris.

Professor Macdonald Holmes continued to utilise the regeneration area and the Broken Hill region as field study sites for his students, visiting on at least three occasions in 1939 and 1941, as well as in 1937.

Professor Macdonald Holmes' expressed amazement at the rapid progress of the regeneration areas. The areas have gone ahead remarkably since he last visited Broken Hill [1937]. *In his opinion the regeneration scheme is one of the most outstanding features of the district. He hopes that the people of Broken Hill will realise the value of the areas and preserve them* (Anon. "University Students" *Barrier Miner* p.3, 31 May 1939).

South Australian government erosion officers inspected the regeneration reserves in 1942, and "stressed the value of the experimental work being done" (Anon. "Regeneration Area" *Barrier Daily Truth* p.3, 18 August 1942). Commissioned to investigate Broken Hill's often precarious water supply, South Australian Government Engineer, Mr J. R. Dridan, reported that the catchments of the local reservoirs should be fenced in the same way as the regeneration reserves, to preserve indigenous vegetation, stabilise soils and reduce calamitous silting of the reservoirs.

"Destruction of the vegetation cover and disturbance of the ground surface by depasturing stock has, however, accelerated erosion, and the careful reservation of the catchment areas for water gathering purposes only would have afforded a great measure of protection for the reservoirs and prolonged considerably their useful life."

"The regeneration area in Broken Hill provides ample evidence of the excellent results obtainable by the exclusion of all grazing stock" (Anon. "Mr Dridan Favours River Scheme" *Barrier Daily Truth* 15 January 1945).

b. Advocacy, publicity

As well as devoting her time to botanical surveys and plant nursery work, Margaret took on the roles of project publicist and advocate. A competent author, she promoted the aesthetic features and social benefits of the reserves in a series of Broken Hill and Adelaide newspaper articles published between 1939 and 1941.

A *Barrier Miner* newspaper article by Margaret described the history of the project, its scientific significance and the amenity benefits (Morris, M. 1939d). In the same article, Margaret carefully explained, in non-technical, accurate language, the potential obstacles that might impede natural regeneration within the reserves, and how these challenges could be managed.

> *It may be found that some areas have been so eroded that there is no seed left of useful plants or that the ground is so denuded of topsoil that plant life is unable to establish itself; in these cases it may be necessary to help either by providing suitable seed or some help to the soil* (Morris, M. 1939d).

In another article, Margaret outlined a specific economic benefit that arose from the reserves. The protective fencing was conserving the many attractive plant species that grew in the Broken Hill area, for example, Sturt's Desert Pea (*Swainsona formosa*). As a result, the flourishing wildflowers in the reserves were drawing tourists to the city (Anon. "Regeneration Areas Show Big Improvement" *Barrier Miner* p.7, 30 September 1939).

Published in the influential Adelaide newspaper, *The Chronicle*, articles by Margaret documented the environmental and social changes that occurred in Broken Hill, as the regeneration area project transformed the barren, sandy wastes on the city's outskirts and created an attractive boundary of natural vegetation around the city (Morris, M. 1939a, 1939b).[132] The success of the project inspired council, residents, progress associations and the mining companies to undertake a series of landscaping projects within the urban area.[133] Streets, parks, the cemetery and vehicular approaches to the city were planted with trees (Batten 1953).

[132] See Denton (1988) p.372: evolution of Broken Hill from a transitory to permanent settlement.
[133] The landscaping projects consisted of tree planting, were essentially beautification work and were not part of the regeneration area project.

As discussed, the severe 1940 drought raised concerns in Broken Hill that the regeneration reserves and their vegetation would be unable to recover from the harsh conditions. Undeterred by dry soils and the pervasive dust, and displaying a considerable degree of ecological perceptiveness, Margaret Morris directly addressed the resilience issue.

Although the grass is burnt and dry the roots are not dead. The seed is piled up in every depression, only waiting for the rain, when it will spring to life again and soon be green…

Amongst the dry grass and protected by it, are many plants of mulga and wattle trees, as well as cassias and several shrubs. These are making quite good growth in spite of the dry season, and when rains do come they should soon go ahead (Morris, M. 1940).

Margaret explained to residents that the roots of the vegetation continued to stabilise the soil of the reserves, despite the extreme conditions. She emphasised the importance of maintaining long-term management of livestock, to ensure ongoing natural regeneration of the local vegetation, and its conservation (Morris, M. 1940).

Margaret also kept up her work with the Barrier Field Naturalists Club, and served a term as Club secretary in the 1940s. She continued to advocate for the reserves in the post war years (see section 6).

Margaret's carefully chosen words confirmed to the Mine Managers Association, residents, community organisations, civic administrators and elected representatives of Broken Hill that the regeneration reserves were valuable, durable public assets. Substantial revegetation outcomes had resulted in the stabilisation of threatening sand-drifts, creating a more comfortable and attractive urban home for residents. Many critics of the project must have been won over by her evocative and informative newspaper articles. Citing ill-health, Margaret moved to Sydney to live with her sister in 1944. She returned to Broken Hill on occasions to visit, lecture and attend meetings, including in 1947 and 1949. A committed and skilled advocate for the regeneration area project,

Margaret died in 1957, just one year before the fencing of the last regeneration reserve was completed.

Community engagement with the project

As well as Margaret Morris, her field naturalist colleagues and members of the Australian academic and scientific community, there were other individuals and organisations that fostered social engagement with the regeneration area project and promoted its benefits. A. J. Keast supported the community planting events conducted in several reserves by the South Progress Association ("Cheap Fares" *Barrier Miner* p.3, 22 April 1939; Anon. "A Green Belt", *Kalgoorlie Miner* p.4, 19 May 1948). The association planned a reserves tour, inviting "all citizens of Broken Hill" to attend a "public inspection of the South regeneration area", an event which "promised to be interesting as well as instructive" (Anon. "Regeneration Area" *Barrier Miner* p.4, 23 July 1940).[134] At least another two progress associations embraced the reserves: in 1941 the Railway Town Progress Association and Central-West Progress Association planted trees in local reserves (Anon. "Railway Town Progress Association" *Barrier Daily Truth* p.4, 19 August 1941; Anon. "Central-West Progress Association" *Barrier Daily Truth* 4 February 1941).[135] A growing number of residents must have welcomed the amenity benefits and financial savings that arose, as natural regeneration within the fenced sections of public common alleviated the sand-drift and dust problems in the south and west of the city.

The New South Wales state election of 1941 resulted in defeat for Premier Stevens and his government, and victory for the Australian Labor Party. Incoming premier, William "Bill" McKell, took a serious interest in regional and rural affairs. As leader of the state parliament's major opposition party, McKell had supported the introduction of the *Soil Conservation Act* (1938) by the Stevens government.[136] For McKell, the degradation caused by wind and water erosion, and the economic, social and environmental

[134] The reserve funded by the state government and constructed between 1938 and 1939. Event cancelled due to bad weather.
[135] Approximately 100 to 200 plants.
[136] An Act informed by the research of Sam Clayton and the NSW Soil Erosion Committee.

repercussions were compelling issues that demanded the attention of legislators and administrators (Cunneen 2012). Quite possibly, the well publicised interest of a popular Labor Party premier in erosion management and soil conservation won over more Broken Hill residents and community members to the regeneration area project.

Levels of social engagement and satisfaction with the regeneration area project may have improved as the benefits became apparent, but during the 1940s an indeterminate number of city residents continued to ignore the regulations that governed use of the reserves.[137] A 1942 ranger's report to Broken Hill Council described extensive "vandalism": vegetation was being destroyed, and fences damaged (Anon. "Regeneration Areas" *Barrier Daily Truth* p.2, 18 July 1942). Owned by peak Broken Hill trade union body Barrier Industrial Council, the *Barrier Daily Truth* newspaper responded to the report. The newspaper tacitly acknowledged that fencing of the regeneration reserves by the mining companies and their executives was a provocation to some residents. Still, the newspaper proposed, the reserves were a community asset and created considerable benefits for all the residents of Broken Hill. The measures that had been put in place to protect the vegetation should be respected (Anon. "Regeneration Areas" *Barrier Daily Truth* p.2, 18 July 1942).

……

[137] The level of damage mentioned in newspaper reports suggests that many people, possibly at least one or two hundred people, were accessing the reserves.

6. Completion of the Broken Hill regeneration area: 1946–58

Introduction

The frequent periods of below average rainfall and drought that the far west of New South Wales experienced during the war years quite probably led to increased loss of vegetation and soil cover. Certainly, the severity of dust storms increased, and they became more frequent. A dust storm on 30 January 1945 was widely considered to be the worst in Broken Hill's history, with a total blackout experienced for nearly an hour (Anon. "Dust" *Barrier Daily Truth* p.2, 31 January 1945). Extremely dusty local conditions made it difficult for residents to travel far from the city. "We are in actual fact Prisoners in the Great Dust Bowl of the Far West" (Anon. "Dust Bowl" *Barrier Daily Truth* p.2, 17 October 1944). Oppressed by years of dryness and dust, in 1946 residents and elected representatives of the city appealed to the state government for a resumption of the regeneration area project, full encirclement of the city with reserves and expansion of the project to regional scale.

Broken Hill regeneration committee: 1946–48

Premier McKell visited Broken Hill in May 1946 to inaugurate the construction of the Menindee to Broken Hill water pipeline, a project designed to alleviate the city's ongoing water shortages. Elected members of Broken Hill Council took full advantage of McKell's visit. At a public reception the dust and erosion problems of the city were brought to his attention by the mayor, also a member of the Australian Labor Party.

> *"I want the Premier to see the regeneration area…I suggest that you, Mr. Premier, and your Party reclaim an area of I5 miles around this city, and that would help to relieve the dust"* (Anon. "Premier and Visiting Party" *Barrier Daily Truth* p.4, 13 May 1946).

Margaret Morris had predicted that the first set of good rains would allow the regeneration reserves to quickly recover from the dry years of the 1940s, and following

good falls of rain in January and February 1946, extensive natural regeneration did occur (Bureau of Meteorology; Anon. “Regeneration Area” *Barrier Daily Truth* p.2, 30 July 1946). The reserves and their healthy vegetation made a strong impression on McKell, and he subsequently noted that they “showed up splendidly” against the rest of the barren, overgrazed landscape (McKell 1946).

Anxious to address the dust and erosion problems of Broken Hill, McKell immediately instructed his Minister for Conservation, George Weir, to arrange a regeneration conference. The conference was to be held in the city, and establishing some form of “Conservation or Regeneration Park” was to head the agenda (McKell 1946). The premier personally announced the details of the conference (Anon. “Regeneration Conference” *Barrier Miner* p.3, 16 May 1946).

Always generous with its allocation of print space to the regeneration area project and erosion issues, in an immediate editorial response to Mckell’s announcement the *Barrier Miner* demanded that a holistic view of the erosion problem be adopted. As well as calling for remediation of local and regional erosion damage, the editorial recognised the need for regulation of pastoral stocking rates, to prevent further erosion.

We Must Demand Regeneration

The institution of a scheme for checking the deterioration of the area immediately surrounding Broken Hill should be coupled with a wider scheme for checking deterioration of the whole of the West Darling pastoral country. The latter would seem to demand at least a limitation on the number of sheep West Darling country is allowed to carry (Anon. “We Must Demand Regeneration” *Barrier Miner* p.3, 16 May 1946).

Community dissatisfaction with frequent dust storms, the economic significance of Broken Hill as a source of minerals and mining revenue, and the sheer gravity of the regional erosion problem and the threat that it posed to pastoralism were factors that pressured McKell and his government to address the environmental challenges that confronted Broken Hill and the far west of New South Wales. Also, there was a growing realisation in the city that the regeneration reserves were resilient, even during conditions

of severe drought. The creation of an even larger zone of naturally regenerated vegetation around Broken Hill, to further relieve the dust problem, was now viewed as a highly feasible proposition.

The regeneration conference was set for October 1946, and The Barrier Field Naturalists Club wasted no time in lobbying Minister Weir. Club Secretary, May Harding, invited the minister to address a meeting in Broken Hill on either "regeneration or conservation", during the week of the conference (Harding 1946). Citing the pressure of his busy schedule, Weir declined (Weir 1946).

The regeneration conference was held in Broken Hill on 9 October 1946. A wide range of commercial, political, community and special interest groups attended. Minister Weir addressed the delegates.

The regeneration areas established by the late Albert Morris, the mining companies, and the City Council have shown that regeneration of natural species of vegetation will follow if kept free from grazing by stock… On certain critical areas where vegetation is slow in appearing, it may be necessary to plant some shrubs. Establishment of these will not be easy and provision must be made for watering; therefore the extent of artificial re-establishment of vegetation must be kept as low as possible (Anon. "First Steps" *Barrier Daily Truth* p.3, 10 October 1946).

Constructing a fifteen miles deep regeneration zone around the city to reduce the dust problem was discussed, and the formation of a Broken Hill Regeneration Committee was ratified (Anon. "First Steps" *Barrier Daily Truth* p.3, 10 October 1946).

A range of stakeholders was represented on the Committee: The Graziers Association, Broken Hill Chamber of Commerce, The Pastoralists Association, Broken Hill Council, Barrier Industrial Council, NSW Department of Conservation, Mine Managers Association and other community and industry groups; Barrier Field Naturalists Club opted for observer status (Anon. "Initial Regeneration" *Barrier Daily Truth* p.4, 31 January 1947). The Wilyakali community was not represented on the Committee, and no mention appears to have been made of them or their interests.

The formal terms of reference permitted the Committee to look at ways and means of extending the existing regeneration area around the northern and eastern perimeters of the city, to mitigate the dust and sand-drift nuisance. Proposals to establish further regeneration reserves within a reasonable distance of Broken Hill could also be examined by the Committee (Anon. “Initial Regeneration” *Barrier Daily Truth* p.4, 31 January 1947).

The Committee met in January and August 1947. Margaret Morris was visiting Broken Hill, and accepted an invitation issued by the Committee and attended the August meeting (Anon. “Initial Regeneration Proposal Put” *Barrier Daily Truth* p.4, 31 January 1947; Anon. “Regeneration Committee Endorses Half Mile Scheme” *Barrier Daily Truth* p.3, 13 August 1947).

Although perhaps tinged with sadness, Margaret must have enjoyed much of her visit to the far west, as the regeneration reserves were thriving and the Regeneration Committee recommended the construction of additional reserves, to fully encircle the city.

PLEASED BY GROWTH.

Mrs. Morris made a thorough inspection of the present regeneration area and was delighted at the excellent growth…

Mrs. Morris said her late husband always considered that to be effective, the regeneration area would have to be extended right round the city and for a depth of about half a mile.

NEED FOR SUPPORT.

She was pleased the local Regeneration Committee had decided on the extension of the scheme, but considered it would need the wholehearted support of the Broken Hill people in the project (Anon. “Regeneration Extension Plan Praised” *Barrier Miner* p.5, 16 August 1947).

