

Draft Loddon-Murray Irrigation Region Irrigation Drainage Strategy

*Management of drainage in the region to benefit environmental,
cultural, agricultural and community resilience.*

Draft 2024

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Acknowledgement of Country

The North Central Catchment Management Authority acknowledges Aboriginal Traditional Owners within the region, their rich culture and spiritual connection to Country. We also recognise and acknowledge the contribution and interest of Aboriginal people and organisations in land and natural resource management.

Document name: "Loddon-Murray Irrigation Region Irrigation Drainage Strategy"

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Executive summary

The Irrigation Drainage Strategy for the Loddon-Murray Irrigation Region (LMIR) is a forward-looking framework designed to guide the effective management of irrigation drainage. Crucial for safeguarding agricultural productivity, high-value industries, environmental and cultural values, and public assets, this strategy replaces the outdated 2001 Loddon-Murray Surface Water Management Strategy.

Acknowledging advancements in irrigation practices, evolving environmental priorities, and the importance of understanding First Nations Peoples aspirations, the strategy aligns with contemporary industry standards and current government policies. It emphasises resilience principles and employs recent research findings to ensure adaptability to an uncertain future.

With a focus on irrigation-induced rainfall runoff, the strategy does not address floodwaters, recognising the changing climate and irrigation water-use trends over the past two decades. Adaptable drainage schemes are deemed essential to support evolving farming systems and address groundwater level fluctuations.

The strategy outlines key components, including the need for a coordinated approach to drainage, climate change impact assessment, definition of drainage functions in specific waterways, quantification of drainage water disposal impacts, clear government and landholder roles and responsibilities, and an extension program incentivising on-farm drainage management improvement.

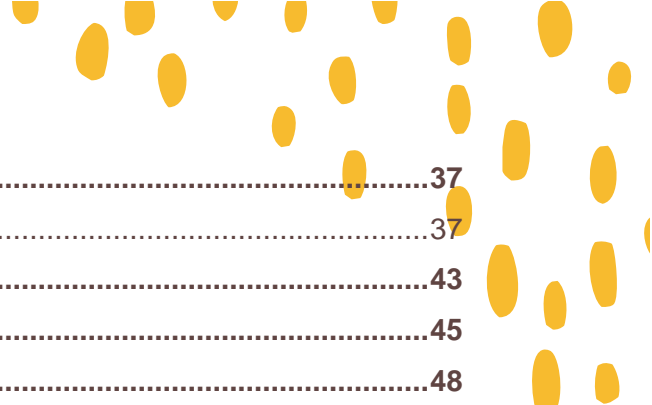
Stakeholders are urged to assess current drainage status, associated risks, and potential future needs. The strategy also reinforces the importance of existing approaches such as Drainage Course Declarations (DCDs) to facilitate cooperation in managing obstructions to restore water flow, especially in unique areas like the Bullock Creek catchment.

Aligned with Traditional Owner Country Plans, Water is Life Nation Statements, State, GMID, and CMA strategic plans, the strategy provides clear funding priorities for future drainage works, contributing to the long-term sustainability of the irrigation region. In summary, the strategy aims to manage surface water movement for the benefit of the community, environment, culture, social values, and agricultural productivity in the LMIR.



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1 Introduction

This Surface Water (Irrigation Drainage) Management Strategy (strategy) documents the ongoing need for an irrigation drainage program and explores contemporary approaches to drainage across the Loddon-Murray Irrigation Region (irrigation region). It provides the context for stakeholders who are interested in understanding irrigation drainage in the irrigation region and clarifies their roles and responsibilities and the rationale for funding identified actions. This strategy is to be reviewed prior to the development of the 2027-32 North Central Regional Catchment Strategy (RCS).

Key stakeholders provided input into the development of this strategy which covers the Loddon Valley Irrigation Area (LVIA) and the Torrumbarry Irrigation Area (TIA) (refer to Figure 1-1). The TIA includes the Nyah, Tresco, Tyntynder, and Woorinen drainage schemes. These drainage schemes are not part of the GMID and are not covered in the GMID Drainage Management Strategy and therefore excluded from this strategy. These discrete drainage schemes have different needs and customer issues to the GMID.

Drainage schemes across the irrigation region remove excess surface water resulting from irrigation-induced rainfall runoff and irrigation tailwater (refer to **Error! Reference source not found.**A1 1). This strategy outlines an approach for surface water management across the LVIA and TIA from a 'whole of catchment' approach – the focus is not just continuing to provide a drainage service under a dynamic water market but to enhance cultural and environmental values that interact with drainage.

The strategy aims to enhance the long-term sustainability of the region, by considering the movement of water across the landscape to benefit agricultural productivity, community, and cultural and environmental values.

Loddon Murray Irrigation Region

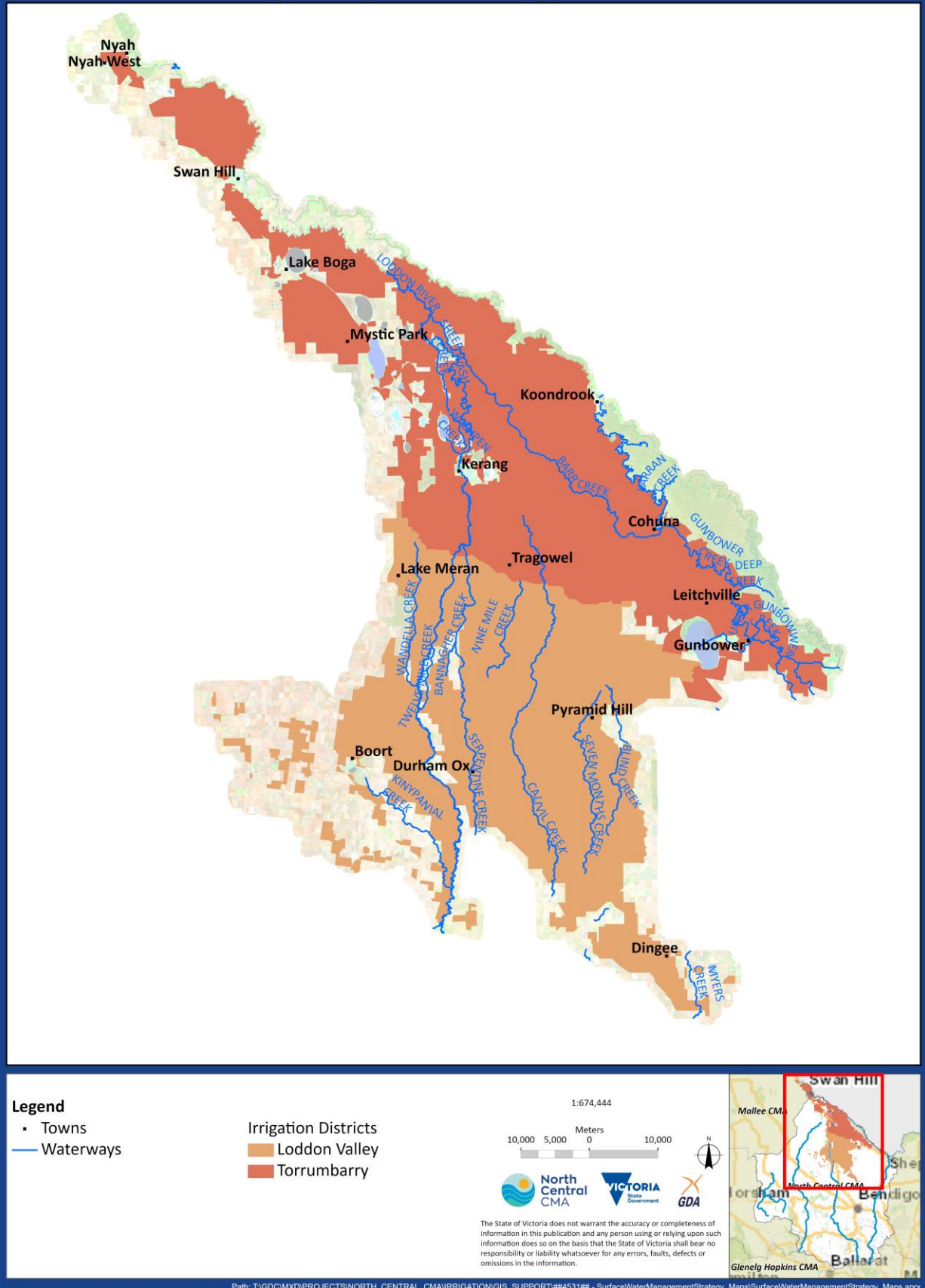


Figure 1-1 The location of major waterways and irrigation districts across the irrigation region.

1.1 Why is this strategy needed?

Drainage planning and management in the irrigation region has historically been ad hoc based on the actions identified in Land and Water Management Plans and without review since the Loddon-Murray Irrigation Region Surface Water Management Implementation Plan in 2004 (North Central CMA, 2004).

Since 2004 there has been a reduction in irrigation water delivered to the irrigation region as a result of increased on-farm efficiencies a move to opportunistic irrigation, and a rise in the recognition and sensitivity of cultural and environmental values across the irrigation region. Community interest in the construction of new primary or community surface drains has shifted with landholders identifying a need for more flexible, fit for purpose options to address landscape-scale drainage issues. This shift has driven the need for a renewed drainage management strategy that better reflects the current day situation.

Importantly, irrigation drainage activities are necessary to remove excess surface water and mitigate the risk of salinity, waterlogging and water quality impacts on surface water and groundwater throughout the irrigation Region (DELWP, 2019). This will protect the productive values of irrigation land, in particular horticulture, dairying and high value irrigated cropping and those areas of high value to the public, such as public assets (roads, bridges, environmental assets) and culturally significant sites. The strategy does not address the movement of floodwaters. Refer to the [North Central Regional Floodplain Management Strategy 2018-2028](#) for an assessment of flooding risks.

It is timely for stakeholders involved in drainage management to review the status of drainage in the irrigation region, the associated risks and the likely need for additional drainage in the future. While coordination between stakeholders has been limited in recent years due mostly to the reduced focus on salinity, reduced volume of irrigation deliveries and increased focus on environmental water recovery, this strategy provides an opportunity to re-engage agencies and landholders in the future management of drainage across the irrigation region.

The irrigation system has changed considerably with the rationalisation of the Goulburn Murray Water (GMW) delivery system, improvements to on-farm irrigation efficiencies and opportunistic volumes of irrigation water applied across the irrigation region. These factors influence the broader direction of drainage required in the irrigation region.

The significant change in climate and irrigation water use over the past 20 years has seen farmers build flexibility and resilience into their farming systems to adjust when they irrigate. The irrigation drainage schemes that support production needs to do the same, including considering the required level of maintenance for current drainage and potential alternative mechanisms to drainage management, such as Drainage Course Declarations (DCDs). DCDs may be feasible, but they need to be understood and developed with landholders as required.

There are legacy issues that need to be addresses to progress this strategy, including the North Central CMA's role regarding drainage in the Bullock Creek catchment and the disposal of excess surface water by private landholders into GMW channels and public land.

Current policy developments now influence the management of, and funding for drainage including:

- The Victorian Irrigation Drainage Program (VIDP) Strategic Irrigation Directions 2021-24
- Goulburn-Murray Irrigation District (GMID) Drainage Management Strategy
- North Central Regional Catchment Strategy 2021-27.

In the previous drainage strategy, Loddon-Murray Surface Water Management Strategy (2001), cultural and environmental values impacted by the management of surface water were considered based on best practice at the time. However, we now have a deeper understanding of these values and this is a key issue identified in the GMID Drainage Management Strategy and the North Central Regional Catchment Strategy 2021-27 that supports further investigation to prevent the risk of losing further environmental assets and cultural values across the irrigation region (Section 4.5 and 4.6).