Sensitive to the dust and erosion issues afflicting Broken Hill, in February 1948 Minister Weir approved the Committee's recommendation. The fencing would be stock-proof but not rabbit-proof (Anon. "Broken Hill" *Barrier Daily Truth* p.1, 24 February 1948).

The proposal to create a fifteen miles wide regeneration belt was deferred, pending further examination of the relevant land ownership issues. The possibility of having regeneration work done at Mundi Mundi Plains, located 30 kilometres to the west of Broken Hill and a suspected source of dust storms, was to be further investigated (Anon. "Broken Hill" *Barrier Daily Truth* p.1, 24 February 1948).

There is no record of the latter two schemes being implemented. Vested interests quite possibly influenced this outcome: the Pastoralists Association was not supportive of an expanded regeneration scheme. Also, the incidence and severity of dust-storms quite possibly decreased after 1945, and this welcome development may have eased community pressure for the construction of a larger regeneration area. An improvement in the dust situation can possibly be attributed to enhanced natural regeneration of vegetation throughout the arid regions, as annual rainfall returned to more normal levels from 1946 (Bureau of Meteorology; Cattle, 2016). Possibly, a reduction in overstocking by the pastoral industry contributed to regeneration and conservation of the vegetation.[138] The successful release of Myoxma virus in the early 1950s and a subsequent decrease in the rabbit population may have further boosted vegetation density.

The final reserves of the regeneration area project: 1950–58

Work commenced in October 1950 on the regeneration reserve planned for the strip of public common located between Nine Mile Road–Kaolin Street and Racecourse Road (Anon. "Regeneration Fence" *Barrier Mine*, p.12, 27 October 1950) (Illustrations 15 and 16).

[138] As per state government policy and legislation, from 1949 (see Ardill 2022).

The Minister [George Weir] *said that this strip* [Kaolin Street to Racecourse Road] *was the first of several designed to almost completely encircle the city and which will be fenced against stock to allow natural regeneration of vegetation including herbage, grasses, bush and trees* (Anon. "Regeneration Area" *Barrier Daily Truth* p.3, 29 January 1951).

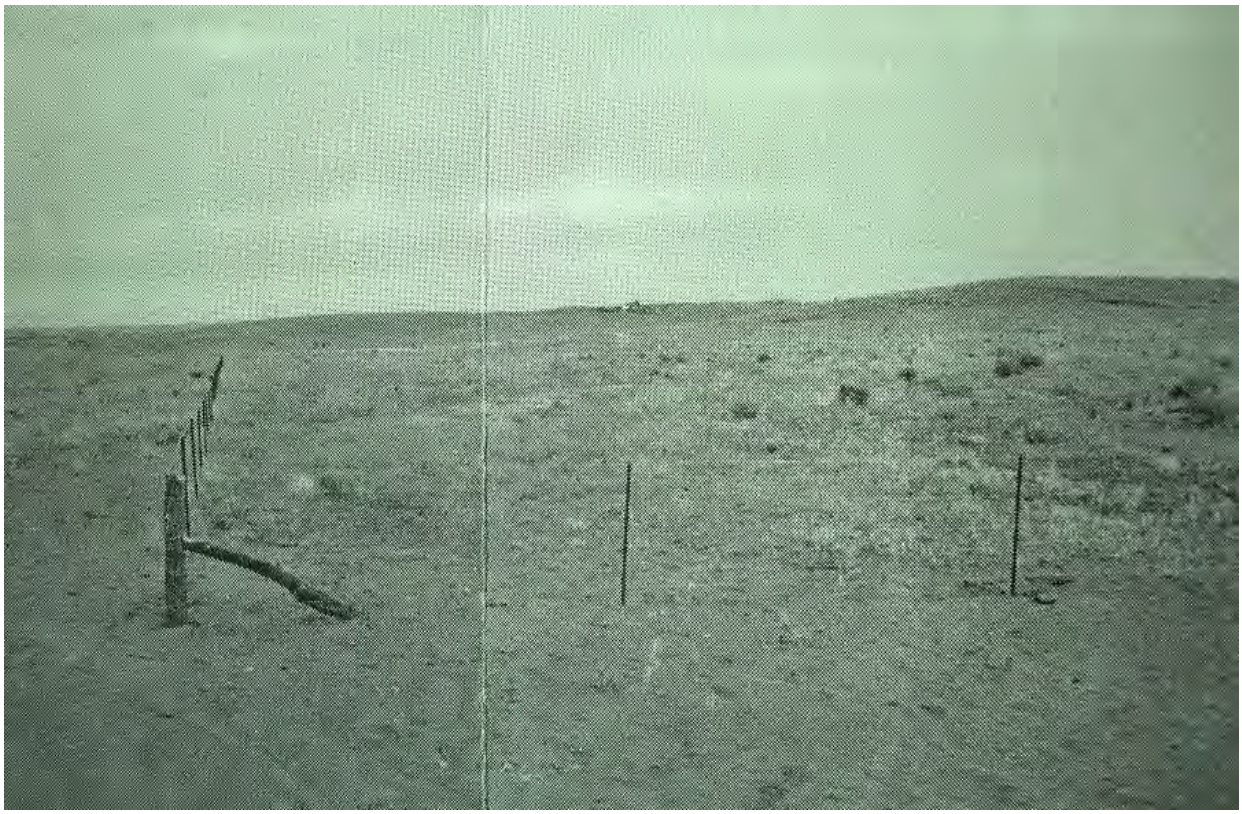

Illustration 15. New 1950–51 regeneration reserve and recently completed fencing Source: Zinc Corporation 1951

Minister for Conservation, George Weir, announced in January 1951 that the reserve was operational. Natural regeneration within the reserve proved to be extensive.

The Minister said that natural growth of herbage, bush and trees on the first of the Department's regeneration areas, since it was fenced in 1951, had been most encouraging (Anon. "Regeneration of Vegetation" *Land* p.45, 3 July 1953).

After several months of fencing work in the common by contractors, in July 1953 Conservation Minister, Ambrose Enticknap, announced completion of the regeneration reserve located to the north-east of the city, between the Radio Station (Racecourse Road) and the road to Wilcannia (Barrier Highway) (Anon. “Regeneration Area” *Barrier Daily Truth* p.4, 27 March 1953; Anon. “Regeneration Area Fenced” *Barrier Miner* p.5, 4 July 1953).

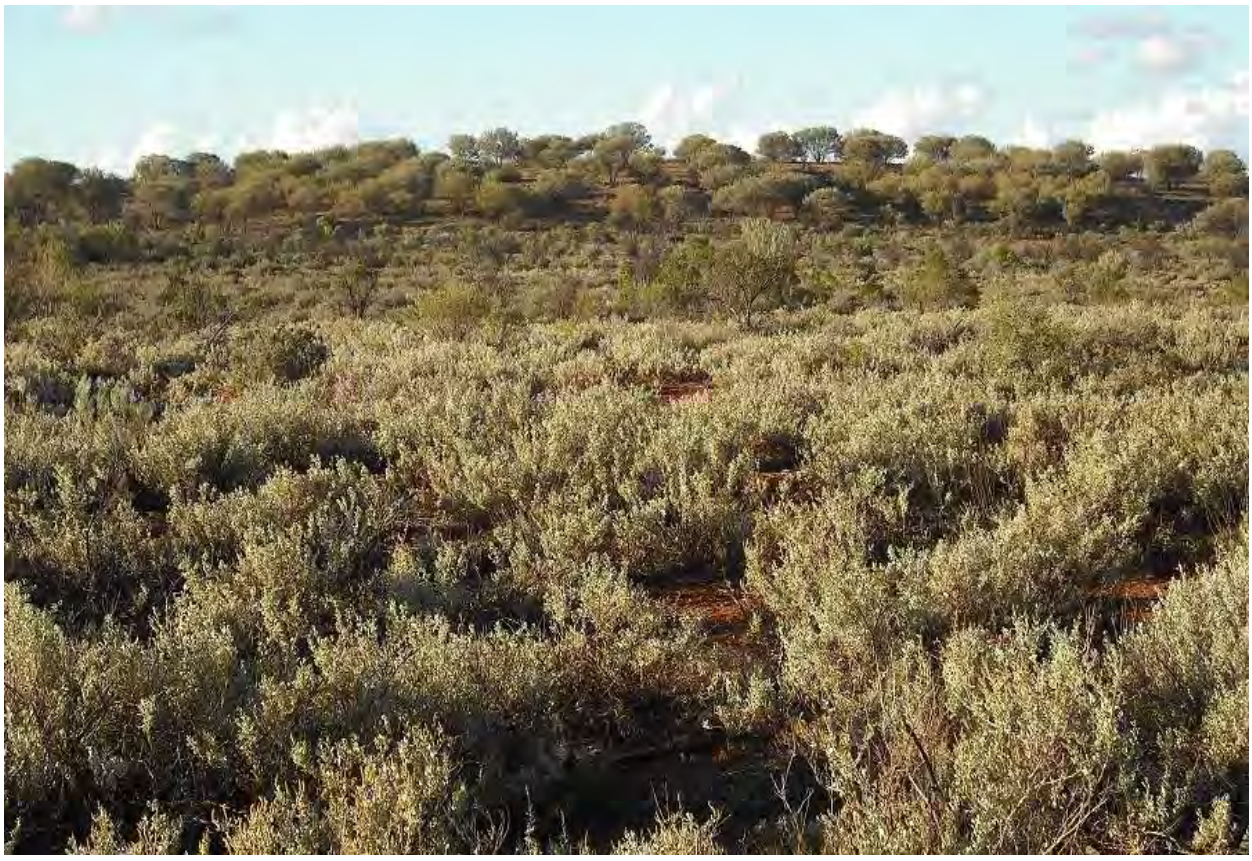

Illustration 16. The 1950–51 regeneration reserve in 2017 with Mulga on hill and saltbushes foreground Source: P Ardill

Enclosing a stretch of public common located between the Menindee Road and South rifle club, fencing of the final regeneration reserve commenced in approximately July 1958. Minister for Conservation, Ernest Wetherell, announced the completion of the project in October 1958 (Anon. “Saving Of Our Silver City” *Sydney Morning Herald* 17 June 1958; Broken Hill Demonstration Supply File - Fencing File 60/1451. NSW State Archives. Kingswood, NSW; Wetherell 1958).

Extending over approximately 1700 hectares (4200 acres), the Broken Hill regeneration area was now fully operational. The costs of fencing the last three reserves were primarily met by the New South Wales state government, with Broken Hill City Council and the Mine Managers Association also contributing funds (Broken Hill Regeneration Area Demonstration Supply File. Fencing File. Item 60/1451. 1948-60. NSW State Archives. Kingswood. NSW). The reserves were declared a fauna sanctuary on 5 December 1958, in accordance with the provisions of the *Fauna Protection Act 1948* (NSW) (*Government Gazette NSW* 5 December 1958 Issue 122 p.3719).

……

7. Appraisal of the Broken Hill regeneration area project

Revegetation of the regeneration reserves

The immediate objective of the regeneration area project was to revegetate targeted sections of Broken Hill's public common and a smaller section of mining company leasehold. Recovery of substantial levels of ecological functioning and the stabilisation of sand-drifts were major aspirations. The revegetation objective was attained; the ecological and erosion management aspirations were fulfilled.

These were remarkable achievements. How were the targeted sections of common and leasehold revegetated? Did one or more specific revegetation concepts or techniques particularly contribute to the revival of the vegetation? Answers to these questions reveal the botanical and ecological foundations of the project, and contribute to the claim that it should be regarded as an ecologically informed environmental repair undertaking of historical significance.

The historical documentation pertaining to the regeneration area project refers to a number of revegetation techniques: stock exclosure and natural regeneration, planting, irrigation, seed scattering and furrowing (Anon. "Plant Regeneration" *Barrier Miner*, p.14, 11 December 1937; Morris, A. 1938 p.48; Morris, M., 1939c, p.47). Commentators have described the use of a range of revegetation techniques (Denton 1988 p.372; Webber 1992 pp.73-75, 82-85; Jones 2016 p.48; Sauter 2017 pp.198-206; Pearce 2019 p.80).

A close reading of the historical documentation reveals that Albert Morris and subsequent managers of the project made relatively little use of shrub and tree planting, irrigation, seed scattering and furrowing as revegetation techniques. These were ancillary activities used to manage specific revegetation and erosion challenges, such as scalds, or to achieve beautification outcomes. They accounted for a very small proportion of the revegetation achieved within the reserves.

Revegetation of the reserves occurred because natural regeneration of local vegetation was encouraged: livestock and rabbits were excluded from the reserves by fencing, and when the naturally distributed seed of local plant species germinated within the reserves, the resultant seedlings flourished.[139] The rootstock of perennial species also naturally regenerated.[140]

The historical documentation presented in section 2 of this article reveals that by 1936 Albert Morris and the Club had settled on the application of a stock exclosure concept and the harnessing of natural regeneration as their primary means of revegetating the degraded perimeters of Broken Hill. A. J. Keast made it clear in his 1939 *Rotarian* article that there was "no idea" of conducting extensive tree planting programs, and that the intention was to exclude stock and encourage the vegetation to "come back", or naturally regenerate (Keast 1939a. p.28).

Following fencing of the first five regeneration reserves by February 1937, rapid natural regeneration of perennial grasses and "flora" occurred (Anon. "Checking Sand Drift" *Barrier Miner* p.1, 3 August 1937; Anon. "Plant Regeneration" *Barrier Miner* p.14, 11 December 1937; Morris, A. 1938, p.48). Albert Morris reported that as at June 1938, more than one year after the fencing of the first reserves, no planting had been conducted, with one exception.

> *With the exception of the section behind the Albert Morris Park* [the park was Plantation No.1] *…the regeneration paddocks* [reserves] *have been left to nature, no planting having been done. They showed good growth of spear grass…* (Morris, A.1938 p.48).

By 1939 natural regeneration of grasses, forbs, shrubs and trees was extensive.

> *The recent rains have worked wonders on the regeneration area, continued Mrs. Morris. Young mulgas, some two feet high, were growing plentifully, while thousands of acacias were springing up near the Silverton road…*

[139] As outlined in section 1, categorised as spontaneous natural regeneration.
[140] Spontaneous natural regeneration.

"The whole [regeneration] *area has blossomed beyond expectations, and naturally the excellent season we are experiencing is having the desired effect," said Mrs. Morris* (Anon. "Twenty Years of Botanical Study" *Barrier Miner* p.1, 13 April 1939).

A series of botanical studies recorded the remarkable transformation that occurred within the reserves. University of Sydney botanists and plant ecologists Professor Eric Ashby and Dr Ilma Pidgeon were drawn to a study of the regeneration reserves specifically because of the dramatic natural regeneration that had occurred: "there is need to study the rate and nature of regeneration in this country" (Pidgeon, Ashby 1940 p.124).[141] They recorded 143 annual (78) and perennial (65) plant species, and concluded in their report that "fencing the land has restored the vegetation" (Pidgeon, Ashby 1940 p.127, 125-126, 132) [142] (Illustration 17).

As discussed, Margaret Morris presented her first botanical report on the regeneration reserves to Broken Hill Council in September 1939. She recorded 142 species.

Mrs. Morris's report said that the ground cover was satisfactory in all enclosures, the wealth of grasses being particularly pleasing, containing a large number of perennial species…

The number of trees and shrubs that have made their appearance is little short of marvellous…

Although all of the reserves were doing well, No. 9 (from the Silverton road to the Nine Mile road) called for special mention because of the great number of young mulgas that were growing rapidly, as well as thousands of cassia bushes of three varieties [species]

[141] The ecological knowledge of Aboriginal peoples would have encompassed natural regeneration. Albert Morris and his field naturalist colleagues had been studying natural regeneration in arid zone ecosystems for many years; their study used a less formal scientific method.

[142] Pidgeon and Ashby surveyed the regeneration reserves and a comparative section of unfenced common; their surveys did not include the plantations. The botanical surveys of Margaret Morris and May Harding (to be presented) focused on the regeneration reserves, and did not include the plantations.

(Anon. "Regeneration Areas Show Big Improvement" *Barrier Miner* p.7, 30 September 1939).[143]

Illustration 17. Natural regeneration at Broken Hill (1) left: unfenced common; right: "South regeneration reserve" (2) left: "western" regeneration reserve; right: unfenced common and cattle August 1939 [144] Source: Pidgeon, Ashby (1940).

There are no historical records of planting or seed scattering being conducted in the reserves on this scale. These plants had naturally regenerated.

[143] Margaret Morris referred to the natural regeneration in the reserves as "most surprising" (Morris, M. 1939c, p.47). She was referring to the great range of species and numbers of plants that naturally regenerated, and the rapid growth of plants, rather than expressing surprise that natural regeneration had occurred.
[144] Heavy rains, totalling approximately 220 millimetres, fell in Broken Hill during the first six months of 1939 (Bureau of Meteorology). Although exposed to regular grazing, even the unfenced common exhibited vegetation for a period (Pidgeon, Ashby 1940 p.124).

Following the drought years of 1940 and 1941, Margaret Morris resumed her surveys of the regeneration reserves. Natural regeneration of grasses, shrubs and trees was widespread.

The trees most commonly found to come up naturally are the Mulgas (Acacia aneura) which have appeared in most blocks ["the reserves"] *and are fairly plentiful…Grasses and annuals are numerous and form a good cover, almost the whole area being covered… Saltbushes of all sorts have come up well in most Reserves and should seed and multiply throughout the paddocks* [regeneration reserves] *and adjoining* [unfenced] *common* (Morris, M. 1942 p.2).

The historical documentation does not reveal estimates of how many plants naturally regenerated in the reserves. The descriptions of widespread natural regeneration that do exist, illustrations, and the size of the reserves (approximately 900 hectares or nine million square metres in 1939), suggest that at least two to three hundred thousand grasses, forbs, shrubs and trees had naturally regenerated by approximately 1942, which is one plant per 30 to 45 square metres.[145] Quite possibly, the figure was much higher.

Field naturalist and Broken Hill Technical College botany teacher, May Harding, participated in an additional 1942 botanical survey. The vegetation cover was extensive.

The [regeneration] *areas only appear to be covered with a few barren patches… A census of the nine areas* [regeneration reserves] *from June to November* [1942] *resulted in 216 species being found, 204 of which occurred naturally, and the remainder Eucalyptus, Nitraria*[146] *and so on have been planted, selected because they belong to the dry conditions of the area and will help to stabilise matters* (Harding, M. n.d. p.1).

Harding's data reveals that natural regeneration accounted for ninety-five per cent of the species growing in the regeneration reserves. The natural regeneration of saltbushes

[145] This estimate makes provision for scalds, rocky outcrops and other areas of naturally low vegetation cover, although as May Harding reported (see next quote), there were only a few bare patches in the reserves.
[146] Possibly Nitre-bush (*Nitraria billardierei*), a local species tolerant of the saline and exposed clay conditions characteristic of scalds.

was prolific. Harding recorded a total of forty saltbush species growing in the regeneration reserves; fifteen of the forty species occurred in "all areas" of the regeneration area, and "the remainder were absent from only one or two areas" (Harding, M. n.d. p.2). [147]

There are no historical records that reveal plants of this many saltbush species being propagated in a nursery and planted in the reserves, or of their seed being scattered.[148] Harding's comments further confirm that planting targeted specific erosion problems, such as scalds, "to stabilise matters".

Many hundreds of thousands of grasses, forbs, shrubs and trees would have been required to adequately revegetate, by planting, the seventeen million square metres of land that comprised the completed regeneration area.[149] There is not the slightest doubt

[147] Hundreds of thousands of plants had naturally regenerated in the regeneration reserves by 1942, primarily from seed, and also from existing root stock. However, the common had been vegetatively degraded for many years. Why was there viable plant seed in the reserves? There are a number of possible explanations. A range of local plant species grew in the common until approximately 1900, by which time it was seriously degraded and reduced to bare soil, due to ongoing overgrazing by livestock (Anon. "Sand Drifts" *Sydney Morning Herald* p.13, 22 April 1936). Until approximately 1900 and the onset of degradation, the seed of these plant species would have been deposited in the soil of the common. Seed deposited at this time that was possessed of long-term viability, such as Mulga seed, would have remained dormant, only germinating when certain environmental conditions were satisfied, as in 1939 (Morris, A. n.d. 1 pp.124-125; Bureau of Meteorology). Protected by fencing, the Mulga seedlings flourished. Degraded Mulga rootstock also naturally regenerated (Morris 1939 p.48). Furthermore, between approximately 1900 and fencing of the reserves in 1936, periods of good rainfall quite possibly created opportunities for the cyclical replenishment of the degraded common's seed-bank. For example, following good rains and the germination of soil-stored seed, substantial plant growth quite possibly occurred in the degraded common. Some of these plants may not have been grazed, because they were located a prohibitive grazing distance, for livestock, from water resources. The distance that livestock will graze from water resources depends on a range of environmental factors, and can vary (Wilson, Hodgkinson, Noble 1984 p.279). Quite possibly the ungrazed plants produced seed, and the seed-bank of the degraded common was replenished. Also, after good rain, soil stabilising but less palatable grasses and shrubs, such as Bunched Kerosene Grass (*Aristida arenaria* syn. *contorta*), and low shrub, Twiggy Sida (*Sida intricata*) (both recorded in the fenced reserves: Pidgeon, Ashby 1940 pp.124, 125-126), quite likely regularly grew and seeded prolifically in the degraded common, because they were less likely to be consumed by livestock attracted to abundant, more palatable plants. And quite possibly seed, including seed of low viability such as that of many grass and saltbush species, was regularly produced by plants protected by hills, rocky outcrops and crevices within the common, and by plants located in protected, urban fringe areas of Broken Hill, such as the South racecourse site and the cemetery, road and railway corridors, and fenced areas. This seed would have been naturally distributed by wind, water and animals. Quite likely, prior to fencing of the reserves, Albert and Margaret Morris and their conservation colleagues observed for many years the natural seed production and distribution processes that operated within the degraded common, particularly in years of good rainfall.

[148] To have collected the seed of this many saltbush species, for direct seeding (or scattering) or to use for plant propagation and subsequent planting would have been an outstanding achievement, well worthy of documentation by Margaret Morris or May Harding, but documentation of this kind was not found.

[149] 1700 hectares; 4200 acres or 6.6 square miles.

that had they been implemented, planting activities conducted on this scale would have been well reported in Broken Hill's two newspapers. However, there is absolutely no mention in the historical documentation of large-scale plant propagation, planting, shelterbelt or irrigation schemes being conducted as part of the regeneration area project. The historical documentation only reveals a limited number of relatively small, highly targeted planting, irrigation, seed scattering and furrowing activities.

As outlined, planting work was conducted in a specific section of one regeneration reserve located on the Zinc Corporation leasehold: "the section behind the Albert Morris Park" (the park was Plantation No.1) (Morris, A. 1938 p.48). The work commenced in January 1937. Relative to the approximate 600 hectares size of the regeneration area project at this time, the quantities of plants used were extremely modest. The small quantity suggests that the area planted was much less than the 9 hectares of Plantation No.1.[150] A scald was furrowed. Seed was scattered, most likely in the furrows.[151]

The regeneration area immediately behind the Albert Morris Park [Plantation No.1] *was ploughed in 50 yard squares (a single furrow) to break up the wind scalded area and afford a place for seeds to collect and germinate. It was also found that enough water was available to plant salt bush and myoporum*[152] *outside the iron fence of the park, and then a line of trees and bushes, zig-zag across the area in a westerly direction, the idea of the broken line being to check the strong wind action. Over 1000 salt bushes and about 750 trees were planted in this area, and the coming year should see many more on the way.*[153]

Seeds have also been scattered in this area and one other, but some areas are being left entirely to nature for the time being, and the results obtained will be of great scientific value, as it is surprising the number of different plants that are "coming back" (Anon.

[150] Converted to an active mining site in 1948.
[151] Quite probably seed was hand scattered (direct seeding) in the furrows created by ploughing of the scald. Accordingly, the ploughing of the scald and subsequent recruitment of plants did not constitute facilitated natural regeneration.
[152] Quite possibly Boobialla (*Myoporum montanum*), a local shrub or small tree. See Pidgeon, Ashby (1940) p.126.
[153] The tree species were not specified. Quite possibly they included "*Eucalyptus*" (Harding, M. n.d. p.1).

"Plant Regeneration" *Barrier Miner*, p.14, 11 December 1937; see also Morris, A. 1938 p.47, 48).[154]

By 1939 a "little" planting of saltbushes had been undertaken in "several" reserves by individuals and progress associations, to augment seed-banks, and seed scattering had been undertaken in "places" (Morris, M. 1939c, p.47). As outlined, the Railway Town Progress Association and Central-West Progress Association planted small numbers of unspecified tree species in the regeneration area during 1941.

Apart from the planting in the reserve behind Albert Morris Park (Plantation No.1), the historical documentation strongly suggests that the only other planting work of any substance undertaken in the reserves was that of Roy Edwards and Bill Cuy, community minded members of the South Progress Association. In approximately 1938 they planted trees (unknown species) in a dry creek bed within a regeneration reserve, and Athel Pines around the base of "old disused tailing dumps";[155] A. J. Keast welcomed their involvement and the Zinc Corporation was able to supply a limited amount of water ("Cheap Fares" *Barrier Miner* p.3, 22 April 1939; Anon. "A Green Belt", *Kalgoorlie Miner* p.4, 19 May 1948). The Corporation supplied a second water pipeline, and planting was undertaken in the vicinity of the former South racecourse site, around a "second dump" and along streets, using saltbushes, Athel Pines and other tree species, including non-local species indigenous to Western Australia (Anon. "South Progress Association" *Barrier Daily Truth* p.3, 5 September 1941; Anon. "A Green Belt", *Kalgoorlie Miner* p.4, 19 May 1948). Interestingly, although not conclusively demonstrated, documentation suggests that planting targeted the larger sand-drifts that were threatening houses in south Broken Hill (Anon. "Cheap Fares" *Barrier Miner* p.3, 22 April 1939). Edwards and Cuy used approximately 6000 trees and shrubs in this series of planting work (Anon. "A Green Belt", *Kalgoorlie Miner* p.4, 19 May 1948). An indeterminate proportion of the work was undertaken in regeneration reserves, and a proportion in streets.[156]

[154] This reserve could be gravity fed with water from the newly constructed Zinc Corporation mine complex.
[155] Tailing dump: stockpile of mined but unwanted ore.
[156] All or most of the tailing dumps were quite likely located within the regeneration reserves.

Edwards and Cuy also planted a reported 14,000 trees in south Broken Hill between approximately 1949 and 1953, apparently for community beautification purposes (Anon. "City Council" *Barrier Miner* p.5, 23 February 1951; Anon. "Regeneration Report" *Barrier Daily Truth* p.1, 31 January 1951; Batten, M. 1953). The Zinc Corporation provided a water pipeline, and "three rows of trees" were planted on each side of the aerodrome road (Bonanza Street) and watered,[157] and quite possibly many of the local streets were landscaped with trees (Anon. "A Green Belt", *Kalgoorlie Miner* p.4, 19 May 1948; Anon. "News For The South" *Barrier Miner* p.4, 7 August 1953; Batten, M. 1953). Quite possibly, a significant proportion of this planting work was conducted in the regeneration reserves that bordered south Broken Hill (Anon. "City Council" *Barrier Miner* p.5, 23 February 1951). Many, and possibly all of the species that Edwards and Cuy used were non-local species indigenous to other regions of Australia, particularly Western Australia (Anon. "Warning To Residents" *Barrier Daily Truth* 19 December 1949).

To summarise, the total number of shrubs and trees that Edwards and Cuy planted in the regeneration reserves is unknown. Quite likely they used between 10,000 and 17,000 plants in the reserves. The survival rate is unknown. When measured against the overall size of the regeneration area project and the numbers of plants that naturally regenerated, their work constituted a very small part of the overall revegetation process.

The historical documentation reveals that Albert Morris developed a land management mind-set informed by the local ecosystems, their functioning and evolved adaptations to climatic and other environmental conditions (McDonald T. in Jordan and Lubick 2011, p.73). His revegetation technique made effective use of a distinctive ecological feature of arid zone vegetation, a capacity to naturally regenerate after a period of good rainfall. Particularly interested in this aspect of the project, during the 1940s botanists, plant ecologists, land managers and soil conservation researchers studied the regeneration reserves. The project's high levels of ecological sensitivity significantly contribute to its national and international status as a settler environmental repair project of exceptional merit and historical significance. Application of formal conservation measures was another important feature of the project (McDonald, T. in Jordan and Lubick 2011, p.74).

[157] Outside the regeneration reserves. Possibly this involved approximately 2500 plants.

Effective erosion remediation techniques

There were discernible conceptual and technical similarities between the erosion remediation and revegetation techniques trialled and applied by Albert Morris and his conservation colleagues, and those subsequently developed by New South Wales soil conservation researchers. The similarities reflect favourably on the work of the Broken Hill conservationists.

Established in 1938, the New South Wales Soil Conservation Service is a state government organisation dedicated to soil conservation research and erosion management.[158] As outlined, Noel Beadle joined the Service in 1939, working as a botanist and soil conservation researcher in western New South Wales.[159] He surveyed the regional indigenous vegetation communities and the extent of wind and water erosion, and then commenced revegetation and erosion remediation research. Ecologically focused, in 1940 Beadle was investigating stock exclosure and natural regeneration, furrowing and the selection, propagation and planting of suitable indigenous vegetation to stabilise scalds (Anon. "Rapid Loss of Soil" *Farmer and Settler* p.5, 18 July 1940).