The strategy does not consider construction of drains for new irrigation developments. Under the Victorian Government's [Northern Victoria Irrigation Development Guidelines](#), approvals are granted on the condition that the developers are responsible for managing their on-farm drainage water (Goulburn Broken CMA et al. 2022). However, as with re-developments, they are still part of the regional irrigation footprint, and cumulative impacts of increased water use must be considered.

This strategy acknowledges these changes and outlines recommended actions that contribute to achieving the goals of Victorian government, GMID and CMA strategies. In addition to these broader documents, this strategy will provide support and direction for funding any future activities for drainage works undertaken in the irrigation region.

1.2 Why drainage matters

Quoted directly from the [GMID Drainage Management Strategy](#) (Goulburn Broken CMA et al. (2022))

Too little or too much water are the most significant yield-limiting factors to crop production.

Excess water can negatively affect plant growth by the ponding of water on the soil surface, the build-up of water in the root zone and the accumulation of soluble salts in the soil.

Consequently, irrigation is often accompanied by drainage, which is the natural or man-made removal of surface and sub-surface water from a given area. Surface drainage is the removal of excess water from the surface of the land and subsurface drainage is the removal of water from the plant root zone.

The GMID is located on the riverine plains of northern Victoria and the land surface is generally very flat. Poor natural drainage is an inherent feature of many parts of the GMID and constructed drainage plays a key role in managing many of the adverse impacts of irrigation.

European settlement set in train a series of changes to the hydrological cycle in northern Victoria which have resulted in watertables rising, mobilising salt and creating waterlogging and salinity problems in the region's land and waterways. Clearing and removal of deep-rooted native vegetation meant that rainfall that infiltrated past the root zone of pasture grasses joined the watertable.

The introduction of irrigation in the early 20th century added further hydrologic loading to the soil, increasing accessions to the watertable. Waterlogging and salinisation risks linked to high watertables emerged as issues in some parts of the GMID soon after large scale irrigation commenced in the 1900s.

The problems became more widespread during the wetter second half of the 20th century. Drainage was installed in the worst affected areas from early in the 20th century and has continued ever since. In an undrained catchment excess surface water can cause inundation of land, roads and crop losses.

It also recharges groundwater and increases salinity and water logging risks. It can take months for water to be removed from low lying areas. Without some form of managed drainage, inappropriate surface water disposal can cause third-party impacts such as road damage, damage to native vegetation and unmanaged nutrient and salt discharge to streams.

For further reading refer to Appendix 4 - A brief history of drainage in the irrigation region.

2 Foundations of the strategy

A “whole of catchment” approach is required in the management of irrigation drainage in the region and therefore government has a role to coordinate this. The obligations of the Victorian Catchment Management Authorities are clearly outlined under the *Water Act 1989* and *Catchment and Land Protection (CaLP) Act 1994*:

- develop and implement drainage programs as identified in regional Land and Water Management Plans and/or the Victorian Irrigation Drainage Program.
- identify opportunities to provide complementary social, Aboriginal and economic benefits through this program.
- promote consistency between municipal strategy and scheme, and the RCS, its sub-strategies and plans related to irrigation drainage.

This strategy has been developed from a review of the previous North Central CMA documents:

- Loddon-Murray Surface Water Management Strategy, 2001
- Loddon-Murray Irrigation Region Surface Water Management Implementation Plan, 2004

These documents required updating to match future drainage needs for irrigated land, given significant recent changes in the irrigation region, in particular the large reduction in irrigation water use. It is also informed and guided by a range of Victorian government, regional and CMA strategies as outlined in Figure 2-1. The strategy is guided by the VIDP Directions 2021-2024 (DELWP, 2021b) (Appendix 3) and the actions related to drainage in the LCIR LWMP 2020-2030 (Appendix 5).

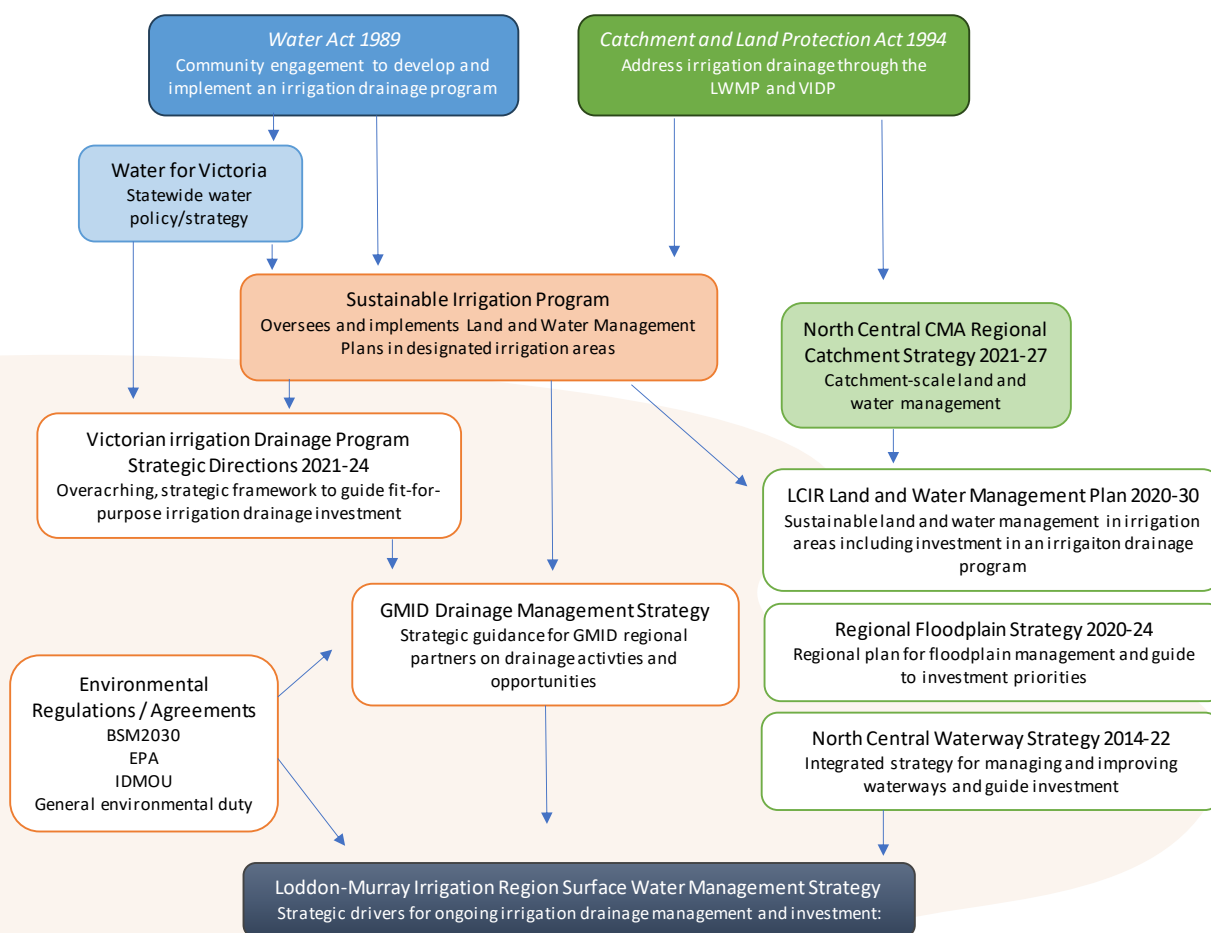


Figure 2-1: Key policy and legislative context for drainage management (an adaptation of Figure 1 in the GMID Drainage Management Strategy 2022, (Goulburn Broken CMA et al., 2022))

In 2018, consultants RMCG undertook a review of the Loddon-Murray Irrigation Region Surface Water Management Strategy (2001) and Implementation Plan (2004) on behalf of the North Central CMA. This document titled Loddon-Murray Irrigation Region Surface Water Management Strategy – Review, working draft – Stages 1, 2 and 3 (North Central CMA, 2018a) identified risks to agriculture and infrastructure with the surface water management strategy and quantified the irrigation region’s average annual volume of drainage water arising from irrigation based on data from the

2013-14 season. This strategy considers the risks identified in the review process and in addition, have been broadened to consider the impacts of drainage on environmental and cultural values.

This strategy is also guided by the outcomes of community engagement activities undertaken in 2018, including:

- A pilot project, funded by DELWP's 'Victorian Rural Drainage Review', surveyed landholders in the Bullock Creek catchment about their preferred level of administrative arrangements in drainage management, with 18% of landholders responding (69 of 383 property owners).
- The development of an Engagement Strategy to establish if landholders in the Wandella Creek, Bullock Creek catchment and Benwell catchment wanted to develop DCDs.

A project steering committee with representatives from Goulburn Murray Water, Agriculture Victoria, local government, DEECA, community and North Central CMA developed this strategy. Upon completion of the draft, it was circulated to the following additional stakeholders for comment:

- Landholders in the region, particularly farmers who responded to the engagement work undertaken in the Victorian Dryland Drainage Strategy pilot project.
- Loddon Valley and Torrumbarry Water Services Committee.
- Local government staff involved in drainage (beyond the representation of the steering committee).
- First Nations Peoples of Dja Dja Wurrung, Barapa Barapa, Wamba Wemba and Yorta Yorta Country.
- First Nations People in the region through established North Central CMA networks.

2.1 Proposed vision and outcomes of this strategy

2.1.1 Vision

Strategy's vision is:

**“Management of drainage in the region to benefit
environmental, cultural, agricultural and community resilience.”**

The strategy's vision is guided by the vision of the Water Theme of the North Central Regional Catchment Strategy 2021-27, *“healthy waterways and floodplains, managed for shared benefits”* and Land Theme: *“healthy landscapes and soils, managed for the future”*. It further aligns with the LCIR LWMP aspirational goal: *“Using water for healthy, productive, sustainable irrigated food and fibre”* and contributing to achieving the desired outcome in the next five to ten years of improved regional irrigation drainage infrastructure and management.

The vision also aligns with the VIDP *“to promote productive and sustainable irrigation, now and into the future, by managing excess water”*, whose mission is to mitigate the risk of salinity, waterlogging, and water quality impacts, to surface and subsurface water resources, from irrigation activities in the Victorian landscape (Appendix 3).

Complementary to the vision are the visions of the following related strategies:

- GMID Drainage Management Strategy, 2022: *“All stakeholders work collaboratively to manage GMID drainage systems adaptively to support viable agriculture, vibrant communities, and to enhance environmental and cultural values.”*
- Victorian Rural Drainage Strategy, 2018: *“Landholders are empowered to work together and will be supported to improve their management of dryland rural drainage.”*

2.1.2 Principles

The preparation of the strategy and actions developed is based on the following agreed principles:

- An adaptive management approach, which will support a structured, continuous review, improvement, and adaptation process.
- Costs are born by those that benefit, except where public benefit exceeds private benefit.
- Cost-effective action.
- Improved outcomes for First Nations People.
- Enhanced environmental benefits, including improved water quality, protect natural flow paths, reduce waterlogging, and manage salinity risks.
- Actions and projects simplify drainage management for the landholder.

2.1.3 Objectives

Strategy objectives:

- Clarify and optimise the future roles and responsibilities of key stakeholders involved in surface water management in the irrigation region.
- Explore the opportunities and issues associated with surface water management and drainage, for agriculture, community, cultural and environment values.
- Make recommendations to guide future funding and action for drainage management in the irrigation region.