Albert Morris would have enjoyed a chat with Beadle but apparently they never met. The latter probably first became aware of the regeneration area in 1939, when he fleetingly visited Broken Hill as part of a Linnean Society of New South Wales botanical expedition (Whalley 2015). He lectured to the Barrier Field Naturalists Club in 1940 and 1941 (Anon. "Story of A Seed" *Barrier Daily Truth* p.3, 30 September 1941). As already outlined in section 5 of this article, during his stays in Broken Hill Beadle would visit Margaret Morris,

[158] Operational in 2022.

[159] As outlined, Soil Conservation Service researcher between 1939 and 1946. Appointed Lecturer in Botany, University of Sydney, in 1946. Appointed Foundation Professor of Botany, University of New England, New South Wales, in 1954.

and his botanical and erosion research must have benefited from Margaret's engagement with the regeneration area project and her botanical surveys.

Beadle was invited to attend the October 1946 regeneration conference held in Broken Hill, but was unable to go as his new position of Lecturer in Botany, University of Sydney, necessitated an overseas study trip. However, he did prepare a written report, in which he analysed the revegetation successes that had been achieved in the regeneration reserves by the application of a stock exclosure concept and the harnessing of natural regeneration (Beadle 1946). Minister for Conservation, George Weir, made good use of the report in his address to the conference (Anon. "First Steps" *Barrier Daily Truth* p.3, 10 October 1946).

Beadle's report explained the significance of the regeneration area's revegetation and erosion management outcomes.

The existing regeneration reserves at Broken Hill have demonstrated that
(a) regeneration of the vegetation is possible;
(b) that regeneration is relatively rapid and
(c) that exclusion of stock minimises the sand-drift problem
(Beadle 1946).

As revealed in section 6 of this article, the regeneration conference explored the possibility of implementing a fifteen miles deep regeneration strip around Broken Hill. Beadle suggested in his report, as a means of managing the overstocking problem that led to wind erosion in the first instance, that if a larger regeneration project was established, it "should have as its prime object the estimation of the correct carrying capacity on range and treeless plains country" (Beadle 1946). The revegetation successes of the Broken Hill regeneration area had confirmed to Beadle that in lieu of the complete exclusion of livestock from the Western Division, a politically, economically and socially impractical proposition, determining appropriate stocking levels could significantly assist with the conservation of indigenous vegetation and management of the wind erosion problem, as the vegetation demonstrably possessed capacity to naturally regenerate.

Beadle, in his landmark 1948 publication on arid lands vegetation, plant ecology and erosion management, *The Vegetation and Pastures of Western New South Wales*, again acknowledged the success of the stock exclosure and natural regeneration approach to revegetation and erosion management (Beadle 1948). Deriving a further lesson from the regeneration area project, Beadle noted in his publication that the time required for successful vegetation recovery is related to the frequency of "good seasons", or years of good rainfall (Beadle 1948 p.219, 82). Having referred to Margaret Morris's 1939 *Australian Journal of Science* article, he must have been aware of Albert's advice to pastoralists to fence off a section of their properties to allow natural regeneration of indigenous vegetation (Beadle 1948 p.219). Quite possibly this knowledge influenced Beadle and his erosion management work, as he encouraged pastoralists to revegetate their degraded properties by planting nursery propagated Old Man Saltbush in fenced reserves (Ardill 2022 p.52).

Most importantly, Beadle recognised that the regeneration area project and its ecologically attuned revegetation technique demonstrated a viable way to restore the millions of hectares of eroded land that he had recorded in his survey of western New South Wales (Ardill 2022 pp.53-54). The regeneration area project, as well as Beadle's own soil conservation research, favourably influenced inclusion in the *Western Lands (Amendment) Act 1949* (NSW) of provisions that codified stock exclosure and the encouragement of natural regeneration as land management techniques, and outlawed overstocking (Ardill 2022 p.55).

That a botanist and researcher of Beadle's stature made use of the revegetation outcomes of the regeneration area project and perceived their relevance to the remediation of eroded arid lands is an impressive testament as to the quality of the Broken Hill conservationists' work. The reader will recall that erosion management specialists Professor Macdonald Holmes and Sam Clayton also highly praised the project. As mentioned in section 2 of this article, Beadle acknowledged Albert Morris's 1923 publication, *Flora Between the River Darling and Broken Hill* as an important contribution to arid lands ecology literature (Beadle 1948 p.15).

Between approximately 1950 and 1970 the Soil Conservation Service devoted resources to the study of stock exclosure and natural regeneration, direct seeding, furrowing and the propagation of indigenous vegetation. The Service experimented at its Fowlers Gap research station[160] with stock exclosure and natural regeneration, and in his new capacity as a university academic and researcher, Noel Beadle played a prominent role in the experiments (Mabbutt 1973). The management of scalds by ripping and furrowing was also investigated at Fowlers Gap (Mabbutt 1973). As mentioned in section 2 of this article, revegetation techniques bearing similarities to those espoused by Albert Morris, Dr I. MacGillivray and Edmund Dow, namely livestock grazing management, direct seeding and furrowing were trialled by the Service from approximately 1950, in the Broken Hill and Cobar regions (Green 1989).

There clearly were conceptual and technical similarities between the erosion management techniques developed by the Broken Hill conservationists and subsequent Soil Conservation Service field trials and experimental work dealing with erosion. These similarities support a claim that the conservationists' work, ecologically focused and technically skilled, constituted an important contribution to the development of effective, environmentally sustainable erosion management techniques that could be applied to the degraded arid landscapes of western New South Wales. In fact, the historical record suggests that Albert Morris, Langford, Brougham, Dow and the MacGillivrays pioneered the development of arid zone erosion management in settler New South Wales.[161]

Similarities with subsequent restoration practice

Throughout the 1960s and 1970s Sydney sisters, Joan and Eileen Bradley, played prominent roles in the evolution of the historically significant Sydney bush regeneration movement. The Bradley's work focused on recovery of indigenous vegetation overwhelmed by weeds. They developed a widely respected approach to this form of

[160] Approximately 100 kilometres north of Broken Hill.
[161] See Ardill (2022).

degraded area restoration, the Bradley Method (Radi 1993).[162] The specific revegetation and erosion management technique that Albert Morris utilised, with its focus on natural regeneration and the resilience of the local vegetation, and his prioritisation of working with naturally occurring site features, was vindicated by the work of the Bradleys and the subsequent development of contemporary bush regeneration industry practices.

In common with Morris's approach to degraded area restoration, the Bradley's bush regeneration strategies exhibited several distinct restoration themes: preserving the indigenous vegetation of a restoration site; acknowledgement of the resilience and restorative capabilities of the indigenous vegetation; minimising soil and site disturbance as much as possible and working with the existing environmental features of a site, such as rainfall, winds and soils.[163] Indeed, all of the early advocates and practitioners of degraded area and ecosystem restoration in settler Australia, people such as Donald MacDonald,[164] Ambrose Crawford,[165] Joan and Eileen Bradley and Roger Good and his colleagues[166] developed revegetation and restoration techniques that were attuned to the ecological features of the ecosystems being repaired.

The work of Albert Morris also shares with these early practitioners of degraded area restoration a deep interest in the permanent conservation of restored ecological communities. This characteristic also explains their status as exemplars of the Australian degraded area and ecosystem restoration movement.

The available historical documentation does not reveal that the early practitioners of degraded area restoration in settler Australia communicated with each other about their respective projects. However, personal and occupational connections did exist between

[162] As adapted to a degraded site, and local ecosystems and environmental conditions.
[163] See Bradley (2002) and Buchanan (2009).
[164] Between ca.1900 and ca.1930 Donald MacDonald advocated for the restoration and conservation of Melbourne's degraded foreshore Coast Teatree (*Leptospermum laevigatum*) vegetation communities, by utilising ecological burning and natural regeneration (Ardill 2021 p.22).
[165] In 1935 Ambrose Crawford commenced restoring a Big Scrub rainforest remnant at Alstonville on the New South Wales north coast, predominantly using local vegetation species (McDonald in Jordan & Lubick 2011 pp.72-73).
[166] Working with the New South Wales Soil Conservation Service and New South Wales National Parks Service, and colleagues Alec Costin and Dane Wimbush, Roger Good pioneered the development of alpine ecological restoration in Australia. See further text in this article.

individuals, projects and organisations, and possibly these connections resulted in the circulation of restoration techniques and ideas.

Were the Bradleys aware of or influenced by the Broken Hill project? There is no historical evidence to suggest that they or the development of the Sydney bush regeneration industry were directly influenced by the regeneration area project.

However, some historical continuity did exist between the Morris project and the Bradley's work: the botanical research and soil conservation work of Beadle and the Soil Conservation Service in the 1940s and 1950s, the expansion of the regeneration area project throughout the 1950s and the development of a 5000 hectares regeneration area at Cobar, in western New South Wales, from 1959 (Ardill 2022 p.63). There is a reasonable chance that the Bradleys may have read of the Broken Hill, Beadle and Cobar works in the Sydney print media; the completion of the Broken Hill project in 1958 was reported in a major Sydney newspaper (Anon. "Saving Of Our Silver City" *Sydney Morning Herald* 17 June 1958). They may also have heard of the Broken Hill regeneration area via restoration and botany associates.[167] But even if they were aware of the Broken Hill project, the Bradleys may not have recognised that it was a restoration project that did share features with their bush regeneration work. Natural regeneration was extensively utilised by Albert Morris and the Bradleys, but there was one major difference in emphasis between their respective restoration techniques: stock exclosure as opposed to weed management.

Another significant, early Australian ecosystem restoration project commenced at Kosciuszko National Park, New South Wales, in approximately 1960. The project was initially conducted by the New South Wales Soil Conservation Service, and from the 1970s by the New South Wales government's National Parks and Wildlife Service. Plant ecologist, wetlands restorationist and project manager, Roger Good, and CSIRO[168] plant

[167] The Bradleys were acquainted with conservationist Thistle Stead (née Harris). Communication to author by email on 20/04/2022 from Dr Tein McDonald, ecological restorationist. As revealed in this article, Stead worked with Albert and Margaret Morris on at least one Broken Hill landscaping project, and quite likely botanised with them.

[168] The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is an Australian federal government agency that conducts a wide range of scientific research. Successor to CSIR.

ecologists Alec Costin and Dane Wimbush worked together on the project for many years (Good, McDonald 2016; Good, Johnston 2019).

The Nagarigo community were the Traditional Owners and Custodians of homelands located in the alpine region and high tablelands of south-east Australia. From the 1820s settler squatters forcibly dispossessed the Nagarigo, and established pastoral stations.[169] Over many decades, livestock grazing destroyed extensive areas of alpine vegetation. Severe erosion developed.

The aim of Good's restoration projects was to "stabilise the country and to enable it to regenerate to hopefully a near natural vegetation condition" (Personal comment by Roger Good to Tein McDonald at time of Good, McDonald 2016).[170] Grazing livestock were excluded from the national park. Initial restoration work targeted the stabilisation of eroded gullies and incised, hydrophobic peat bogs. Alpine plant species were encouraged to naturally regenerate in sections of lesser erosion damage. In areas that had been severely eroded, planting and seeding interventions were implemented (Good, McDonald 2016; Good, Johnston 2019).

The historical record does not reveal that Good and his colleagues were aware of the Broken Hill regeneration area project and its outcomes, or of other early Australian settler attempts to reverse environmental degradation. However, it is quite possible that they did know of the Broken Hill work, through their connections with the NSW Soil Conservation Service.

The historical documentation presented in this article revealed that the revegetation successes of the regeneration area project informed the Soil Conservation Service's growing awareness that indigenous vegetation had capacity to naturally regenerate on eroded land, if livestock were excluded. Long-time Service Director, Sam Clayton, and researcher, Noel Beadle, were enthusiastic about the Broken Hill project and its impressive revegetation and erosion management outcomes.[171] Roger Good was employed by the

[169] Today, members of the Ngarigo community advise the New South Wales National Parks and Wildlife Service on management of Kosciuszko National Park.
[170] Supplied to author on 03/09/2022 by email from Tein McDonald.
[171] See also Ardill (2022) pp.49-53.

Service in the 1960s. Early in his career, Alec Costin worked for the Soil Conservation Service, and was well acquainted with Clayton (Salt 2006). Possibly the Service's institutional body of knowledge influenced Good, Costin and Wimbush, as well as their own extensive research that explored the capacity of alpine vegetation communities to naturally regenerate. Possibly Good, Costin and Wimbush were aware of the natural regeneration project at Cobar, as it was being monitored by the Soil Conservation Service during the early years of the alpine restoration project (Ardill 2022 p.63).

The regeneration area and contemporary ecological restoration

In March 2016 the Society for Ecological Restoration Australasia published its National Standards for the Practice of Ecological Restoration in Australia.[172] The National Standards set out six key principles that characterise best practice ecological restoration, a systematic, degraded area restoration management framework that maximises project success. The principles entail adoption of a local indigenous reference ecosystem; guidance of restoration activities by onsite levels of resilience and degradation; the setting of targets, goals and objectives; commitment to achievement of substantial to full recovery of ecological functioning; partnering of practice with restoration knowledge and science; social engagement with stakeholders and community (SERA 2021 pp.4-20).

McDonald (2017a) has considered the question of whether the entire Broken Hill regeneration area qualifies as a bona fide, high quality ecological restoration project. Applying the National Standards, McDonald's short reports conclude that the regeneration area can be regarded as an ecological restoration project that has progressed the recovery of Broken Hill's local vegetation communities to a substantial extent (McDonald 2017a) and reflects the National Standard's six key principles (McDonald 2017b).

[172] A revised 2021 edition 2.2 of the National Standards has been published and is cited in this 2023 fourth edition of the article. The revised 2021 edition 2.2 retains the same six practice principles set out in the 2017 edition of the National Standards, with some changes in content and terminology.

The Broken Hill regeneration area project is one of Australia's earliest known, ecologically informed attempts by settlers to restore a degraded ecosystem (McDonald in Jordan & Lubick 2011 p.73). A slightly earlier degraded area restoration project featured the work of dairy farmer, Ambrose Crawford. As already outlined, he initiated a rainforest restoration project in 1935, at Alstonville, north coast New South Wales. Over many decades Crawford restored and conserved a Big Scrub rainforest remnant, a vegetation community largely destroyed by settler land clearing (McDonald in Jordan & Lubick 2011 pp.72-73). He consulted botanists, and primarily selected local plant species for planting (Lymburner 2018). The historical documentation strongly suggests that opportunities for First Nations communities to engage with the management of their homelands and reverse settler environmental degradation did not arise in Crawford's project.