2.1.4 Outcomes

The strategy aims to ensure an adaptive drainage system (both on and off-farm) that responds to future drainage needs by:

1. Ensuring each stakeholder involved in surface water management in the irrigation region clearly understands their roles and responsibilities, including the management of assets associated with drainage.
2. Clearly defining issues and risks associated with surface water management in the irrigation region to be mitigated through the proposed recommendations.
3. Clearly defining the actions required to protect and enhance environmental values associated with surface water management in the irrigation region and engage with First Nations People to identify opportunities to protect cultural values.

2.2 Strategy drivers

The following drivers demonstrate the need for acting on drainage in the irrigation region. Each are addressed in the following sections of this strategy:

1. The need for a coordinated approach to drainage management.
2. Impact of climate change on future drainage and management options.
3. Resolving management of drainage in the Bullock Creek catchment.
4. Protecting and enhancing environmental values.
5. Improving outcomes for First Nations People.
6. Implications of disposing of drainage water into GMW channels and pumping to public land.
7. Determining future actions for drainage schemes in areas that service land that no longer has a WUL and therefore not irrigated.
8. Rationale of new drainage.
9. Future irrigation area scenarios and drainage needs.
10. Feasibility of Drainage Course Declarations.
11. Improving on-farm management of drainage.

2.3 Coordinated approach to drainage management

2.3.1 Situational analysis of drainage in the irrigation region

A total area of 510,000 ha as reported in the RMCG review of LMIR IDS for North Central CMA, (2018a) includes:

- **Drained area of 181,000 ha.** This area is served by existing GMW or community drainage schemes and the waterways of the Bullock Creek catchment, once part of the Bullock Creek Improvement Trust.
- **Adequate natural drainage of 42,000 ha.** This area does not require drainage and has adequate natural drainage and is usually adjacent to natural water courses.
- **Undrained area of 138,000 ha.** This includes non-irrigated and irrigated areas. Some areas are irrigated with pressurised systems or are new developments where the developer is expected to manage their own drainage needs as outlined in the Irrigation Development Guidelines (DELWP, 2021b). These 'undrained' areas should be considered as potentially requiring drainage and may have undocumented private drainage arrangements in place.
- **Not classified 149,000 ha.** Most of this area is not irrigated and includes public land, such as Gunbower Forest.

The drainage status can be seen in Figure 2-2. This strategy will focus on ensuring the drainage across this region occurs effectively and minimise the off-site impacts of irrigation-induced rainfall runoff.

Drainage Status

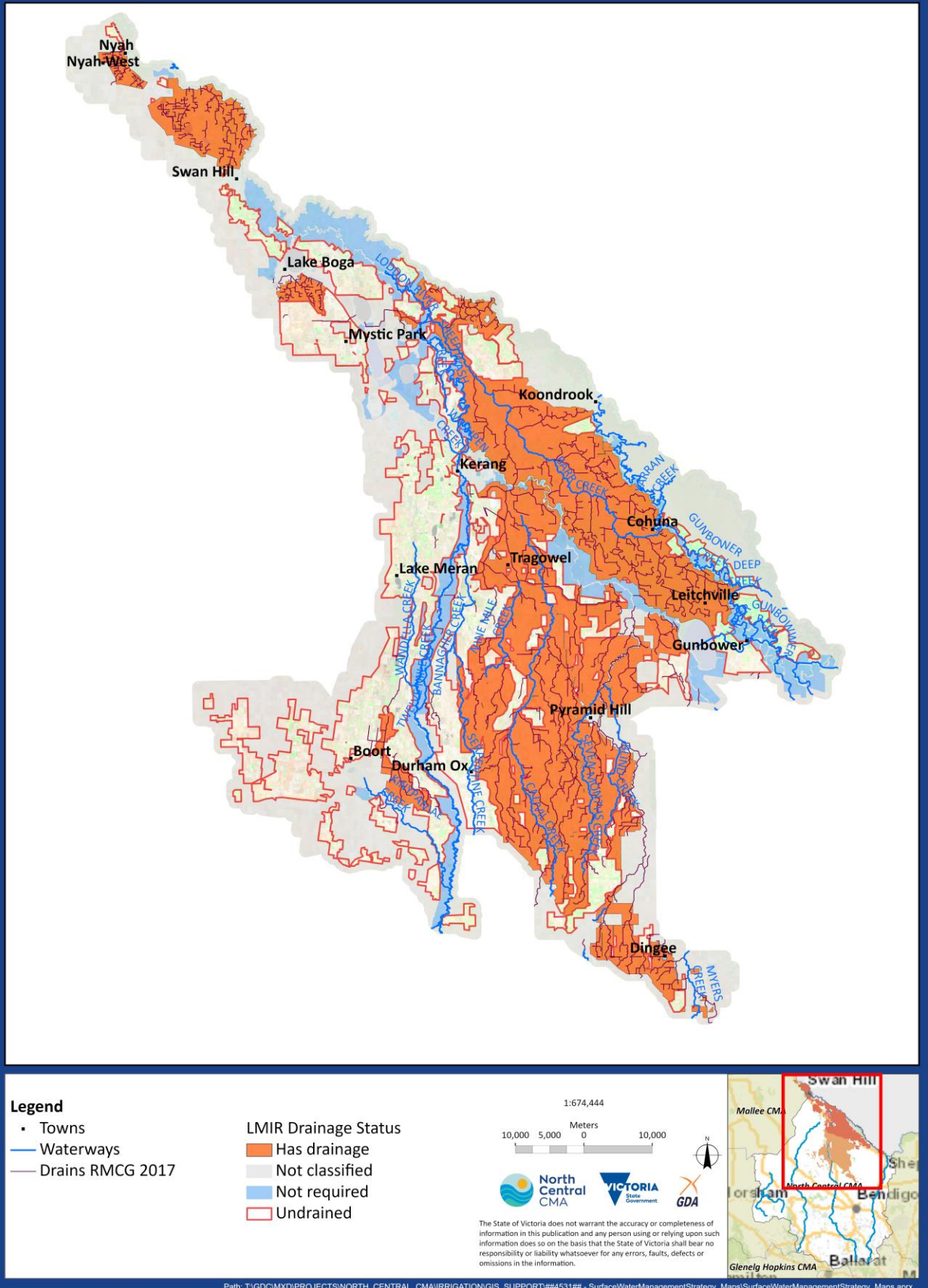


Figure 2-2: Drainage status of land in the region.

2.3.2 Roles and responsibilities for surface water management

There are a number of stakeholders who have a role in the management of surface water. This can be clarified by clearly defining and agreeing on the roles and responsibilities of each of the stakeholders involved in drainage in the irrigation region. (Table 2-1)

Table 2-1: Overview of stakeholder roles and responsibilities regarding surface water management in the irrigation region

Partner	Roles and responsibilities
Victorian Government agencies and statutory bodies	
Department of Energy, Environment and Climate Action (DEECA)	<ul style="list-style-type: none"> Determine government investment priorities within their service areas. Specify government expectations of statutory entities through Statements of Obligations. Support agencies responsible for irrigation drainage to deliver the outcomes in alignment with the VIDP Strategic Directions. Support adaptive management approaches to irrigation drainage. Balance private benefits and costs with public values. Regulate externalities to protect public values. Work with government agencies and councils to support a collaborative approach to irrigation drainage. Overarching program manager of the Victorian Regional Water Monitoring Partnership, who undertake water quality monitoring at Capel's Crossing on Barr Creek.
North Central CMA	<p>Established under the <i>Water Act 1989</i> and <i>Catchment and Land Protection Act 1994</i> the North Central CMA addresses land management issues that reduce the quality and productivity capacity of the land and are responsible for facilitating community involvement in this management in the North Central CMA region. The CMA oversees a series of designated waterways that provide critical drainage services to a large area of the LVIA.</p> <p>The CMA's roles and responsibilities for surface water management include:</p> <ul style="list-style-type: none"> Obligation to develop a Land and Water Management plan for the Loddon Campaspe Irrigation Region to guide government investment in natural resource management across designated irrigation areas. This will include details of an Irrigation Drainage program for the LMIR. Develop an IDS that will implement adaptive management of irrigation drainage in the LMIR. Oversee the delivery of an irrigation drainage program, guided by the IDS. Identify opportunities to facilitate improved drainage management for environmental benefit. Support First Nations self-determination by walking and working together co-designing project work in irrigation drainage. In designated waterways with a drainage function, balance the outcomes of public and private. Determine arrangements for unmanaged infrastructure on waterways where ownership is unknown. Work with government agencies and local governments to help landholders resolve drainage issues. Take responsibility for oversight of the Drainage Information Management System (DIMS) to provide a centralised place to record drainage issues. Ensure surface water management, including irrigation drainage, is included in the RCS. Participate in the development and delivery of the 2014-2022 North Central Waterway Strategy and North Central Regional Floodplain Management Strategy 2018-2028 to ensure priorities complement the irrigation drainage activities.
Agriculture Victoria	<p>Irrigation program staff to provide a range of extension services to irrigators in the irrigation region. Subject to future funding and priorities, this includes:</p> <ul style="list-style-type: none"> Provision of irrigation extension services and engagement with landholders. Deliver on-farm programs with a focus on increasing irrigation water-use efficiency and minimising negative off-site impacts. Provide technical support and share relevant R&D to the VIDP. Work with government agencies and councils to help landholders with the management of irrigation drainage on farm.
Environment Protection Authority	<ul style="list-style-type: none"> To support businesses to meet their obligations under the General Environmental Duty (GED). Control water pollution. Undertake compliance and enforcement activities.

Department of Transport and Planning (DTP)	<p>VicRoads:</p> <ul style="list-style-type: none"> Under the <i>Road Management Act 2004 (Vic)</i> DTP is responsible for arterial roads, as listed in the DTP Register of Public Roads. DTP maintains these roads, and road related infrastructure, (including culverts and bridges) in accordance with the <i>Road Management Plan and the Road Management Act Code of Practice Operational Responsibility for Public Roads</i>. <p>VicTrack:</p> <ul style="list-style-type: none"> Manage infrastructure that interacts with irrigation drainage (except where the infrastructure is licensed to third parties).
Rural water corporations	
Goulburn Murray Water (GMW)	<p>Water corporations in Victoria are established under the <i>Water Act 1989</i> and provide a range of water services to customers and stakeholders within their service areas. GMW provides a combination of irrigation services and drainage, both surface and subsurface in the irrigation region. Water corporations have a responsibility within their service areas to ensure water availability is maximised for entitlement holders and paying customers while protecting their supporting infrastructure. This includes:</p> <ul style="list-style-type: none"> Manage GMW-owned, operated, and maintained infrastructure for irrigation delivery and drainage associated with irrigation in regulated districts. Provide drainage services, mostly in northern Victoria, where dryland rural drainage infrastructure outfalls into GMW-owned infrastructure and where existing arrangements are in place for landholders to pay for these services. GMW is responsible for the GMW-owned outfall drains and associated assets. Undertake the role of the responsible authority for a Drainage Course Declaration following formal approval by the GMW Managing Director and/or GMW Board. Comply with the regulatory requirements of the <i>Water Act 1989</i>, EPA and the MDBA in northern Victoria. Minister's delegate for take and use license and water use licence ensures compliance as per Statement of Obligations, for example, with conditions on water-use licences.
Local government	
Loddon Shire Council Gannawarra Shire Council Swan Hill Shire Council	<ul style="list-style-type: none"> Ensure waterlogging, salinity, water quality and drainage issues are considered as part of their statutory planning approvals processes. Manage drainage assets for which they are responsible. Manage the interaction between their assets and drainage – in particular, drainage through road culverts and/or beside road reserves (table drains). Consider planning permit applications and ensure compliance with permit approvals. Work with government agencies to help landholders resolve drainage issues.
First Nations Peoples	
Dja Dja Wurrung Yorta Yorta	<p>Registered Aboriginal Parties:</p> <ul style="list-style-type: none"> Primary source of advice and knowledge on matters relation to Aboriginal places or Aboriginal objects in their regions. Their core functions include: <ul style="list-style-type: none"> evaluating Cultural Heritage Management Plans assessing Cultural Heritage Permit applications making decisions about Cultural Heritage Agreements providing advice on applications for interim or ongoing Protection Declarations entering into Aboriginal Cultural Heritage Land Management Agreements with public land managers nominating Aboriginal intangible heritage to the Victorian Aboriginal Heritage Register and managing intangible heritage agreements. (Victorian Government, 2023) This will help clarify expectations about how agencies and landholders need to consider cultural heritage in drainage management.
Barapa Barapa Wamba Wamba Wadi Wadi	<p>First Nations Peoples:</p> <ul style="list-style-type: none"> Traditional Owner groups, legally recognised under the Aboriginal Heritage Act, with responsibilities for managing and protecting Aboriginal Cultural Heritage on Country. Their role is to care for their Country, Culture, Connection, and People. It is their self-determined right if they want to partner with anyone.
Community	

Landholders	<ul style="list-style-type: none"> Responsible, individually or in collaboration, for managing on-farm drainage that respects environmental and social impacts beyond farm boundaries. Landholders are required under the GED of the <i>Environmental Protection Act 2017</i> to reduce the risk of harm from activities impacting human health and the environment from pollution or waste. Responsible for on-farm drainage (on both irrigated land and dryland), including funding ongoing management and maintenance of drainage systems and infrastructure on their land. Determine management arrangements for their specific drainage systems and identify other landholders willing to participate in agreements to manage drainage schemes (where appropriate). In the case of accessing GMW drains, landholders are required to comply with the responsibilities and rights and are tariffed. Consult with the relevant authority regarding new irrigation developments or any changes to their current drainage system. Comply with the regulatory requirements of the <i>Water Act 1989</i>, and any other Acts that may apply.
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3 Drainage types in the irrigation region

3.1 Drainage system and who is responsible

The North Central CMA has been responsible for the drainage function in designated waterways, along with managing drainage for cultural, environmental, and recreational values, which includes the waterways of the Bullock Creek catchment.

From the 1970s to mid-1990s the waterways of the Bullock Creek catchment were managed by the Bullock Creek Improvement Trust (BCIT) as regional drains for irrigation. In other irrigation regions across the state, water authorities primarily manage public irrigation drainage networks. The regional drains the BCIT operated provided a similar service as a water authorities primary drain, to a lesser specification. When the BCIT was dissolved, North Central CMA took over the responsibility of the BCIT assets, however the CMA views these particular assets as designated waterways with a drainage function. Therefore, the drainage infrastructure in the Bullock Creek catchment is unique compared with other designated irrigation regions and has resulted in some confusion around the terminology associated with drains servicing irrigated land in the region. This is clarified in the following table (Table 3-1) which describes the parts of the drainage system in the irrigation region, and importantly who is responsible for maintaining them. Figure 3-1 shows the location of these drains.

Local governments, VicRoads and VicTrack also construct and maintain drains to ensure surface water does not impact the infrastructure for which they are responsible. Both the infrastructure and drains play a role in the movement of surface water across the irrigation region.

Table 3-1 Parts of the drainage system description and responsibility for their maintenance

Parts of the drainage system	Description	Who is responsible for maintaining these drains?
GMW surface drains (May also be referred to as primary drain or constructed drain)	<p>GMW surface drains occur across the irrigation region, of which some parts no longer have irrigation water applied. The purpose of these drains is to remove irrigation-induced rainfall runoff.</p> <p>GMW constructs drains to a drainage construction standard. Landholders are rated to ensure ongoing maintenance. There is 804 km of GMW primary surface drains in the irrigation region, most of which occur in the TIA.</p> <p>In some places the GMW drains are designated waterways, such as Barr Creek. The waterways of the Bullock Creek catchment become GMW drains at the lower parts of the catchment. This requires all irrigators in the irrigation region to pay a Surface Drainage Fee to GMW for this service.</p>	GMW

<p>Subsurface drains (not shown in Figure 3-2)</p>	<p>Subsurface drains service the Nyah, Woorinen, Tyntynder and Tresco irrigation districts and were built to dispose of groundwater from the plant root zone and occur in parts of the region which mostly support horticulture. GMW owns the pumps and drains with O&M costs funded by landholders.</p> <p>These drainage schemes are not part of the GMID and are not covered in the GMID Drainage Management Strategy and therefore excluded from this strategy. These discrete drainage schemes have different needs and customer issues to the GMID.</p>	<p>GMW</p>
<p>Community surface drains managed under agreement</p>	<p>Groups of landholders constructed their own community surface drains which outfall directly to GMW primary drains or via the designated waterways in the Bullock Creek catchment.</p> <p>The purpose of these drains is to remove irrigation-induced rainfall runoff.</p> <p>Agriculture Victoria has previously facilitated an incentive program on behalf of the Salinity/Land and Water Management Plans of the time. If CSD's were constructed as a GMW system (not landholder managed) under this program, a capital finance/repayment option for landholders was made available.</p> <p>Design and service standards are similar to those of GMW primary drains but are generally smaller in cross section, length and lower flow capacity as they provide drainage outfall to a smaller catchment (< 20 landholders).</p> <p>If GMW does not manage CSDs, landholders develop private agreements that are registered in accordance with the provisions of the <i>Water Act 1989</i> and outline the management and on-going financial arrangements for operation and maintenance. (North Central CMA 2021)</p> <p>Approximately 650 km of private CSDs across the Bullock Creek catchment were established under private agreements to be managed by landholders. It is unknown to what the extent these agreements are still in place and if the drains on the map are in the right location or still exist.</p> <p>There are no other CSDs, private or GMW-managed, outside the Bullock Creek catchment in the irrigation region.</p>	<p>Landholders/Landholder groups</p> <p>GMW may take on responsibility for ongoing O&M and rating if petitioned by a landholder group. To date, this has not occurred in the irrigation region.</p>
<p>Designated waterways¹</p>	<p>Designated waterways occur across the irrigation region and are a natural structure that allows the collection and movement of water across the landscape.</p> <p>Approximately 347 km of designated waterways in the Bullock Creek catchment were managed for irrigation drainage by the Bullock Creek Improvement Trust (BCIT). The BCIT was transferred to the North Central CMA in 1997, however the CMA was unable to rate farmers for O&M costs to maintain these waterways as drains.</p> <p>North Central CMA oversee the management of designated waterways across the catchment. If a landholder would like to undertake works that will impact</p>	<p>North Central CMA with landholders responsible for minimising impact of drainage water off-farm on environment and human health, as outlined in the GED.</p>

¹ Designated waterways are named or unnamed, permanent or seasonal, and range in size from a river to a natural depression. Designated waterways are declared under the [Water Act 1989](#).

	<p>the waterway they must apply for a Works on Waterway permit.</p> <p>Designated waterways provide the following drainage functions for the irrigation properties:</p> <ul style="list-style-type: none"> - Receives irrigation-induced rainfall runoff from landholder properties. - Lowers groundwater pressure levels. - Reduces risks associated with waterlogging and salinity. <p>The CMA acknowledges the drainage function these waterways provide, additional to the natural values and implement the irrigation drainage program to manage this. As at 2023, there are no known structural assets owned and/or managed by North Central CMA.</p>	
Private / on-farm drains (not shown in Figure 3-2)	<p>Irrigation drains and reuse systems located on-farm, which are not part of a CSD, are considered private drains to be managed by the landholder. The main purpose of these drains is to remove irrigation-induced rainfall runoff and irrigation tailwater from the irrigated part of the farm, and it is the recommended practice of including a reuse dam to capture and store tailwater for farmers to reapply. Irrigation drains may be constructed or follow the natural topography across the property.</p>	Landholder
Drains associated with public assets	<p>Local government, VicRoads and VicTrack have drains constructed to protect public assets such as roads and railways. These drains are constructed to move excess surface water away from public assets and can play a key role in the movement of surface water through the irrigation region.</p>	Local government, VicRoads and VicTrack

Bullock Creek Catchment

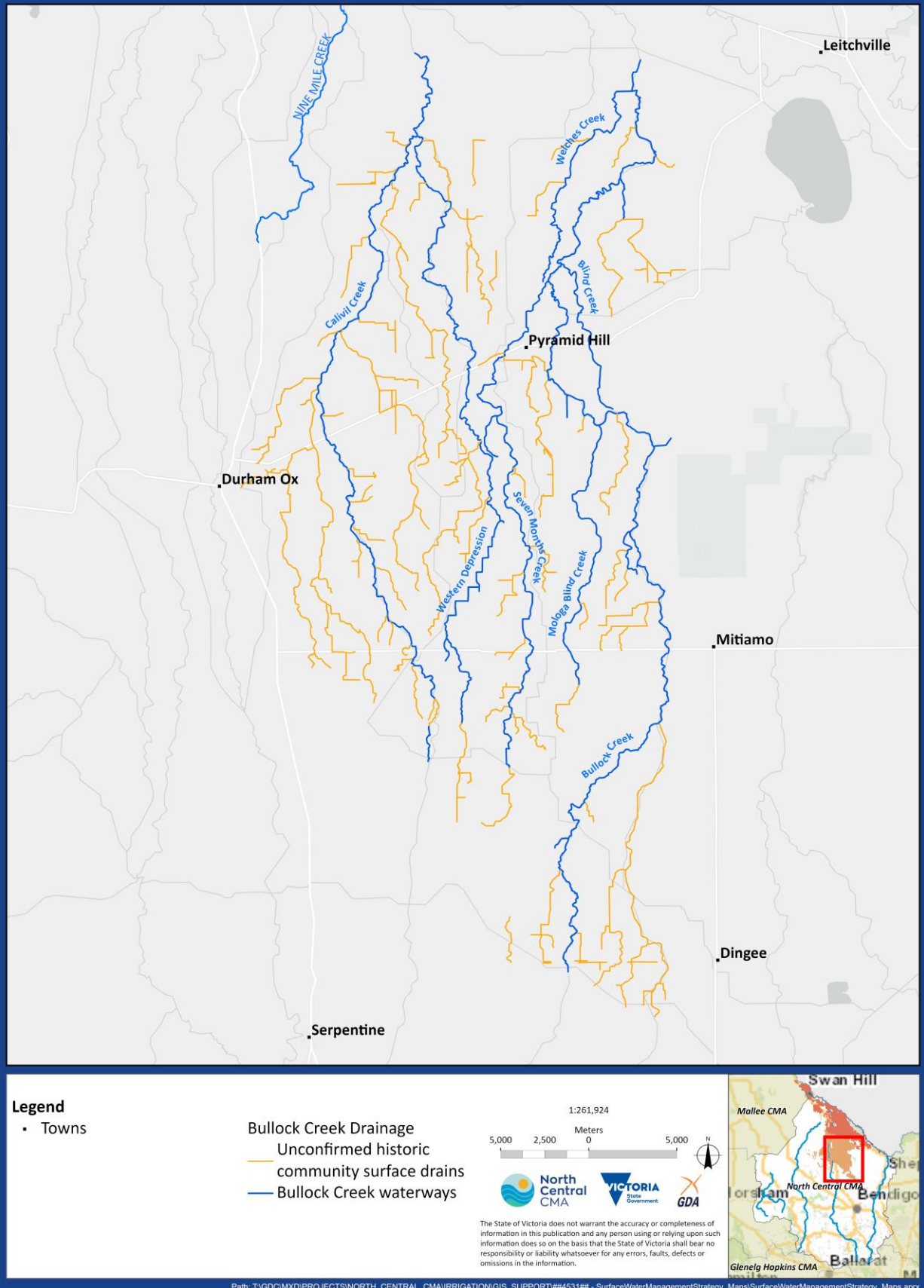


Figure 3-1 – Location of designated waterways of Bullock Creek catchment with an indication of the network of historic CSDs.