As outlined in section two, from approximately 1930 South Australian pastoralists were restoring degraded arid zone land, using a stock exclosure and natural regeneration revegetation technique. However, the historical documentation reveals only limited details about the specific projects, and whether they reflected contemporary ecological restoration principles is unknown (Ardill 2022 p.63). Quite likely, opportunities for First Nations communities to reverse settler environmental degradation did not arise.[173]

Internationally, an ecosystem restoration project of historical significance commenced in the mid-1930s, at the University of Wisconsin, Wisconsin USA. The project was inspired by concern at the widespread loss of indigenous plants, animals and ecosystems. The intention of the managers was to reconstruct a sample "of original Wisconsin … grassland and forest associations native to the region", to serve as a research resource for the university (Jordan III & Lubick 2011 p.77).

Management, social, economic and conservation benefits

[173] As discussed in this article, there is a possibility that the ecological knowledge of Traditional Owners was used in early settler restoration projects, with permission or by appropriation, but use was not recorded and acknowledged.

Although the Broken Hill regeneration area project was highly innovative and made extensive use of complex ecological concepts and information, it was relatively straightforward to implement and maintain. Natural resources and evolved ecological processes were utilised to address the loss of local vegetation. Traditional horticultural and technical interventions, such as costly and potentially environmentally degrading planting and irrigation schemes, inappropriate for arid conditions, were kept to a minimum. In fact, the quality of precious soil and vegetation resources was considerably enhanced. The possibility of catastrophic infrastructure failures was low, although ongoing vandalism and theft of fencing were always problems.

The revegetation technique overwhelmingly utilised local plant species and vegetation communities. This vegetation is well adapted to the prevailing environmental conditions, and persists despite long periods of dryness and drought. The vegetation has capacity to naturally regenerate after adequate rainfall, and natural regeneration can be relied on to maintain vegetation quality and density. Despite many periods of extended dryness and severe drought, the reserves have remained vegetated for more than eighty years, resulting in ongoing provision of soil cover and stability throughout the regeneration area.

The social benefits of the regeneration area project were substantial. Natural regeneration of local vegetation resulted in long-term stabilisation of threatening sand-drifts. Residents no longer had to worry about disruption of their daily activities, damage occurring to homes and neighbourhood infrastructure, and repair expenses. The local dust problem was alleviated, an outcome which quite possibly resulted in better management of respiratory diseases and created other community health benefits. Drift of toxic mining dusts was reduced (Pearce 2019 p.76). The regeneration area project inspired urban landscaping projects that further enhanced city amenity. The regeneration reserves “define the boundaries of the city and inhibit urban sprawl, a common eyesore in other arid cities” (Denton 1988 p.372). Economic benefits arose: reduced civic expenditure on sand removal and repair and replacement of infrastructure. An environmentally sustainable tourism industry developed.

The revegetation successes of the project led to the formal conservation of restored

natural ecosystems, and their plant and animal life. Margaret Morris noted that avifauna benefited.

The successful revegetation outcomes provided botanists and plant ecologists with vital insights into the features and functioning of the local vegetation communities and ecosystems. The regeneration area served as a study model for Australian soil conservation researchers, and informed the development of New South Wales government erosion management policies applicable to the semi-arid and arid regions of the state. The project demonstrated land management practices that might better sustain indigenous vegetation and local ecosystems. Webber (1992) maintains that revegetation techniques used at Broken Hill favourably influenced Australian mining industry environmental management practice.[174]

Flaws, failings of the regeneration area project

Commendably, the project directly addressed a major Broken Hill social issue, the need to improve city amenity: stabilise sand-drifts; manage dust; enhance urban perimeter aesthetic qualities. However, project manager engagement with important social entities and interested parties exhibited flaws and failings.

The planning, approval and initial work stages of the project were implemented over a short period of time, and during this crucial period communication with the community of Broken Hill only covered the most basic project details. The benefits were not well publicised. Negative impacts of the project were not dealt with. This lack of effective engagement quite possibly alienated a substantial number of residents.

[174] Webber (1992): urban tree planting, for landscaping and beautification purposes, was undertaken in mining townships; managed by Maurice Mawby, natural regeneration was encouraged at Weipa, Queensland, to restore mine sites (undated). The first Australian mine site rehabilitation work is attributed to Alcoa Australia Limited (Trigger et al. 2008). The work commenced in 1966, in south-west Western Australia, on the homelands of the Noongar nation. Whether the Alcoa work was influenced by the work at Broken Hill, or Weipa, is unknown.

By 1938 project managers were realising that social engagement and community involvement were vital to the success of the project. Progress association contributions were welcomed and actively facilitated. Margaret Morris continued the social engagement process, and from approximately 1939 she worked hard to promote the amenity, economic and environmental benefits of the project, by submitting botanical reports to city council and writing newspaper articles that reached out to the Broken Hill community.

Respectful opportunities to consider engagement with the project were not extended to Traditional Owners, the Wilyakali community. There is no evidence to suggest that during the planning and implementation stages managers gave appropriate consideration to traditional owner interests in the common and the skills that they might bring to the project. Wilyakali people may have stories to relate about the historical development of the project and how it affected their community at the time and in subsequent years. They may have observations to make about the merits and failings of the project, its implementation, the outcomes and in particular, how application of their ecological knowledge possibly did or might have benefited the project in practical ways.

Non-local plant species[175] were almost certainly planted in the regeneration reserve adjacent to Plantation No.1, and were planted in south Broken Hill regeneration reserves. The work would have been well intentioned: a scald was remediated; an attempt was made to replicate the attractive urban landscaping projects of Albert Morris; amenity benefits were created. However, local species were available, and the planting of non-local tree and shrub species came with the cost of reducing local ecosystem integrity in what was an important conservation project.[176]

Ethical restoration

[175] Non-local species: overseas species, and species indigenous to Australia that did not occur naturally in the Broken Hill region.

[176] There is no historical record of locally extinct plant and animal species being reintroduced to the regeneration reserves, or assessment of this issue being undertaken.

Over many millennia, the First Nations communities of Australia formed relationships of respect, reciprocity and spirituality with their respective homelands, and the plants, animals and other natural qualities of those lands (Rose 1996). The distress of dispossession was compounded by accompanying environmental degradation.

The regeneration area project managers did not engage with the Wilyakali community, by extending opportunities to consider participation in the project.[177] Cultural and spiritual values concerning nature and people were not exchanged. Failure to publicly acknowledge, in a respectful manner, an important cultural and social entity with deep, long-standing interests diminished the ethical standing of the project. Wilyakali people may have stories and accounts of their own to relate about the project, and the roles that their values might have played in the ethical enrichment of the project.

Being a matter of rapidly emerging concern, contemporary environmental ethicists are addressing the issue of how degraded natural areas can be ethically managed and restored.[178] One approach seeks to conserve the intrinsic values of nature: naturally evolved landscapes feature ecological complexity and harmony, the stable functioning of the biotic community and aesthetic values (Leopold, A. 1948).

Degrading processes destroy the qualities that embody and reveal the intrinsic values of nature and should be avoided; environmental degradation cannot be justified by a promise to undertake restoration of a degraded site in the future (Elliot 1992, p.154). Where degradation has occurred in the past, undertaking restoration is necessary and is justified and commendable, but there is a concern that the restoration process and its human component might compromise the naturalness and associated intrinsic values of the restored ecosystem (Elliot 1992, p.155; Katz 2012, p.72, 96, 68-69). Can naturalness be retained throughout a restoration process?

Where degradation has occurred, a restorative activity that is “guided and structured by the designs of nature” displays greater ethical merit, as the activity maintains “continuity

[177] Due to dispossession and oppression, the Wilyakali were unable to independently manage their homelands and initiate their own restoration projects.
[178] For example, see O’Neill, Holland, Light (2008).

with the natural past"; highly contrived restoration techniques that do not maintain continuity are of lesser ethical merit (Elliott 1992 p.154). Accordingly, the ethical merit of a restoration technique is enhanced when it acknowledges, engages with and maintains, throughout the restoration process, the evolved qualities of nature, and maximises the presence of those qualities and the associated values of nature in the restored ecosystem.

Albert Morris was distressed by the environmental degradation created from the mid-1880s by Broken Hill mining and urban impacts. He wished to preserve the biodiversity, inherent knowledge and beauty of the arid ecosystems. To do so, he and his restoration colleagues attempted to restore local natural qualities to the surrounds of the city, by utilising a value preserving restoration technique.

Albert's restoration technique attempted to maintain continuity of desired qualities between the evolved, pre-degradation era ecosystems of the Broken Hill locality, and the ecological outcomes intended for the regeneration reserves, to the extent that the remnant qualities of the pre-degradation era ecosystems allowed. By utilising the historical, naturally distributed soil-stored seed of local plants, and allowing on-site processes of seed germination and plant growth to occur under typical arid conditions, connections were maintained with evolved nature and its ecological processes, and the naturalness of pre-degradation era local ecosystems. This revegetation technique made full use of the remnant qualities of the pre-degradation era arid ecosystems. Substantial restoration of an extensive range of local plant species was effected, primarily by the work of nature. Human intervention was minimised. Potential was created for the natural recovery of local animal species and other local ecological features and functions.

McDonald (2017a) reports that the reserves do represent relatively healthy ecosystems of their kind, despite there being continuing symptoms of decline, including reduced numbers of local species, particularly animals, and persistence of introduced pastoral plant species. The attempt at maintaining desired values of nature and naturalness appears to have achieved a substantial degree of success, as a diverse range of local plant species and other natural qualities were recovered throughout the restoration process, and persist today.

The project did feature direct human intervention in the revegetation process. In many cases, this intervention was necessary and ecologically beneficial. For example, a degraded scald was furrowed, to restore a range of local plant species, including Old Man Saltbush. In this way, the ecological complexity of evolved nature, as a value, was recovered on a highly degraded section of the regeneration area.

Planting of non-local tree and shrub species occurred. Certainly, relative to the existing, severe levels of degradation, this planting possibly benefited local biodiversity, in the form of habitat provision for local animal species. However, local plant species were available for planting. The use of non-local species inhibited a more comprehensive recovery and ongoing flourishing of the characteristic, evolved qualities of the pre-degradation local ecosystems, and local ecological functioning. This compromised the complexity, harmony and naturalness of nature in the reserves. In this way, the planting of non-local species detracted from the overall ethical standing of the regeneration area project.

The regeneration area project exhibited ethical deficiencies, but admirably, the need for restoration was recognised, restoration was attempted, and pre-degradation era, naturally evolved ecological qualities were recovered and persist. In this way, the project displayed merit as an attempt to revive and perpetuate the intrinsic values of evolved nature and the naturalness of the arid ecosystems.

The need to enhance utilitarian value by recovering vital ecosystem services was recognised and addressed. Amenity for residents was recovered when the urban fringes of Broken Hill were revegetated. Threatening sand-drifts stabilised, dust settled and the surrounds of the city were restored to a condition of attractive natural vegetation.

……..

8. Conclusion

From approximately 1860 First Nations communities living west of the Baaka were dispossessed of their homelands by settlers. Decades of unregulated pastoralism progressively degraded indigenous vegetation. Mining and associated urban impacts devastated the local vegetation of Broken Hill. Loss of vegetation resulted in widespread, severe wind and water erosion.

Dedicated erosion research facilities did not exist. Distressed by loss of biodiversity and natural ecosystems, Dr William MacGillivray, Albert and Margaret Morris and field naturalist colleagues resolved in the 1920s to engage with overstocking and soil erosion. The sand-drifts and dust storms that afflicted the residents of Broken Hill were further major concerns.

Advocacy by the Broken Hill conservationists highlighted environmental degradation and called for its remediation. Observations of indigenous vegetation and natural ecosystems, erosion management experiments and degraded area field trials informed the conservationists development, by 1936, of an effective revegetation technique that largely eschewed traditional horticultural practices. The technique involved the application of a stock exclosure concept and the harnessing of natural regeneration to restore local vegetation and stabilise eroded soils.

In August 1936 Albert Morris's resourcefulness secured mining industry funding for an innovative, degraded area restoration project. Known today as the Broken Hill regeneration area, work commenced in September 1936. Historically significant, the project proved to be a striking ecological, erosion management and conservation success, praised by researchers. Natural regeneration of local vegetation was outstanding. Substantial levels of ecological functioning were recovered. Small amounts of planting, irrigation, seed scattering and furrowing were utilised as ancillary revegetation techniques.

The attainment of amenity benefits for the people of Broken Hill was a major objective of the project. The benefits were realised: stabilisation of threatening sand-drifts; dust

abatement; aesthetic enhancement of urban perimeters. Although initially inadequate, project manager liaison with community did improve. Margaret Morris realised the importance of social engagement and worked hard to promote the benefits of the project. However, project managers failed to acknowledge the deep interests and ecological knowledge of Traditional Owners and Custodians, the Wilyakali community.

Following the death of Albert Morris in 1939 and the conclusion of war in 1945, Margaret Morris and her field naturalist colleagues, residents, Broken Hill Council, representatives of industry and the New South Wales government pursued completion of the project. Encirclement of the city by regeneration reserves was accomplished in 1958.

The historical regeneration area project extensively exhibited characteristics of the contemporary environmental repair technique, ecological restoration. The conservation of restored ecosystems was prioritised.

The Broken Hill conservationists had also aspired to the remediation of the eroded plains and ranges of western New South Wales. This objective was pursued by New South Wales government botanist and soil conservation researcher, Noel Beadle. Throughout the 1940s he studied and promoted the regeneration area project and its impressive revegetation and erosion management outcomes, benefits and lessons. Beadle's research informed the development of state government land use policies that regulated commercial exploitation of arid zone ecosystems and restored and conserved indigenous vegetation.

As the success of the regeneration area project became evident, the validity of the Broken Hill conservationists' overriding land management principle was confirmed. Approaches to the avoidance and remediation of environmental degradation must be grounded in respect for the evolved attributes and processes of local, natural ecosystems.

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9. Epilogue

Doctor William MacGillivray (1933), Albert Morris (1939), Edmund Dow (1944), Doctor Ian MacGillivray (1951) and Margaret Morris (1957) all pre-deceased the completion of the regeneration area project in 1958. Margaret must have gained some well-deserved satisfaction from participating in the 1947 regeneration conference and learning that extension of the project had been approved by the state government.

News of the completion of the project must have pleased administrative supporters A. J. Keast (1892–1980) and Maurice Mawby (1904–1977). They both pursued careers as senior executives in the Australian mining industry (Fairweather 1996; Strahan 2000).

May Harding (1908–1971) was an active office-holder of the Barrier Field Naturalists Club for many years, and pursued successful careers as a Broken Hill artist, botanist, conservationist and teacher (Lemon 2000). Clarence Chadwick (1909–2004) achieved considerable repute as an entomologist (Anon. 2013).