3.1.1 Drainage on dryland areas of the irrigation region

When a WUL is removed and the land can no longer be irrigated, this land is managed as dryland. The Victorian Rural Drainage Strategy (2018) states the following responsibilities for landholders and local water authorities.

Farmers/landholders

- Manage private dryland rural drainage and develop dryland rural drainage management plans.
- Fund ongoing management and maintenance of drainage systems and infrastructure.
- Determine management arrangements for their specific drainage systems (including developing dryland rural drainage management plans where appropriate).
- Identify other landholders willing to participate in agreements to manage dryland rural drainage systems (where appropriate).

Rural water corporations (in this case GMW)

- Regulate the take and use of water.
- Manage infrastructure and drainage associated with irrigation in regulated districts.
- Continue to provide drainage services, mostly in northern Victoria, where dryland rural drainage infrastructure drains into irrigation district infrastructure, or where dryland rural drainage has been established in or near an irrigation area, and existing arrangements are in place for landholders to pay for these services.

3.2 Drainage beneficiaries

Surface and subsurface drainage across the irrigation region provide multiple functions with multiple beneficiaries, as outlined in Table 3-2². This table includes benefactors of drainage (natural or constructed) in the irrigation region.

Table 3-2 Drainage beneficiaries in the irrigation region

Input	Beneficiary
Irrigation tailwater through on-farm drainage into a reuse system	Irrigators / community / environment
Irrigation-induced rainfall runoff	Irrigators / community / environment
Operation channel outfall	GMW
Emergency channel outfall	GMW
Public groundwater pump discharge	Landholders / community / Local government / GMW
Private subsurface drainage discharge	Landholders / community
Roadside and railway drainage	Local government, VicRoads and VicTrack
Environmental site water management	Environment
Water for the environment	Environment

² A variation of Table 4: Surface drainage beneficiaries in the GMID Drainage Management Strategy

Land Use and Drain Location

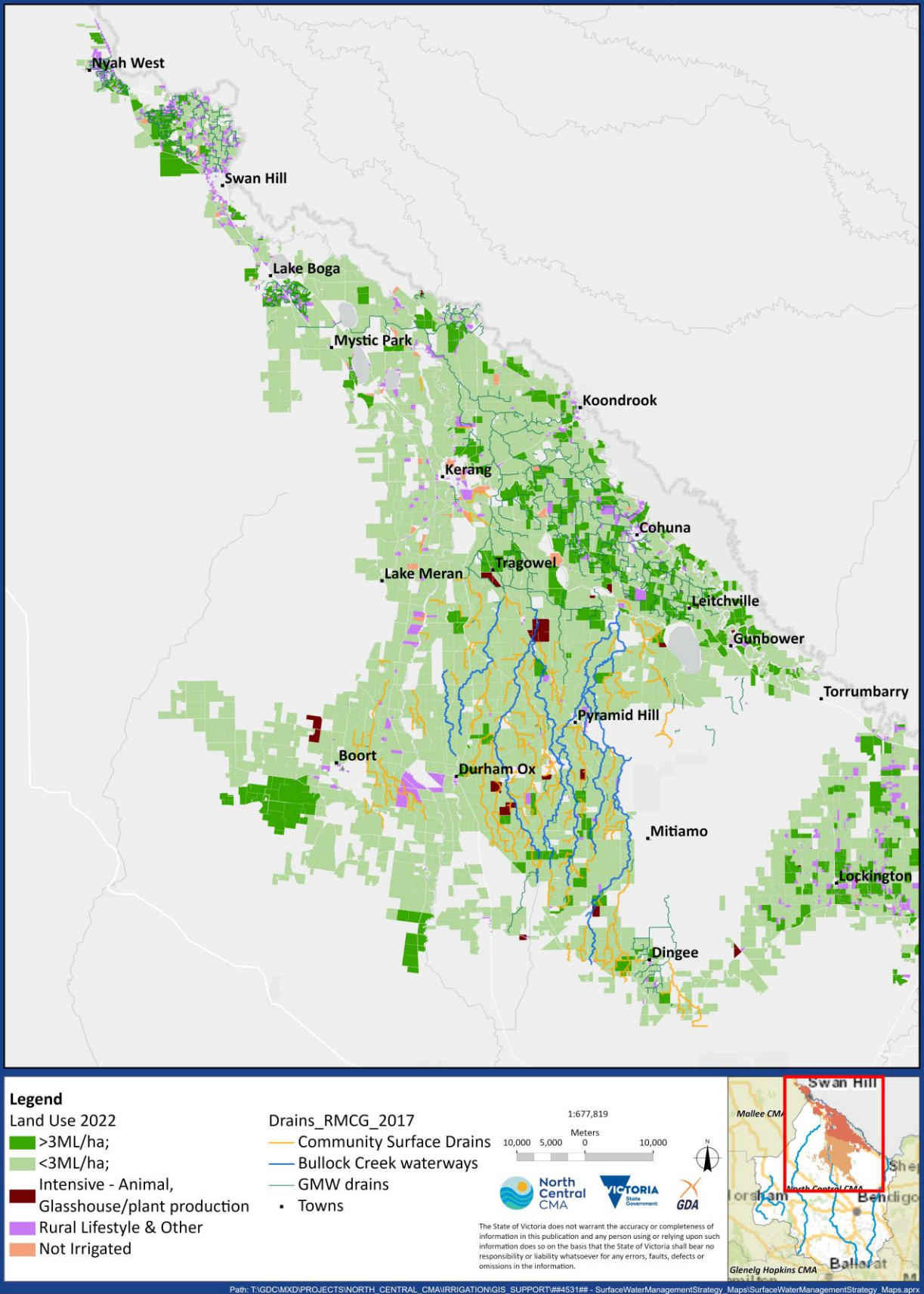


Figure 3-2: Types of drains excluding subsurface drains and private on-farm drains, and areas of land use based on the 2021–22 land use mapping.

4 The ongoing need for drainage in the irrigation region

Historically, irrigation has contributed to rising regional watertables, leading to increased soil and water salinity, with parts of the region showing signs of salinity impacts as early as 1914. Increasing salinity can impact agricultural productivity, environmental assets, and downstream users. Major engineering works were installed from 1968 on the Barr Creek diversion scheme which reduced salinity inflows into the Murray River. Prior to undertaking these works, Barr Creek and Tragowel Plains were exporting 200,000 tonnes of salt to the Murray River and was the single largest source of salt within the Murray-Darling Basin. (Appendix 4).

Groundwater levels were considered high when they were less than two metres below the ground surface. When this occurred, farmers modified farming practices in an effort to keep groundwater two metres or below the surface, including improved drainage of summer rainfall runoff due to irrigation on and from their properties. This community-led work was supported by the regional Salinity Management Plans which have now transitioned to Land and Water Management Plans.

Since the year 2000 there has been a significant decrease in rainfall and the volume of irrigation water used resulting in reduced groundwater levels and salinity across the region. However, groundwater levels can rise with wet seasons and flooding, and along with climate change creating variable weather patterns, the region needs to maintain an adaptive drainage system that will continue to provide this service.

Over the past 20 years groundwater has remained at a depth that had minimal impact on agricultural production across most of the irrigation region i.e., greater than two metres below the ground surface. Improved drainage has also allowed for the removal of excess water from the landscape, in particular irrigation-induced rainfall runoff from irrigated areas. Figure 4-1 shows an overall drop in watertables with changes to groundwater levels in response to wet seasons and floods. However, the fluctuation in groundwater levels with change in seasonal rainfall and flooding (Figure 4-4) drives the ongoing need for drainage across the irrigation region.

This section describes the status and future considerations for drainage in the irrigation region and identifies potential risks for drained and undrained areas based on the review of the Loddon-Murray Irrigation Region Surface Water Management Strategy (North Central CMA 2018a). Where appropriate, the VIDP strategic priority will be highlighted.

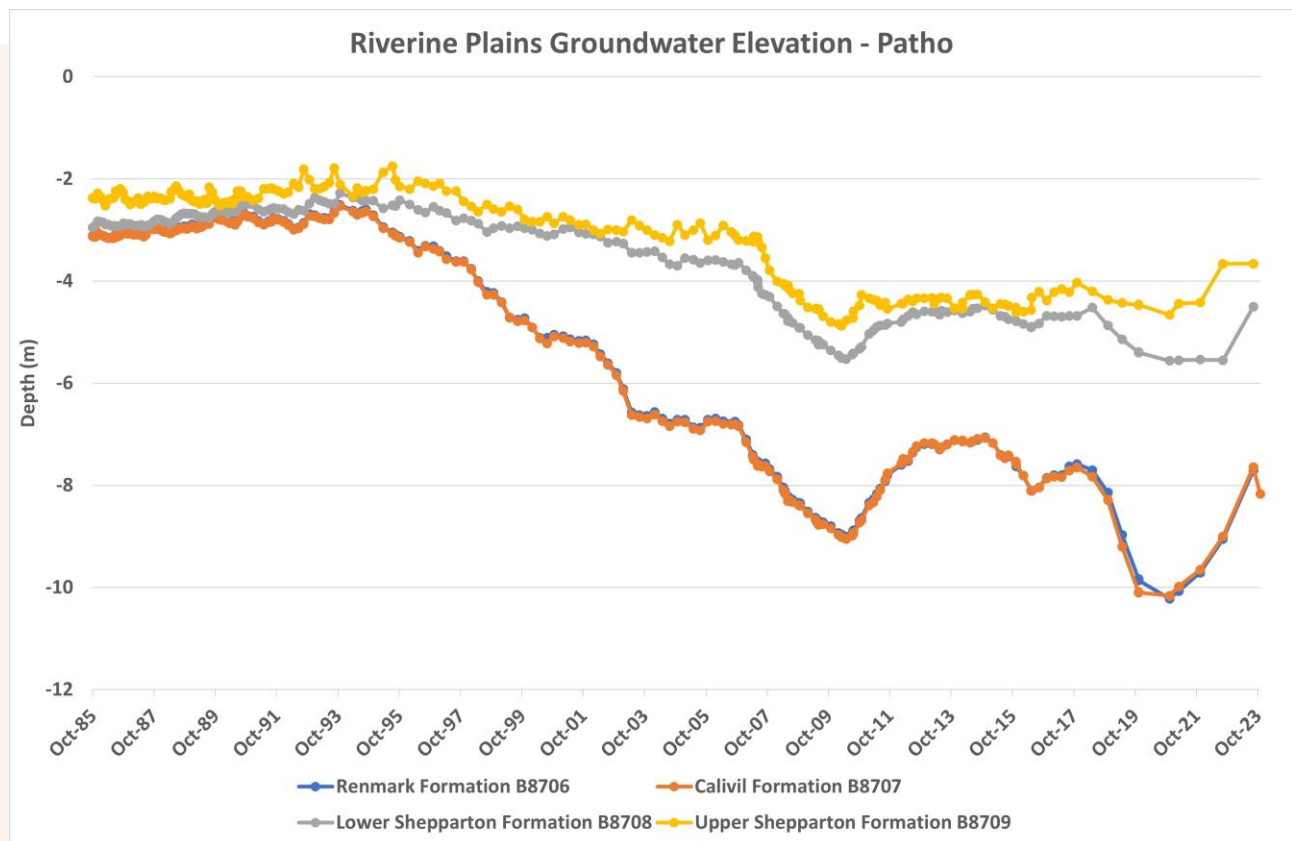


Figure 4-1: Changes since 1985 in groundwater aquifers related to the LMIR

4.1 Changed land use and irrigation intensity

The current land use is very different to the land use in the 1990s when irrigation water use was higher. There has been a reduction in area of perennial pasture irrigation (active all year round) and annual pasture irrigation (autumn/winter/spring active). Figure 4-3 illustrates water deliveries into the irrigation region in recent years at approximately 400 to 500 GL/y compared to around 900 GL/y in the 1990s. The decline in irrigation usage can be attributed to water trade out of the irrigation region, Murray-Darling Basin Plan water savings policies and other water reforms such as conservative allocation policy and carry over. If 400 GL/y of deliveries to the irrigation region is the future norm (based on GMW's forecast annual delivery of 900GL (GMW, 2023)) and with application rates averaging around 4 ML/ha, then the irrigated area is predicted to be approximately half that of the 1990s from 200,000 ha to 100,000 ha. (North Central CMA, 2018a) This forecast strengthens the need for the irrigation system to be adaptive to the changes in water use as we move in and out of climate cycles.

An analysis of total land area in the irrigation region by irrigation intensity and presence of drainage³ shows that for contemporary conditions:

- Of the 510,000 ha, 44% of the irrigation region is not irrigated, 10% is high intensity irrigation (>3ML/ha) and 46% is low intensity irrigation (<3ML/ha).
- Considerable variation exists across the irrigation region, with a much higher percentage of high intensity irrigation occurring on Gunbower Island (18%) and Barr Creek (28%).
- 51,000 ha of non-irrigated land is serviced by a drainage system.
- 34% (81,000 ha) of the 236,000 ha of low intensity irrigated land is undrained.
- Within the 50,000 ha of high intensity irrigation 15,000 ha is undrained (30%), of which 5,000 ha in the Wandella Creek catchment and 3,000 ha in Boort West.

Figure 4-2 shows the irrigation intensity for the 2021-22 season⁴, with the undrained areas highlighted to show the range of land use occurring without formal drainage. In this irrigation season, 12% of the region was under high intensity irrigation, with 82% low intensity irrigation and only 1% not irrigated.

Despite an overall reduction in the volume of irrigation water used and the area irrigated there are some sub-catchments which have experienced growth. For example, undrained areas in the Wandella Creek and Boort-West sub-catchments have experienced such growth in recent years. These new areas of irrigation are usually irrigated with efficient systems such as centre pivots or drip systems that are much less prone to generate surface runoff except for during rainfall events. (North Central CMA, 2018a)

The drainage risk in these undrained areas may increase with additional new development in these sub-catchments. This risk is partly addressed with landholders who undertake new irrigation developments being responsible for managing their own drainage risk. The new irrigation development guidelines and the development approval process require an Irrigation and Drainage Plan (IDP) to be developed and outline how any excess surface water from irrigation will be kept on farm (Northern Victorian Irrigation Development Guidelines, 2021).

Land used for high value and intensively irrigated enterprises are prone to higher costs from lack of drainage than lower value dryland or extensive agriculture. Horticulture, dairying and irrigated cropping such as maize crops are the highest value land uses and tend to have the highest irrigation intensity (ML/ha). With some exceptions, this occurs in areas already served by GMW drains such as the Barr Creek, Dinglee, Swan Hill, Tresco and Woorinen drainage catchments.

Ongoing oversight of drainage in the region, lead by North Central CMA and Agriculture Victoria, is required to respond to fluctuating changes in irrigation use and application. This oversight will allow agencies to respond to community requirements with changes in future drainage flow, protect and enhance environmental values and work with First Nations People to protect cultural values.

³ This analysis looked at the irrigation region by irrigation status by a) the areas not being irrigated; b) high intensity irrigation (>3 ML/ha) and c) low intensity irrigation (<3 ML/ha) based on 2013/14 usage values and presence or absence of a drainage system. This piece of analysis was complicated to undertake and therefore cannot easily be repeated for a more recent season. However, 2013/14 still provides a snapshot of the changes that have occurred in the catchment since the last strategy completed in 2001.

⁴ Data from the 2021-22 Land and Water Use Mapping in the Goulburn Murray Irrigation District.

Land Use and Undrained Areas

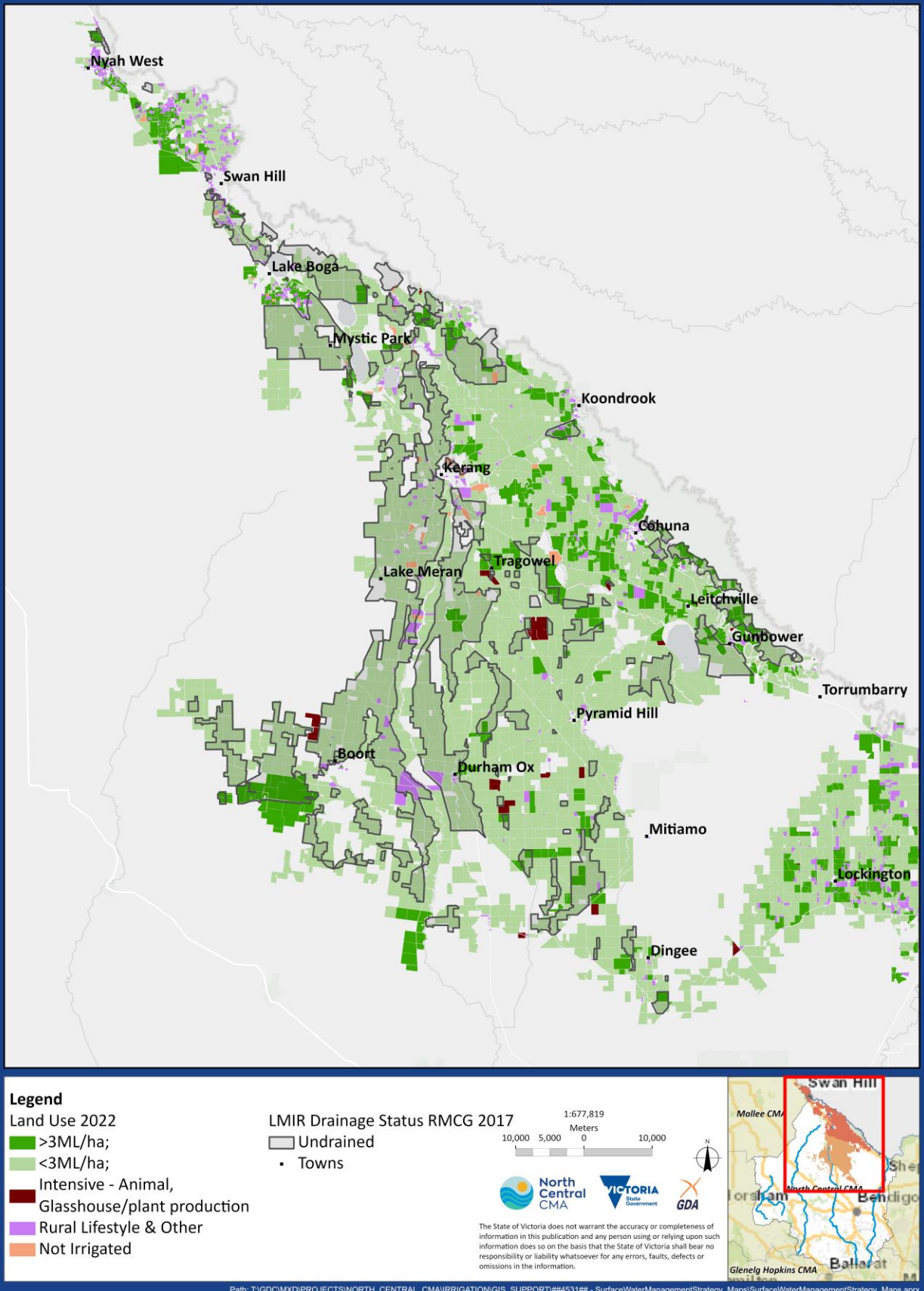


Figure 4-2: Irrigation intensity (2021-22) of undrained land in the Loddon-Murray Irrigation Region.

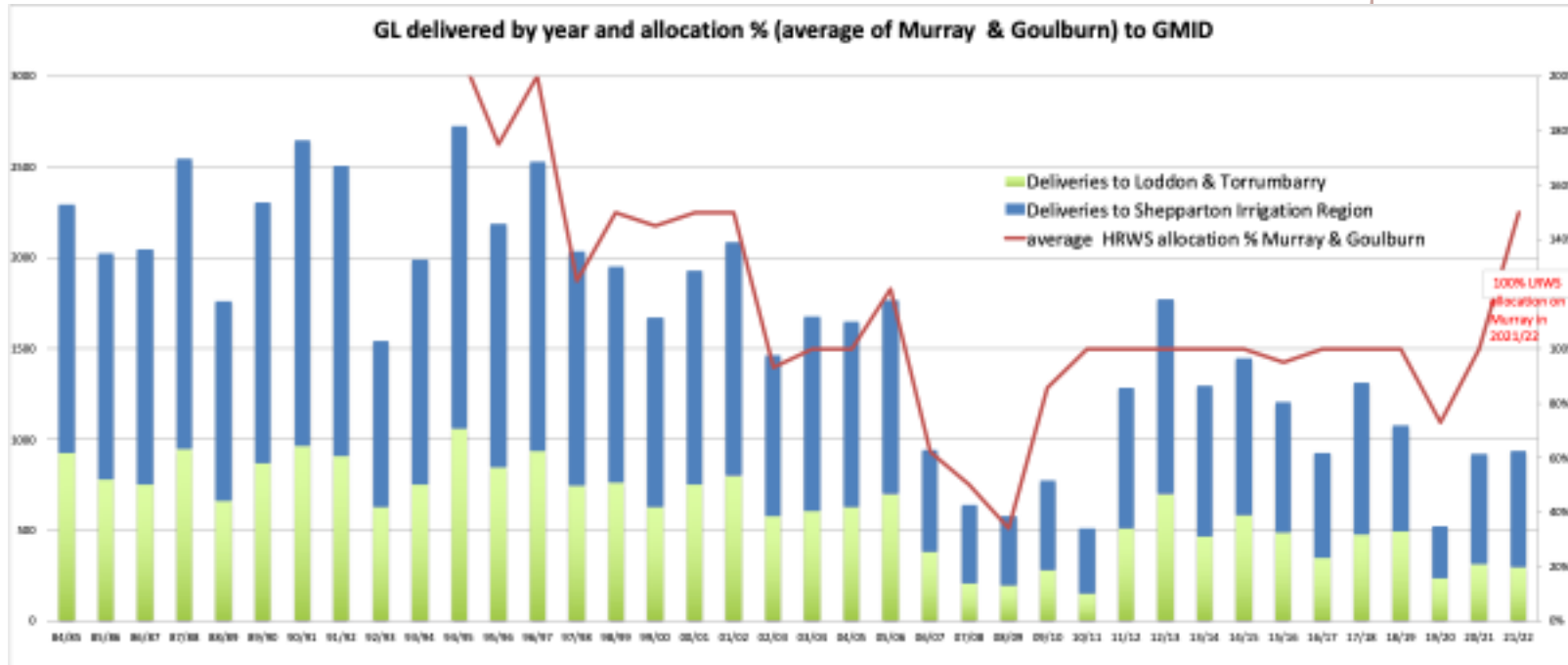


Figure 4-3: GMID Irrigation water deliveries – the irrigation region shown in light green



4.2 Drainage flows

Changes in land use, area irrigated, and irrigation intensity explains the change in drainage flow since the 1990s, however extreme climatic conditions and fluctuating groundwater levels still present the need for a drainage system that can adapt to the changes in drainage flows.