The regeneration reserves are classified by the National Trust (NSW) as a vital cultural item of the City of Broken Hill. In 2015 the entire city was declared a place of National Heritage values by the Australian government, and was entered in the National Heritage List. The Schedule to the List records Albert Morris's achievements and the actual regeneration area as heritage values of the city.[179]

The eightieth anniversary of the fencing of the first regeneration reserves was commemorated in 2017. Combining with partner environmental organisations, including the Barrier Field Naturalists Club, the Australian Association of Bush Regenerators (AABR) conducted four days of workshops (February 2017) and five days of public celebration and field activities (August 2017) in the city of Broken Hill and throughout the regeneration reserves.[180]

[179] See Jones (2016).

[180] The commemorative events of 2017 and the story of the regeneration area were documented for the Australian Association of Bush Regenerators (AABR) RegenTV project by Little Gecko Media. See "Renewal in the Desert" at https://www.aabr.org.au/regentv/. For further documentation see Ardill, Brodie (2018).

The Australian Association of Bush Regenerators, the Barrier Field Naturalists Club and the Society for Ecological Restoration Australasia initiated the Albert Morris Award in 2017. The award celebrates well-established ecological restoration projects or programs that have outstanding ecological and social outcomes (SERA 2021).

Broken Hill City Council, as trustee, continues to administer the regeneration area. Members of Landcare Broken Hill undertake voluntary revegetation and weed management works within the reserves, on a regular basis. The Barrier Field Naturalists Club celebrated its one hundredth birthday in 2021. Members continue to advocate for the environmental values of the regeneration area.

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APPENDIX A

Chronology: Plantations 1936–37, Reservoirs Regeneration Project 1936–39 and the Broken Hill Regeneration Area Project 1936–58.

The three main revegetation projects:

A. Plantations No.1 & No.2 (1936, 1937). Primarily planting of dense tree groves on the Zinc Corporation leasehold. Natural regeneration of local vegetation also occurred.

B. The reservoirs regeneration project (1936–39). Fencing of Waterworks Hill and Block 10 Hill in Broken Hill to allow natural regeneration of local vegetation. Possibly some planting of unspecified tree species occurred.

C. Broken Hill regeneration area (1936–1958). Fencing of regeneration reserves that encircled Broken Hill and allowed natural regeneration of local vegetation. Minor planting, irrigation, seed scattering and furrowing occurred.

Concise chronology

1936 May 9. Morris, Keast and Mawby meet to discuss the construction of tree plantations to control soil-drift around a new Zinc Corporation mine.

1936 May 18. Announcement made that work on Zinc Corporation tree plantations (Plantations No.1 & No.2) has commenced. Landscaping continues for several years.

1936 May 27. Albert Morris and Barrier Field Naturalists Club initiate the reservoirs regeneration project.

1936 September 7. Announcement made that an experimental half-mile wide and rabbit-proof fenced strip of land (regeneration reserves) will be built between old South racecourse and Broken Hill Cemetery to allow natural regeneration of local vegetation and control sand-drift. Fencing of regeneration reserves starts in September.

1937 February. Fencing of the first set of regeneration reserves of the Broken Hill regeneration area, extending from South racecourse to the Cemetery and old Silverton Tramway, is completed (south to west Broken Hill).

1937 August-September. Fencing of the regeneration reserve between old South racecourse and Bonanza St is completed (south Broken Hill).

1937 September. NSW government approves and agrees to fund fencing of Waterworks Hill and Block 10 Hill reservoirs regeneration project.

1938 March. Fencing of the regeneration reserves between the Cemetery and Nine Mile Rd are completed (north-west Broken Hill).

1939 March. Fencing of the regeneration reserve from Bonanza St. to South rifle range is completed (south-east Broken Hill).

1939 April. Fencing of Waterworks Hill and Block 10 Hill reservoirs regeneration project is completed.

1946 October. Broken Hill Regeneration Committee is established.

1948 February. NSW Minister for Conservation approves fencing of further regeneration reserves.

1951 January. NSW Minister for Conservation announces that fencing of the regeneration reserve between Kaolin St. and Racecourse Rd has been completed (north Broken Hill).

1953 July. NSW Minister for Conservation announces that fencing of the regeneration reserve between Racecourse Rd – Radio Station and Wilcannia Rd has been completed (north-east Broken Hill).

1958 October. NSW Minister for Conservation announces that fencing of the regeneration reserve between Menindee Rd and South rifle range has been completed and that the Broken Hill regeneration area now fully encircles Broken Hill (east Broken Hill).

Detailed chronology

1935

October-November approx.

• Albert Morris and the Barrier Field Naturalists write to the New South Wales state government and recommend that an area of the public common be fenced, with the intention of excluding stock and allowing natural regeneration of local vegetation.

1936

April

• Albert Morris presents a submission to the New South Wales Erosion Committee and recommends that pastoralists fence off sections of their properties to exclude stock and allow natural regeneration of local plant species and facilitate the production and natural distribution of seed.

May 9

• A. J. Keast, M. Mawby and Albert Morris meet to discuss the construction of a tree plantation to protect the proposed new Zinc Corporation mine works from drifting sand. Morris agrees to assist with the provision of resources and advice.

May 18

• An announcement is made that a plantation (Plantation No.1) will be built to protect the proposed Zinc Corporation Mine. The plantation will use a range of Australian tree species suitable for local conditions. Work on this plantation has commenced. A six foot (2 metres) galvanised iron fence will enclose the plantation. A saltbush hedge will be grown inside the fence. A plant nursery will be established. The plantation will be 10–12 acres; *And*[181]

• Plantation No.1 (aka Albert Morris Park, Zinc/Twin Lakes Park, Wentworth Rd.) is approximately 20 acres with a galvanised iron fence on three sides with a rabbit-proof wire mesh fence on the side nearest the mine works; *And*

• No. 1 Plantation is about 22 acres and located on the south-west side of the new mine works, with a tank on the highest point for gravitational watering. The fence is topped with barbed wire. Iron fences are on two sides and the balance is rabbit-proof.

May 25

• A. J. Keast announces the construction of a new three-storey mine complex for the Zinc Corporation. Demolition of the old buildings will commence immediately and construction of the new mine buildings will take about two years.

May 27

• Albert Morris and the Barrier Field Naturalists Club initiate the reservoirs regeneration project. They resolve to write to the NSW government to secure approval and financing for the fencing of Waterworks Hill and Block 10 Hill in Broken Hill.

May to August

• Plantation No. 1 is fenced. Local grass species naturally regenerate within the fence, as predicted by Albert Morris.

[181] The historical documentation reveals alternative versions of the same event. This is indicated by *And*

August

• Using this evidence of potential for natural regeneration around the outskirts of Broken Hill, Albert Morris approaches A. J. Keast (Zinc Corporation manager) and obtains approval for the construction of the first set of regeneration reserves (1936–1937) of the Broken Hill regeneration area.

August 27

• Broken Hill Council approves the regeneration reserves project.

September 7

• Mr. Fairweather of the Mine Managers Association announces the regeneration area project. North, South and Zinc Corp mining companies will enclose with a rabbit and stock proof fence a strip of land half a mile wide extending from the old South racecourse to the Cemetery. The objective is to encourage natural regeneration of the local vegetation.

September

• Work on the first regeneration reserve has commenced by September 30.

October

• Planting in Plantation No.1 commences with 1000 Old Man Saltbush plants.

November

• Albert Morris announces that fencing of the proposed series of regeneration reserves from South racecourse to the Cemetery has progressed from the old South racecourse to the city abattoir (south-west Broken Hill).

1937

January 9

• Five hundred saltbushes are planted outside the iron fence of Plantation No.1 in the adjoining regeneration reserve, which is now fenced to exclude stock; *And*

January

• A section of the regeneration reserve immediately behind Plantation No.1 (Albert Morris Park) is ploughed in 50 yards squares to break up scalds and allow seed to collect and

germinate, and over 1000 saltbushes and 750 trees are planted (Note: most likely from January to December, 1937). Seed is scattered in this section of the reserve (Note: at some time in 1937); *And*

• A section of the regeneration reserve behind Plantation No.1 (aka Albert Morris Park, Zinc/Twin Lakes Park) is irrigated and planted in the same way as the park (Note: most likely from January and throughout 1937).

• Tree planting commences in Plantation No.1 (aka Albert Morris Park, Zinc/Twin Lakes Park). Eventually approximately 2500 trees are planted in this plantation; *And*

• In Albert Morris Park (aka Plantation No.1, Zinc/Twin Lakes Park) River Red Gums are planted. Fifteen different kinds of trees are used and 60-90 trees are planted and staked each day. By the end of January 1188 trees have been planted in Albert Morris Park (aka Plantation No.1, Zinc/Twin Lakes Park), with planting continuing for some months.

February approx.

• Fencing of other areas of the mine lease (Plantation No.2) is completed and general beautification of the Zinc Corporation lease is carried out around the mine cottages, Manager's residence and the Guest House, with avenues of trees on the main roads. A wide range of plants are used; *And*

• A second plantation (Plantation No.2) is created at the front and back of the cottages on the Railway Town side (north) and South Broken Hill side of the mine (Note: exact date unspecified but approx. February 1937).

February

• The fencing of the first set of regeneration reserves of the pre-War Broken Hill regeneration area is completed. They stretch from the South racecourse in south Broken Hill to the Cemetery and Silverton tramway (south to west Broken Hill). There are five of these reserves.

June 18

• The South Australian Soil Erosion Committee (Chairman: W. J. Spafford) tours the plantations and fenced regeneration reserves with Albert Morris and E. B. Dow. The Committee meets Dr I. MacGillivray and A. J. Keast. Spafford is very impressed and

recommends extending the first set of regeneration reserves south, past the racecourse area towards Bonanza St. (the airport road).

• The regeneration reserves are declared NSW state flora reserves.

August

• Work on the regeneration reserve extension from old South racecourse to Bonanza St. is well advanced and is expected to be completed in September (south Broken Hill).

• The mining companies also wish to extend the regeneration reserves from the Cemetery and Silverton tramway to Nine Mile Rd (north-west Broken Hill). Council is expected to agree to this proposal at its next meeting.

• A.J. Keast comments that recent rains will encourage good plant growth in the regeneration reserves and that he is pleased with the results so far.

September 17

• NSW government approves the fencing component of Waterworks Hill and Block 10 Hill reservoirs regeneration project in Broken Hill for the purposes of natural regeneration.

December

• Work commences to extend the regeneration reserves from the Cemetery and Silverton tramway to the Silverton Road and then to Nine Mile Rd (north-west Broken Hill).

1938

February

• A. J. Keast announces that he expects the regeneration reserves extension to the Silverton Road and Nine Mile Road to be finished by March.

• Mine Managers Association announced that complete encirclement of the city with regeneration reserves will not take place until the success of the scheme is definite.

March

• The Zinc Corporation sponsored tree planting scheme for the Cemetery commences.

March 25

• The regeneration reserves are strictly protected under the regulations of the newly published Broken Hill Council by-laws. Public access is prohibited.

Albert Morris, Jack Scougall, Maurice Mawby and three others are appointed rangers.

July-September approx.

• Natural regeneration of local vegetation is encouraged in all regeneration reserves, as the primary revegetation technique. Planting, irrigation, seed scattering and ploughing are intensively used in a section of one reserve, to manage a scald.

September-November

• Albert Morris is diagnosed with a serious medical condition, receives treatment in Adelaide and returns to Broken Hill, where he is hospitalised.

December

• Work commences on fencing of the regeneration reserve between Bonanza St (airport rd.) and South rifle range (south-east Broken Hill).

1939

January 9

• Death of Albert Morris.

• A. J. Keast, Manager of the Zinc Corporation mine, pays tribute to Albert and acknowledges his initiation of the regeneration area project.

March

• Fencing of the regeneration reserve from Bonanza St to South rifle range is finished and the pre-War 1936–1939 section of the Broken Hill regeneration area is completed.

April approx.

• Fencing of the Waterworks Hill and Block 10 Hill reservoir sites for the purpose of encouraging natural regeneration is completed.

September

• Due to good rains in 1939, extensive natural regeneration of annual and perennial grasses, shrubs and trees has occurred throughout the regeneration reserves. Degraded plant root stock has naturally regenerated. Small amounts of planting have been undertaken by individuals and progress associations.

• A small amount of seed scattering has been conducted in some sections of the regeneration reserves.

• As noted, a section of the regeneration reserve behind Albert Morris Park, possibly 5-10 hectares, has been planted with trees, saltbushes and myoporums, and is irrigated in a similar way to the park.

• Second World War commences (1939–45).

1940–44

• Several botanical surveys reveal widespread natural regeneration of local grasses, saltbushes, bluebushes, Mulga and many other local plant species in the regeneration reserves. No further regeneration reserves are constructed during this period. NSW Soil Conservation researcher, Noel Beadle, studies the regeneration area.

• Severe drought and many dry years. Large dust storms afflict Broken Hill and region.

1945

October

• Work has commenced on the construction of Zinc-Twin Lakes in Albert Morris Park, formerly Plantation No.1. Some trees are removed.

1946

May 10-14

• NSW Premier McKell visits Broken Hill. He is lobbied by the Broken Hill mayor and city administrators to create a larger regeneration area to manage regional dust storms.

October 9.

• The Broken Hill Regeneration Conference is held. A Broken Hill Regeneration Committee is formed. Natural regeneration of local vegetation is endorsed as the main revegetation policy; planting is to be kept to a minimum due to the arid conditions.

1947

September

• New Broken Hill Consolidated mining company announces construction of a new mine complex in the regeneration reserve adjoining Zinc/Twin Lakes Park (Plantation No.1; Albert Morris Park) and immediately west of Wentworth Rd. This regeneration reserve is heavily modified when a plantation and orchard, mine buildings and cottages are built.

1948

February

• NSW Minister for Conservation Weir approves the Regeneration Committee recommendation to fence more regeneration reserves to the north and east of the city and fully encircle the city with reserves.

1951

January 29

• NSW Conservation Minister Weir announces that the fencing of the regeneration reserve from Kaolin St. to Racecourse Rd has been completed (north Broken Hill).

1953

July 3

• NSW Conservation Minister Enticknap announces that fencing of the regeneration reserve from the Radio Station (Racecourse Rd) to Wilcannia Rd has been completed (north-east Broken Hill).

1957

• Death of Margaret Morris in Sydney.

1958

October 15

• NSW Conservation Minister Wetherell announces that the final regeneration reserve between Menindee Rd and the South rifle range (east Broken Hill) has been fenced and the city of Broken Hill is fully encircled by regeneration reserves. The regeneration reserves (1936–58) encircling Broken Hill are now known collectively as the Broken Hill regeneration area.

Reference: Peter J. Ardill (2023) *Albert Morris and the Broken Hill regeneration area: ecologically informed restoration responses to degraded arid landscapes 1936–58* Australian Association of Bush Regenerators Sydney.

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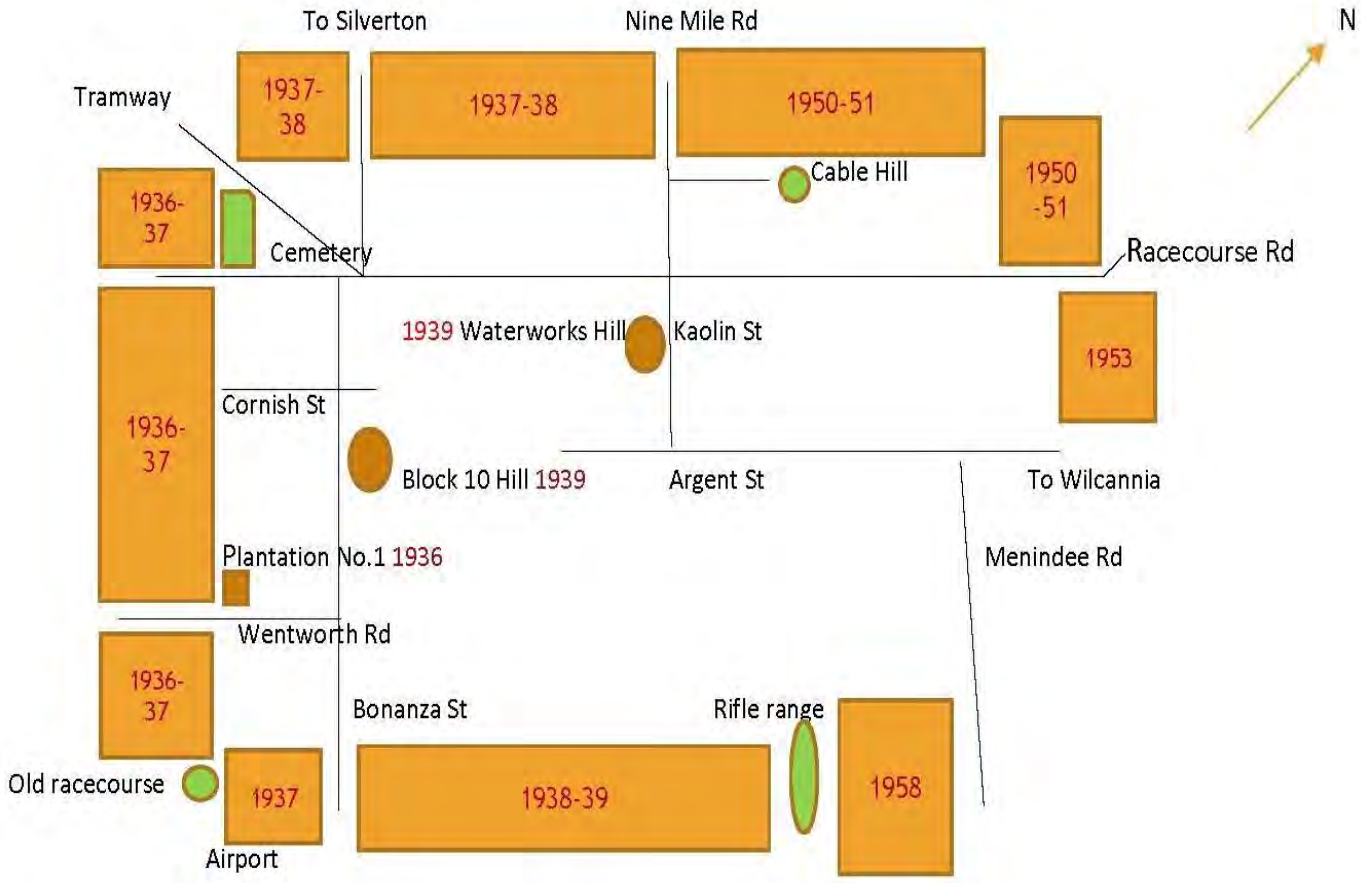
Appendix B Diagram

Plantation No.1, Reservoirs Project, Broken Hill Regeneration Reserves 1936–58

[not to scale]



Reference: Peter J. Ardill (2023) *Albert Morris and the Broken Hill regeneration area: ecologically informed restoration responses to degraded arid landscapes 1936–58* Australian Association of Bush Regenerators Sydney.

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Appendix C Map

New South Wales Australia 1934

Map. New South Wales Australia 1934 Source: Department of Lands New South Wales National Library Australia

Notes

1. Baaka (labelled Darling River), left.
2. • Broken Hill, County of Yancowinna, far left, centre.
3. Western Division as labelled, centre and left, with boundary marked from south along Lachlan River north to Barwon River [– – – – –].
4. • Wilcannia, Baaka, County of Young.
5. • Menindee, Baaka, County of Menindee.

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List of cited references

AIATSIS (2022) “Australia's First Peoples” The Australian Institute of Aboriginal and Torres Strait Islander Studies (October) https://aiatsis.gov.au/explore/australias-first-peoples

Anon. (2013) “Story of a Bequest: Clarence E Chadwick” Australian Museum. Sydney. https://australian.museum/get-involved/join/foundation/story-of-a-bequest-clarence-e-chadwick/

Anon. (2016) “Koonamore Vegetation Reserve”. Head of Faculty of Sciences. School of Biological Sciences. The University of Adelaide. August 2016. South Australia. https://biological.adelaide.edu.au/about/fieldwork/koonamore/

Anon. (n.d. 1) “The Following Is A List of Plants Being Grown In The Plantation” Photocopies of typed carbon-copied notes on 2 x A4 paper sheets. Unlabelled file. Barrier Field Naturalists Club Archive. Outback Archives Broken Hill City Library. Broken Hill Council. NSW.

Anon. (n.d. 2) “Regeneration Around Broken Hill” Photocopy of typed carbon-copied notes on 1x A4 paper sheet. Unlabelled file. Barrier Field Naturalists Club Archive. Outback Archives Broken Hill City Library. Broken Hill Council. NSW.

Ardill, Peter J. (2018) “The South Australian arid zone plantation and natural regeneration work of Albert Morris” *Australian Association of Bush Regenerators (AABR)* Sydney. [182] (September) https://www.aabr.org.au/morris-broken-hill/

Ardill, Peter J. Brodie, Louise (2018) *Albert Morris and the Broken Hill regeneration area. Essays and supplementary materials commemorating and celebrating the history and eightieth anniversary of this project* Australian Association of Bush Regenerators. Sydney.

[182] New edition in preparation as at December 2022.

Ardill, Peter J. (2021) “Innovative Federation and Inter-war Period repair of degraded natural areas and their ecosystems: local government and community restoration of Coast Teatree *Leptospermum laevigatum* at Port Phillip Bay, Victoria, Australia” *The Repair Press* Sydney (February) https://ecologicalrestorationhistory.org/articles/

Ardill, Peter J. (2022) “Rekindling memory of environmental repair responses to the Australian wind erosion crisis of 1930–45: ecologically aligned restoration of degraded arid-zone pastoral lands and the resultant shaping of state soil conservation policies” *The Repair Press* Sydney (January) https://ecologicalrestorationhistory.org/articles/

Barrier Field Naturalists Club (1936) “Committee Meeting, May 27th, 1936” *Barrier Field Naturalist Club Minutes 1932-39.* Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Barrier Field Naturalists Club (n.d.) “Barrier Field Naturalists Club. Report of Sub-Committee” *Barrier Field Naturalists Club Minutes 1932–1939.* Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Batten, M. (1953) “Broken Hill’s Trees” in *Sun* p.23, 5 March 1953 http://trove.nla.gov.au/newspaper

Beadle, N.C.W. (1946) “Establishment of a Protected Timber Belt Westward of Broken Hill”. Report to Broken Hill Regeneration Conference of October 9, 1946. Broken Hill Regeneration Area - Old File 1945-48. Item 55/560. New South Wales State Archive. Kingswood. NSW.

Beadle, N.C. W. (1948) *The Vegetation and Pastures of Western New South Wales* Department of Conservation of NSW. Sydney, NSW.

Beckett, J. Hercus, L. Martin, S. Colyer, C. (ed.) (2008) *MUTAWINTJI Aboriginal Cultural Association with Mutawintji National Park* Office of the Registrar, Aboriginal Land Rights Act 1983 (NSW). Glebe, Sydney.

https://www.academia.edu/60504491/Mutawintji_Aboriginal_Cultural_Association_with_Mutawintji_National_Park

Black, J. M. (1927) “Additions to the Flora of South Australia No.25” pp.378-385 at 381*Transactions and Proceedings of the Royal Society of South Australia.* South Australia. https://www.biodiversitylibrary.org/bibliography/168318

Bradley, J. (2002) *Bringing Back the Bush: The Bradley Method of Bush Regeneration* New Holland. Sydney.

Broken Hill City Council (1936) “Minutes of Broken Hill Council Meeting: The Common”. 27 August 1936. Broken Hill City Council Minutes 1936. Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Brooks, G. (1939). Letter: Brooks to Honorary Secretary. 28th March 1939. *Barrier Field Naturalists Club Correspondence: 1933-1940.* Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Buchanan, R. A. (2009) *Restoring Natural Areas in Australia* NSW Department of Primary Industries. Sydney.

Bureau of Meteorology. “Monthly rainfall Broken Hill (Patton Street)” Australian Government Bureau of Meteorology. Commonwealth of Australia 2017. http://www.bom.gov.au/climate/averages/tables/cw_047007.shtml

Cattle, R. C. (2016) “The case for a South-eastern Australian Dust Bowl 1895–1945” *Aeolian Research* 21:1- 20 (June)

Collins, M. (1923) “Studies in the Vegetation of Arid and Semi-Arid New South Wales Part i: The Plant Ecology of the Barrier District” *Proceedings of the Linnean Society of New South Wales* 48 229-266 at 262 https://www.biodiversitylibrary.org/item/109055#page/5/mode/1up

Collins, M. (1924) “Studies in the Vegetation of Arid and Semi-Arid New South Wales Part ii The Botanical Features of the Grey Range and its Neighbourhood” *Proceedings of the Linnean Society of New South Wale*s 49 1-18 https://www.biodiversitylibrary.org/item/109114#page/5/mode/1up

Committee, Barrier Field Naturalists Club (1970). “The Story of the Club”. Barrier Field Naturalists Club Archive. Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Commonwealth Bureau of Census and Statistics (1938). *1938 Australian Year Book*. Australian Government. Canberra. Australian Capital Territory. http://pandora.nla.gov.au/tep/133815

Corkery P/L (2003) “Management Plan for Willyama Common” R.W. Corkery & Company Pty. Limited. Orange. New South Wales. https://www.industry.nsw.gov.au/__data/assets/pdf_file/0009/178713/willyama-common-pom.pdf

CSIR (1936) “Tenth Annual Report of the Council for Scientific and Industrial Research for the Year ended 30th June 1936”. Council for Scientific and Industrial Research. Government of the Commonwealth of Australia. Canberra. https://nla.gov.au/nla.obj-2769289935/view?sectionId=nla.obj-2792410263&partId=nla.obj-2771032895#page/n0/mode/1up

Cunneen, C. (2012) “McKell, Sir William John (1891-1985)” http://adb.anu.edu.au/biography/mckell-sirwilliam-john-15293 *Australian Dictionary of Biography*. National Centre of Biography. Australian National University (ANU).

Denton, A. (1988) “Albert Morris and the Broken Hill Revegetation Scheme” *Landscape Australia* 4/88 pp.369-373.

Dow, E. B. (1938) “Our District Rich In Relics of Native Tribes” *Barrier Miner* p.31, 10 December 1938

Elliott, R. (1992) “Intrinsic Value, Environmental Obligation and Naturalness*” The Monist* Vol.175 issue 2, pp.138-160.

Embury, E. M. (1933) “Macgillivray, William David (1868–1933)” from *Sydney Morning Herald* http://oa.anu.edu.au/obituary/macgillivray-william-david-15571 Obituaries Australia

Environment NSW (2002) “Former Kinchega Station Sites: Kinchega National Park Conservation Management and Cultural Tourism Plan” *NSW National Parks and Wildlife Service* September 2002. New South Wales Department of Environment. https://www.environment.nsw.gov.au/research-and-publications/publications-search/kinchega-national-park-conservation-management-and-cultural-tourism-plan

Fairweather, D. F. (1996) “Keast, Asdruebal James (1892–1980)” *Australian Dictionary of Biography*. National Centre of Biography. Australian National University. http://adb.anu.edu.au/biography/keast-asdruebaljames-10664

Forest History Society (n.d.) Image. “Nebraska Shelterbelts circa 1946” supplied by Forest History Society Durham North Carolina USA http://prestohost26.inmagic.com/Presto/search/SearchResults.aspx?q=SW1hZ2UuUGhvdG9ncmFwaGVyPSJodWZuYWdsZSByIHci&qrs=MQ==&qcf=YzRmOGVlNDAtMmY0YS00YjI2LTk2ZjYtZjgzMmJlNDk1OWY2

Good, R. Johnston, S. (2019) “Rehabilitation and revegetation of the Kosciuszko summit area, following the removal of grazing – An historic review” *Ecological Management & Restoration* 20:1 (January)

Good, R. McDonald, T. (2016) “Alpine restoration in the NSW Snowy Mountains: Interview with Roger Good” *Ecological Management & Restoration* 17:1 (January)

Green, D. R. (1989) “Rangeland Restoration Projects in Western New South Wales.” *Australian Rangeland Journal,* 11(2) pp. 110-116.

http://www.southwestnrm.org.au/ihub/rangeland-restoration-rojectswestern-new-south-wales

Griffiths, T. (1996) *Hunters and Collectors* Cambridge University Press. Cambridge.

Harding, M. (n.d.) "The Regeneration Areas of Broken Hill [annotated] by Miss May Harding Tech College: Observations and conclusions of Botanical Studies during 1942". Photocopies of typed carbon-copied notes on 2 sheets x A4 paper. Unlabelled file Barrier Field Naturalists Club Archive. Outback Archives, Broken Hill City Library. Broken Hill City Council. NSW

Harding, M. (1946) Letter: Harding to Weir. 10 September, 1946. Broken Hill Regeneration Area File. Item 55/560. NSW State Archives. Kingswood. NSW.

Jones, D. (2016) "Evolution and significance of the regeneration reserve heritage landscape of Broken Hill: history, values and significance". *Historic Environment*. 28:1.

Jordan III W. R. & Lubick G. M. (2011) *Making Nature Whole* Island Press. Washington D.C.

Katz, E. (2012) "Further Adventures in the Case against Restoration" *Environmental Ethics* 34: 67-97 (Spring)

Keast, A. J. (1939) "Passing of Mr. Albert Morris: An Appreciation" in *Barrier Miner*, p.3, 9 January, 1939. Broken Hill. NSW. http://trove.nla.gov.au/newspaper

Keast, A. J. (1939a) "Saving Soil at Broken Hill" in *The Rotarian* (July) pp.27-29. Rotary International. Chicago.