High rainfall events are the dominant driver of drainage flow reported in the Jacobs study (North Central CMA, 2018a). This study of drainage flows in Barr Creek showed that summer runoff had significantly reduced, because there has been a 75% reduction in area of summer irrigation and reductions in application rates, resulting in summer drain flows less than 10% of historic peaks. Runoff during the autumn/spring and winter periods is less reduced with similar areas of irrigation this time of year, maintaining the hydraulic loading.

Drainage systems in the irrigation region serve to reduce the impact of highly saline watertables within 2m of ground level as well as reducing the accession of applied irrigation water. Watertable levels were high across the region in the 1990's and dropped during the millennium drought. The changes in groundwater levels over this time can be seen Figure 4-1, which show the regional aquifers (Calivil and Renmark) levels falling and the overlying aquifers of the Lower and Upper Shepparton Formation, closer to the surface and can be influenced by seasonal conditions and irrigation, have followed the same trend with an overall drop in groundwater levels. Monitoring of groundwater bores over the last three wet La Nina years and October 2022 floods have shown groundwater levels have risen, however the relationship between groundwater levels and seasonal conditions in this varying climate is still to be fully understood.

Drainage flows have reduced across the irrigation region, however frequent extreme climatic conditions and fluctuating groundwater levels along with variable irrigation application in response to seasonal conditions and the water market require an adaptive drainage system into the future. It is anticipated there is a similar trend for subsurface drainage systems.

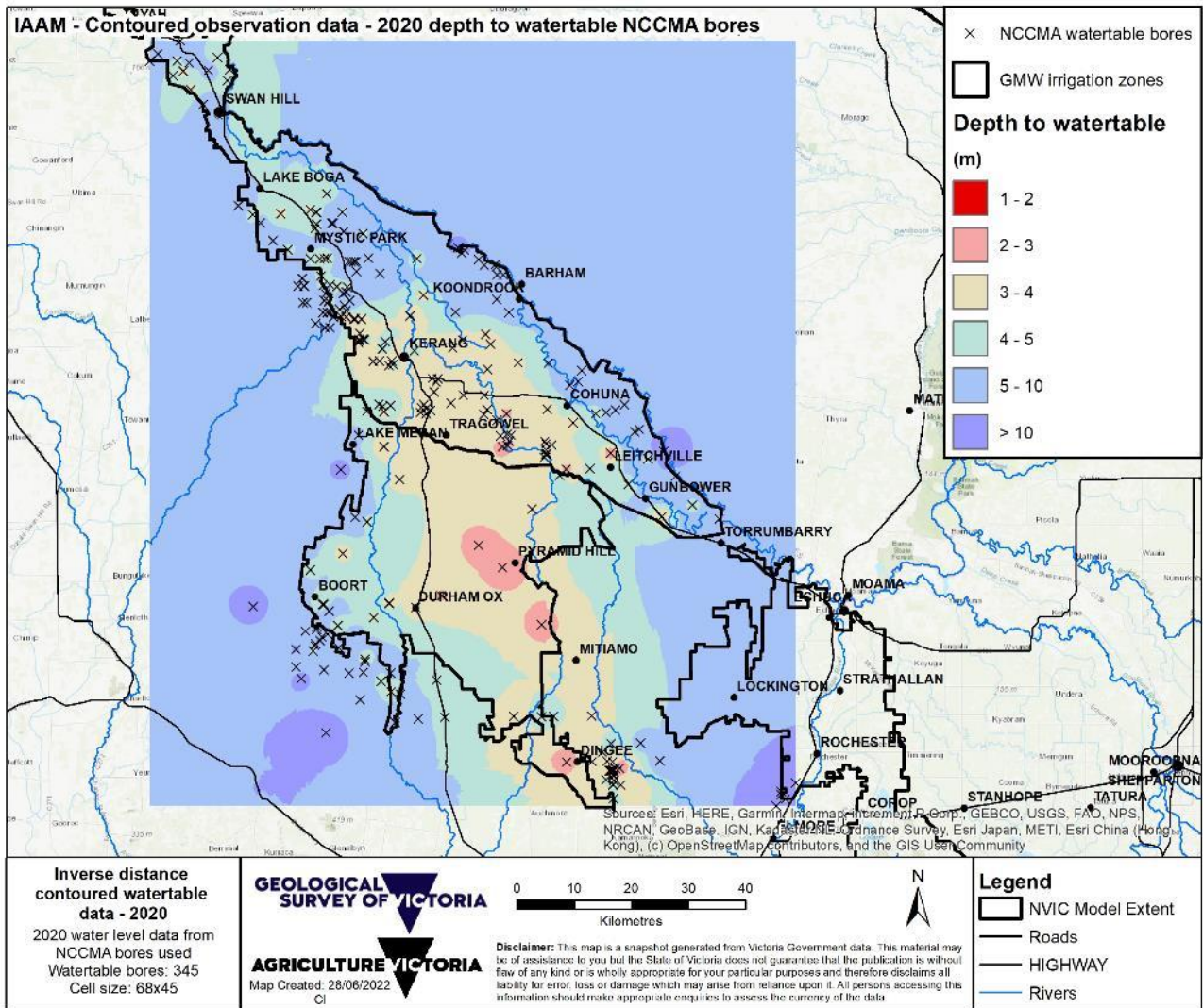


Figure 4-4: Depth to watertable 2020

4.3 Future drainage needs

4.3.1 Impact of climate change on future drainage flows

CSIRO research for the Murray-Darling Basin (CSIRO 2020) indicates the future climate is likely to be characterised by:

- Increased air temperature by nearly 1.5 degrees relative to the 1910-1950 average. This is around 30 per cent greater than the global average temperature increase.
- Overall reduction in rainfall, particularly in the southern connected Basin.
- Large reductions in winter rainfall, with possibly some increases in summer rainfall.
- An increase in extreme rainfall events.
- A greater number of hot, and fewer cold days.
- An increase in the number and intensity of extreme fire days.

The experience from the Millennium Drought, and the 2011 and 2022 floods, provided insight into the wide range of drainage scenarios. The relationship between rainfall and surface drainage flows is demonstrated by work by Feehan Consulting⁵. Higher than average rainfall in the 1980s and 1990s produced much higher drain flow and declining rainfall in the 2000s resulted in much lower drain flow. This relationship is also influenced by the proportion of the catchment that was irrigated – much higher in the 1990s. The area irrigated in the early 1990s was approximately four times the size compared to the drought period and double the post-drought period.

The pattern of surface drainage flow is changing, with flow becoming more dominated by peak rainfall events. The emphasis becomes more on the need for removal of excess extreme summer storm events to protect areas of high value, such as public assets (roads, bridges, environmental assets) and high value irrigation areas such as horticulture and dairying (North Central CMA 2018a).

The strategy identifies the risk that changing weather patterns resulting from climate change and the potential impact to high value assets and high value irrigation areas. This risk aligns with the VIDP strategic priority to adapt irrigation drainage activities to balance environmental benefits and community benefits, and to build resilience to climate change, while continuing to support the Victorian irrigation sector.

4.3.2 Future options for constructed drainage

The intent of the original drainage program was equal access to surface drainage for everyone or protecting all land at risk from high watertables however due to greater opportunistic irrigation occurring between irrigation seasons and land requiring protection by existing surface drainage the intent has shifted.

There is less justification for extending drainage if the area drained is more than the land area that can be irrigated unless there are public assets (wetlands, biodiversity, or roads) that are 'at risk'. The annual benefit from constructed drainage for these public assets is more than agriculture and cost sharing should be considered.

An option to maintain the integrity of the natural drainage courses present in a sub-catchment that is currently undrained is to implement a DCD. Implementing a DCD would provide the opportunity to protect and potentially enhance environmental and cultural values. An economic analysis of the cost of DCDs showed that it is economic in three of the eleven undrained sub-catchments. These are the undrained parts of the Barr Creek, Loddon and Wandella Creek catchments (North Central CMA 2018a). A proposed approach using DCDs is discussed in Section 4.10.

If required in the future, consulting with landholders and determining whether to implement a Drainage Course Declaration aligns with the VIDP strategic priority to undertake research and monitoring activities to address knowledge gaps.

4.3.3 Oversight to assist with resolving future drainage issues

Currently if a drainage issue arises or a development is proposed that may change the movement of surface water, the process for resolving the issue or assessing the development's impact on drainage is undertaken in an ad hoc basis, with landholder's working with each relevant agency separately, which may result in perverse outcomes. A coordinated approach between stakeholders who have a role in drainage will allow consideration of the issue or development within the landscape context will improve process and outcomes.

⁵ With permission pers. comm 25/10/2017

A range of statutory requirements sit with the appropriate responsible authority. Clear communication and understanding between stakeholders, in particular with landholders about who is responsible and the processes will greatly assist in resolving drainage issues. This will be addressed with the development of an Irrigation Drainage Toolkit which will clearly outline the statutory processes and requirements for landholders to undertake drainage works.

This approach aligns with the VIDP strategic priorities to a) empower irrigators to make informed decisions about best practice irrigation drainage management, and b) increase responsiveness and uptake of rural water policy across the irrigation sector.

4.4 Management of Bullock Creek catchment

In the 1970s the BCIT developed an innovative drainage scheme by modifying the designated waterways of Bullock Creek catchment to function as a lower standard, lower cost alternative to the GMW designed primary drain. These were augmented by private on-farm drains and private CSDs, which were encouraged through the Victorian Government Salinity Program "SALT ACTION: JOINT ACTION" (1988-99).

4.4.1 Designated waterways

The roles and responsibilities of the BCIT were transferred to the North Central CMA in 1997⁶ and then in 1999 the regional drains were Gazetted as designated waterways⁷. These include Blind Creek, Bullock Creek, Calivil Creek, Pompapiel Creek, Seven Months Creek, Welches Creek and the Western Depression (refer to Figure 3-1). As at 2023, there are no known structural assets from the BCIT owned and/or managed by North Central CMA.

BCIT funded the development and management of the drainage function in the designated waterways of Bullock Creek catchment by rating farmers. This management involved modification of the waterways including altering depth and direction to increase the drainage capacity. North Central CMA does not have the authority to rate farmers and generate funds to maintain the drainage function of the designated waterways. Therefore, little maintenance has been undertaken and the standard of drainage currently provided by these designated waterways is unknown. In the past, the CMA has received funds to undertake works to ensure the designated waterways were disposing of drainage water:

- In 2010, North Central CMA assessed the designated waterways for silting and weed infestation. Ten kilometres of the 329km of designated waterways assessed required desilting or weed control. This is a small proportion of the waterways considering the little management undertaken in the 13 years prior to when the North Central CMA incorporated the function of the Trust (North Central CMA, 2010).
- In late 2010 to early 2011, 25% of the North Central CMA region experienced flooding. North Central CMA managed a flood recovery program in the Bullock Creek catchment which included desilting 172 km of waterways, weed removal on 30 km and reinstatement of culvert structures at 20 sites. This work was undertaken on 19 properties with each landholder signing a Works Agreement which defined the length of desilting and culvert repair and required the landholder to maintain for 10 years (North Central CMA, 2013). These 10-year agreements have expired. The initial surveys for this project also identified council and VicRoads owned infrastructure impeding drainage function.
- After the October 2022 floods, farmers were asked to report damage they observed along the Bullock Creek catchment waterways. Sixty-five sites were assessed, with five sites identified that the flood damage would impede the waterways drainage function and repairs were required.