Keith, D. A. (2004) "Compilation Map of Native Vegetation of NSW: Reconstructed Vegetation (Northern Section) Version 2.1" in *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT*. Department of Environment and Department

of Infrastructure, Planning and Natural Resources, Sydney. Department of Environment and Conservation (NSW) (Pub.) Hurstville. NSW.

Kennedy, B. E. (1986). "Morris, Albert (Bert) (1886-1939)". http://adb.anu.edu.au/biography/morris-albertbert-7659 *Australian Dictionary Of Biography*. National Centre of Biography. Australian National University.

Lemon, B. (2000). "Harding, Florence May (1908-1971)" http://womenaustralia.info/biogs/AWE4056b.htm
The Australian Women's Register. The National Foundation for Australian Women (NFAW) & The University of Melbourne.

Leopold, A. (1948) *A Sand County Almanac.* Oxford University Press. New York.

Lymburner, S. (2018) "Lumley Park and rainforest restoration's early champion. Ambrose Crawford – Regeneration Pioneer. The Lumley Park story" *AABR News* No.137 (July) Australian Association of Bush Regenerators. Sydney. https://www.aabr.org.au/learn/publications-presentations/aabr-newsletters/

McDonald, T. (2017a) "How do the Broken Hill Regeneration Reserves stand up as an Ecological Restoration project?" *AABR News*. No. 132, April 2017. Australian Association of Bush Regenerators. Sydney. Australia. https://www.aabr.org.au/learn/publications-presentations/aabr-newsletters/

McDonald, T. (2017b) "Would the Broken Hill Regeneration Reserves meet today's National Standards?" *AABR News*. No.134, October 2017. Australian Association of Bush Regenerators. Sydney. Australia. https://www.aabr.org.au/learn/publications-presentations/aabr-newsletters/

McKee, B. (2018) "Shelter Belt Project (1934)" The Living New Deal. Department of Geography University of California. Berkeley CA (May 6) https://livingnewdeal.org/glossary/shelterbelt-project-1934/

McKell, W. (1946) Letter: McKell to Weir. 5 June, 1946. Broken Hill Regeneration Area Old File. Item 55/560. NSW State Archives. Kingswood. NSW.

Mabbutt, J. A. (1973) "Historical Background of Fowlers Gap Station" ch. 1. in Mabbutt J. A. (ed.) (1973) *Lands of Fowlers Gap Station New South Wales.* Fowlers Gap Arid Zone Research Station Research Series No. 3. University New South Wales. Sydney. http://www.fowlersgap.unsw.edu.au/sites/default/files/fghistory.pdf

Mawby, M. (1975) "Foreword" in Morris, A. (1975) *Plantlife of the Western Darling*. 2nd edn. Barrier Field Naturalists Club. Broken Hill. NSW.

Morris, A. (1921a) "Wattles" [From Original Article-Lecture Given 16 July 1921] in Morris, A. (1975) *Plantlife of the West Darling* p.122 2nd edn. Barrier Field Naturalists Club. Broken Hill NSW.

Morris, A. (1921b) "Notes on the Flora of Cockburn District" in Morris, A. (1975) *Plantlife of the West Darling* p.33, 2nd edn. Barrier Field Naturalists Club. Broken Hill NSW.

Morris, A. (1921c) "Notes on the Flora of Mt Robe District" in Morris, A. (1975) *Plantlife of the West Darling* p.25, 2nd edn. Barrier Field Naturalists Club. Broken Hill NSW.

Morris A. (1923) "The Flora Between the River Darling and Broken Hill*"* in Morris, A. (1975) *Plantlife of the West Darling* p.7, 2nd edn. Barrier Field Naturalists Club. Broken Hill.

Morris, A. (1924) "Interesting Places Near Broken Hill…Beauty At Your Own Door" [Reprinted from *Barrier Miner,* 22 May 1924] in Morris, A. (1975) *Plantlife of the West Darling* 2nd edn p.129. Barrier Field Naturalists Club. Broken Hill NSW.

Morris, A. (1929) "How To Grow Gum Trees*"* [Reprinted from *Barrier Miner,* 13 May 1929] in Morris, A. (1975) *Plantlife of the West Darling* 2nd edn p.135. Barrrier Field Naturalists Club. Broken Hill NSW.

Morris, A. (1937a) Letter: Morris to Spooner. 7th April, 1937. Barrier Field Naturalists Club Correspondence: 1933-40. Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Morris, A. (1937b) Letter: Morris to Spooner. 15th July, 1937. Barrier Field Naturalists Club Correspondence: 1933-1940. Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Morris, A. (1938) "Broken Hill Fights Sand-Drift" (Published *Walkabout* November 1938) republished in Morris, A. (1975) *Plantlife of the West Darling* pp.43-50 2nd edn. Barrier Field Naturalists Club. Broken Hill NSW.

Morris, A. (n.d. 1) "Growing Native Plants From Seeds: From the Notes of Albert Morris" in Morris, A. (1975) *Plantlife of the West Darling*. pp.111-119. 2nd edn. Barrier Field Naturalists Club. Broken Hill. NSW.

Morris, A. (n.d. 2) "List of the Plants of the West Darling District of New South Wales" in Morris, A. (1975) *Plantlife of the West Darling*. pp.53-108. 2nd edn. Barrier Field Naturalists Club. Broken Hill. NSW.

Morris, A. (n.d. 3) "Notes on the Flora Between Broken Hill and Mootwingee" in Morris, A. (1975) *Plantlife of the West Darling* p.15. 2nd edn. Barrier Field Naturalists Club. Broken Hill. NSW.

Morris, A. (1975) *Plantlife of the West Darling* 2nd edn. Barrier Field Naturalists Club. Broken Hill. NSW.

Morris, M. (1933) "To the Members of the Barrier Field Naturalists Club from Margaret Morris" 1 x A4 typed sheet. 15 July 1937. Unlabelled file. Barrier Field Naturalists Club Archive. Outback Archives Broken Hill City Library. Broken Hill Council. NSW.

Morris, M. (1939a) "Broken Hill's Rehabilitation" p.13 *Chronicle* 8 June, 1939. Adelaide. South Australia. http://trove.nla.gov.au/newspaper

Morris, M. (1939b) “Broken Hill’s Rehabilitation” p.12 *Chronicle* 15 June, 1939. Adelaide. South Australia. http://trove.nla.gov.au/newspaper

Morris, M. (1939c) “Plant Regeneration in the Broken Hill District” in *Australian Journal of Science* pp.43-48, October, 1939.

Morris, M. (1939d) “Regeneration Reserves” in *Barrier Miner*. p. 23. December 9, 1939. Broken Hill. NSW. http://trove.nla.gov.au/newspaper

Morris, M. (1940) “Trees As Monuments” in *Barrier Miner*. p.22, 7 December, 1940. Broken Hill. NSW. http://trove.nla.gov.au/newspaper

Morris, M. (1941) “Beautifying Our City” in *Barrier Miner.* p.19, 6 December, 1941. Broken Hill. NSW. http://trove.nla.gov.au/newspaper

Morris, M. (1942) “Regeneration Reserves at Broken Hill: Notes by Margaret Morris, April 1942” Photocopies of typed carbon-copied notes on 2 x A4 paper. Unlabelled file Barrier Field Naturalists Club Archive. Outback Archives Broken Hill City Library. Broken Hill Council. NSW.

Morris, M. (1975) “Biographical Notes” in Morris, A. (1975) *Plantlife of the West Darling* pp. 1-4. 2nd edn. Barrier Field Naturalists Club. Broken Hill. NSW.

Neatrour, A. (2015) “Roosevelt’s Tree Army: Civilian Conservation Corps” Digital Public Library of America. (September) https://dp.la/exhibitions/civilian-conservation-corps.

OEH (2017) “The Bioregions of New South Wales: their biodiversity, conservation and history” NSW National Parks and Wildlife Service (2003) NSW National Parks and Wildlife Service Office of Environment and Heritage Hurstville NSW https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Bioregions/bioregions-of-new-south-wales.pdf

O'Neill, J. Holland, A. Light, A. (2008) *Environmental Values* Routledge. London and New York.

Pearce, Lilian M. (2019) "Critical Histories for Ecological Restoration" (Thesis for Doctor of Philosophy: Australian National University) https://openresearch-repository.anu.edu.au/handle/1885/173547

Pidgeon, I. Ashby, E. (1940) "Studies in Applied Ecology I. A Statistical Analysis of Regeneration Following Protection from Grazing*"* in *Proceedings of the Linnean Society of NSW*. 65 pp.123-143. http://www.biodiversitylibrary.org/bibliography/6525#/summary

Radi, H. (1993) "Bradley, Joan Burton (1916–1982)", *Australian Dictionary of Biography*. National Centre of Biography. Australian National University. http://adb.anu.edu.au/biography/bradley-joan-burton-10001

Reed, L. (2017) "FDR's Great Wall of Trees continues to provide lessons" University Communication and Marketing. University of Nebraska – Lincoln (May 18)https://news.unl.edu/newsrooms/today/article/fdr-s-great-wall-of-trees-continues-to-provide-lessons/

RBA (2023) Calculator: "Pre-Decimal Inflation Calculator" Reserve Bank of Australia Commonwealth of Australia https://www.rba.gov.au/calculator/annualPreDecimal.html

Richardson, P. (1988) "Robinson, William Sydney (1876–1963*)". Australian Dictionary of Biography*. National Centre of Biography. Australian National University. http://adb.anu.edu.au/biography/robinsonwilliam-sydney-8247

Robertson, R. (1988) "Osborn, Theodore George Bentley (1887–1973) "*Australian Dictionary of Biography*. National Centre of Biography. Australian National University https://adb.anu.edu.au/biography/osborn-theodore-george-bentley-7924

Robin, L. (2007) *How A Continent Created A Nation* University of New South Wales Press. Sydney.

Rose, D. B. (1996) *Nourishing Terrains: Australian Aboriginal Views of Landscape and Wilderness* Australian Heritage Commission. Canberra. https://www.academia.edu/4539641/Nourishing_Terrains_Australian_Aboriginal_views_of_Landscape_and_Wilderness_Australian_Heritage_Commission_Canberra._1996

Rowse, Tim (2017) *Indigenous and Other Australians Since 1901* University of New South Wales Press. Sydney.

Salt, D. (2006) Interview. “Dr Alec Costin, Alpine Ecologist” Conversations with Australian Scientists. Australian Academy of Science. https://www.science.org.au/learning/general-audience/history/interviews-australian-scientists/dr-alec-costin-alpine-ecologist

Sauter, S. C. A. (2017) “Dust Bowls Down Under: An Environmental History of Wind Erosion in the South-East of Australia, 1929–1945/46” (Thesis for Doctor of Philosophy: University of Tubingen Germany) https://publikationen.uni-tuebingen.de/xmlui/handle/10900/79144

SERA (2021) Standards Reference Group “National Standards for the Practice of Ecological Restoration in Australia” Edition 2.2. *Society for Ecological Restoration Australasia* www.seraustralasia.com

Simper, E. (1995) Copy of typed, untitled statement. “E. Elsie Simper” typed as author. Signature not visible. Dated “15th February, 1995”. Ballarat. Victoria. Statement supplied to Peter J. Ardill on 04/08/2017 by Dr Barbara Briggs, AM, PSM, niece of Margaret Morris.

Solomon, R. J. (1988) “The Richest Lode: Broken Hill 1883 – 1988” Hale and Iremonger Pty Ltd. Sydney in Corkery (2003) “Management Plan for Willyama Common” at p.C-5. R.W. Corkery & Company Pty. Limited. Orange. New South Wales.

https://www.industry.nsw.gov.au/__data/assets/pdf_file/0009/178713/willyama-common-pom.pdf

Spooner, E. (1936) Letter: Spooner to Horsington. 11 November, 1936. Barrier Field Naturalists Club Correspondence: 1933-1940. Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Spooner, E. (1937a) Letter: Spooner to Morris. 24 May, 1937. Barrier Field Naturalists Club Correspondence: 1933-1940. Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Spooner, E. (1937b) Letter: Spooner to Morris. 17 September, 1937. Barrier Field Naturalists Club Correspondence:1933-1940. Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Spooner, E. (1937c) Letter: Spooner to Morris. 29 September, 1937. Barrier Field Naturalists Club Correspondence: 1933-40. Outback Archives. Broken Hill City Library. Broken Hill City Council. NSW.

Strahan, F. (2000) “Mawby, Sir Maurice Alan Edgar (1904–1977)” *Australian Dictionary of Biography.* National Centre of Biography. Australian National University. http://adb.anu.edu.au/biography/mawbysir-maurice-alan-edgar-11090

Thorn, J. (1939) Letter: Thorn to Editor. 14 January 1939. “Comments of Readers. Appreciation of Late Mr M. Morris” *Barrier Miner* p.3.

Trigger, D. Mulcock, J. Gaynor, A. Toussaint, Y. (2008) “Ecological restoration, cultural preferences and the negotiation of ‘nativeness’ in Australia” *Geoforum* 39 1273–1283

Walsh, G. P. (1996) “Holmes, James Macdonald (1896–1966)” *Australian Dictionary of Biography.* National Centre of Biography. Australian National University. https://adb.anu.edu.au/biography/holmes-james-macdonald-10527/text18685

Webb, J. (2012) “Stead, Thistle Yolette (1902-1990)” *Australian Dictionary of Biography*. National Centre of Biography. Australian National University http://adb.anu.edu.au/biography/stead-thistle-yolette-15520

Webber, H. (1992) *The Greening of the Hill*. Hyland House. Melbourne. Victoria.

Weir, G. (1946) Letter: Weir to Harding. 16 September, 1946. Broken Hill Regeneration Area File. Item 55/560. NSW State Archives. Kingswood. NSW.

Wetherell, E. (1958) “NSW Department of Conservation: Minister’s Press Statement, 15 October, 1958”. Broken Hill Regeneration Area Demonstration Supply File – Fencing File. Item 60/1451, NSW State Archives. Kingswood. NSW.

Whalley, R. D. B. (2015) “Beadle, Noel Charles William (1914–1998)” Biographical Notes. Australian National Herbarium. Council of Heads of Australasian Herbaria. https://www.anbg.gov.au/biography/beadle-noel.html

Wilson, A. D. Hodgkinson, K. C. Noble, J. C. (1984) *Vegetation attributes and their application to the management of Australian rangelands* Chapter 11 in Harrington, G. N. Wilson, A. D. Young, M. D. (ed.) (1984) *Management of Australia's Rangelands* Division of Wildlife and Rangelands Research, Commonwealth Scientific and Industrial Research Organization Australia. East Melbourne. Victoria.

Wood, J. G. (1936) “Regeneration of the Vegetation on the Koonamore Vegetation Reserve, 1926 to 1936” *Transactions of the Royal Society of South Australia* (December) 60: 96-111 Biodiversity Heritage Library Washington https://www.biodiversitylibrary.org/item/129824#page/2/mode/1up

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