Contemporary natural resource management has progressed since the days of the BCIT, with waterways now managed for multiple values, including environmental values, Aboriginal cultural values and uses, social and recreational uses and values, and economic values. In the case of the Bullock Creek catchment designated waterways, the clear articulation of the drainage functions will guide future irrigation drainage program. These designated waterways provide the following drainage functions for the irrigation properties:

- Receives irrigation-induced rainfall runoff from landholder properties.

⁶ The North Central Catchment Management Authority takes over all property, rights, obligations, powers, functions and staff of the (c) Bullock Creek Management Board ([Victorian Government Gazette, 1997](#)).

⁷ The North Central Catchment Management Authority, under Section 188 of the Water Act 1989, declares the following waterways within the Authority's District to be designated waterways: Bullock Creek and Blind Creek. Together with all the named and unnamed tributaries draining directly or indirectly into the above waterways as detailed by plan on the (SACRED) stream system published by the Department of Natural Resources and Environment ([Victorian Government Gazette 1999](#)).

- Lowers groundwater pressure levels.
- Reduces risks associated with waterlogging and salinity.

4.4.2 Community surface drains

There are approximately 650 kms of private CSDs mapped across the Bullock Creek catchment. These were established in the 1970s and 1980s to assist with the removal of irrigation-induced rainfall runoff and reduce waterlogging and salinity impacts on farm. At the time of defining the CSDs, agreements were made between neighbouring landholders about the location and flow of these drains, however the extent that these agreements remain in place is unknown. There is now some uncertainty amongst landholders about the terms of the agreements, including who is responsible for maintaining the CSDs. Anecdotal reports indicate there has been extensive modification across the landscape over the 30 years since the CSDs were defined and therefore the map showing the CSDs is only an indication of their potential location.

Consultation was undertaken to establish the Bullock Creek catchment community's interest in different levels of drainage management. In 2019 landholders were provided a postal survey with a brochure outlining five possible levels of drainage management of the CSDs and designated waterways. Sixty-nine landholders responded to the survey. Half of the respondents indicated they would prefer to continue "to maintain CSDs running through their properties" while the preferred management of designated waterways was that the waterways remained "unmanaged". A fifth of the respondents were happy to cooperate regarding the maintenance of their drains through amicable arrangements with neighbours and undertake management of designated waterways when needed, and a similar number were keen to manage drains through a formal written agreement and some government support. There was little interest in implementing DCDs, however the survey brochure indicated that there may be fees associated with this option, which may have deterred landholders from this option. Therefore, landholders did not express a need to create formal arrangements to manage drainage of Bullock Creek catchment designated waterways or CSDs.

The position of landholders regarding a cooperative approach to irrigation drainage on private land and in designated waterways may change over time. Providing clarity of the roles and responsibilities of drainage across this system through an Irrigation Drainage Toolkit could guide landholder approaches to reduce the impact of modifications to the drainage system up and down stream. The location of intensive farming systems and high water use activities across the catchment may indicate priority areas for assessing the drainage function in the catchment. The 2021-22 land use data indicates these farming systems are at the top of the catchment, with potential to impact landholders downstream in a high run off event (refer to Figure 3-2).

The approach taken to undertake community consultation in the Bullock Creek catchment aligns with the VIDP strategic priority to ensure proposed irrigation drainage activities are supported by the community.

4.5 Enhancing and protecting environmental values

4.5.1 Enhancing environmental values

The irrigation region is located on the lower Loddon floodplain and is part of the Murray River floodplain. The floodplain comprises several ephemeral waterways which flow during wetter seasons and once had many permanent and temporary wetlands receiving water with high flows. European settlement, agriculture, irrigation, draining of wetlands and removal of vegetation has significantly changed the landscape. These changes resulted in highly saline groundwater impacting the root zone and excess surface water moving across the landscape causing waterlogging. Construction of drains and/or deepening natural drainage lines provided a system to remove excess water and improve productivity.

While the BCIT undertook works in the 1970s and 1980s on the designated waterways to improve drainage, these waterways have still retained aspects of their natural features, which need to be identified, protected, rehabilitated and enhanced.

The community is interested in improving the health of wetlands by reconnecting natural flow paths, facilitating opportunities for watering events delivering water to sites which were previously wetlands. An outcome that could be achieved with a mechanism such as DCDs. There is a risk of salinity if water for the wetland contributes to local groundwater recharge and brings saline water to the surface. North Central CMA has commenced the development of guidelines to assess the risk of salinity from undertaking this action. The Salinity Risk Assessment Guidelines for Wetlands should be used by any stakeholder looking to reinstate water to a wetland, either permanently or on a temporary basis.

This strategy aligns with the GMID Drainage Management Strategy Strategic Direction 21 which states: "Drain owners should identify opportunities for existing drains to perform environmental-ecological functions based on their ability at times to hold or move water across the landscape." Both strategies also identify the need to assess the extent that water

is disposed onto public land, by undertaking monitoring and understanding landholder motivations (refer to Section 4.7 for further details).

The recommended actions are to identify opportunities to improve the condition of environmental values across the irrigation region, with particular focus on:

- reconnecting wetlands, once part of this floodplain, using DCDs.
- apply the Salinity Risk Assessment Guidelines for Wetlands when reinstating wetlands.
- assess the extent drainage water from irrigated land is disposed of onto public land.

This aligns with the VIDP strategic priority to adapt irrigation drainage activities to balance environmental benefits and community benefits, and to build resilience to climate change, while continuing to support the Victorian irrigation sector.

4.5.2 Protecting environmental values

There are statutory requirements in place to protect environmental values associated with drainage. Landholders are required to manage their irrigation drainage activities to avoid the risk of environmental damage and risks to human health under the General Environment Duty (GED). Further information regarding how businesses can manage their risks under the GED, refer to GED for businesses on the [Victorian EPA website](#).

Undertaking works that may impact surface water movement require landholders to obtain a permit from local council if earthworks are to be undertaken and from the North Central CMA if works will be undertaken on designated waterways. Local government can provide advice on a planning permit that requires the removal of native vegetation. Landholders need to comply with the [Northern Victorian Irrigation Development Guidelines](#) for a new irrigation development and all legislation under the relevant *Acts*.

To gain approvals to undertake drainage works landholders are required to follow a complex process. The opportunity exists to streamline this process for landholders in the region and create a mechanism for stakeholders to work together and resolve drainage issues. The protection of environmental values will be strengthened by the permit process when landholders make changes to drainage and the movement of irrigation drainage.

Protecting important areas of native vegetation and threatened species, as well as monitoring flow and water quality are integral to complying with the guidelines that govern drainage works and/or new irrigation developments.

Drainage provides the mechanism to remove excess water from the landscape however this has contributed to the salt and nutrient loads being transported to downstream landscapes and waterways including the Murray River. Any actions undertaken as part of this strategy need to consider the North Central CMA's obligation to undertake actions that meet Victoria's BSM2030 salinity accountability and reporting requirements, and that any actions will not adversely impact the environment or human health where discharged. This can be achieved through working with landholders to minimise diffuse pollution sources through improved farm practices that improve water use efficiency and reduce excess irrigation water leaving the property.

Nutrients and salt can be removed into the drainage systems and in the case of Bullock Creek catchment into the designated waterways and eventually into the Murray River. North Central CMA agreed under the IDMOU 2010 to set targets and undertake monitoring of phosphorus in Barr Creek. The commitment was to aim for a total phosphorus loading of 8.5t/y in 2010/11, down to 6t/y in 2020-21. There was a particular interest in understanding what the phosphorus loading was at flood peaks. However, phosphorus levels were not monitored in 2010-11 due to budget constraints. Phosphorus loading in 2020-21 was 0.94t/y at Capel's Crossing with 0.03 t/y flowing out of Barr Creek after the diversion scheme. These values are significantly lower than the 6t/y target set.

Taking care of the environmental values across the landscape, particularly in drains, is covered by the statutory processes and requirements required to undertake drainage works. The development of an Irrigation Drainage Toolkit will assist landholders maintain these values by outlining and simplifying these requirements (identified in Section 4.3.3).

This recommended action aligns with the VIDP strategic priorities to a) ensure compliance and consistency with relevant statutory obligations, policies and strategies; and b) promote appropriate long-term governance, operation and management of irrigation drainage investment.

4.6 Improved outcomes for First Nations People

First Nations People maintain an enduring link to the region's floodplains and rivers. The irrigation region includes the traditional lands of Dja Dja Wurrung, Yorta Yorta, Barapa Barapa, Wamba Wemba, and Wadi Wadi. This is an opportunity to strengthen engagement with First Nations People to understand their aspirations regarding surface water

management, in particular, how drainage occurs across the landscape and identify opportunities to enhance cultural values.

The Victorian Government sought statements for the Water is Life strategy from each Traditional Owner group who wish to participate and have the capacity to manage or own water. These Nation Statements are an expression of the Traditional Owners' cultural and water-related values, goals, aspirations, outcomes and any other relevant information articulated in their own words (DELWP 2022, Section B). Each statement is clear and powerful in stating the position of each Nation.

The Dja Dja Wurrung and Barapa Barapa have prepared Country Plans that set out aspirations and goals for waterways.

Both the Water is Life Nation Statements, and the Country Plans are important documents that should form the basis for engagement with these First Nations People.

First Nations People connection to land and water expresses itself in many ways, including the rich cultural heritage enduring within the landscape. Engagement with First Nations People will identify new opportunities to enhance cultural values.

Greater inclusion of First Nations People is required to meet First Nations landholder interests and aspirations and create more opportunities for self-determined involvement in surface water management. Action from this strategy aims to engage with First Nations People on surface water management and establish the opportunities to work together.

This aligns with the VIDP strategic priority to recognise, understand, and protect Indigenous water values and interests by collaborating with First Nation People in planning and delivering irrigation drainage activities and projects.

4.7 Disposal of drainage water to supply channels and public land

The disposal of excess surface drainage into channels, natural drainage lines and to public land has occurred for many years. Such disposal methods have been adopted by those landholders without access to drains, including those in the Benwell catchment.

Pumping excess drainage water into GMW channels is subject to the landholder entering into an agreement with GMW. There are conditions within this agreement, which the landholder needs to meet. This is a different scenario for disposal to public land, which there are no agreements between landholders and public land managers, meaning the public land manager has no oversight of when and where this practice occurs.

GMW is concerned about water quality risks, particularly the risks posed to domestic users or town water offtakes downstream of channels that may receive drainage water. GMW sees that continuing with this practice will result in increased costs, increased risk of litigation from polluted water; and is concerned that there is reduced incentive to install surface drainage works. Continuing this practice is also administratively and operationally demanding.

Pumping into GMW supply channels is a different type of drainage service than pumping into a constructed GMW drain. Supply channels are not designed to be drains and their downstream capacity reduces, requiring active management to avoid overtopping the channel and flooding downstream landholders. Recent channel modernisation has confounded this issue with automated channel regulator gates, less channel outfall points on the backbone network and less staff to oversee pump discharges.

Any landholder looking to undertake disposal of excess surface water into a GMW channel are required to work with GMW to determine the long-term acceptability of these practices in consultation with GMW's Water Quality Unit and Water Delivery Services and public land managers.

GMW does not support channel disposal as an acceptable long-term solution due to obligations under the *Safe Drinking Water Act 2003*. The provision of new drainage may reduce the amount of channel pumping and improve water quality in the affected GMW channels and reduce operational costs, but this is yet to be quantified.

While GMW undertakes due diligence with drainage disposal into channels, there is no process to monitor disposal onto public land. Landholders' responsibility under the GED requires them to mitigate the risk of harm to the environment from disposing of water on public land.

The options to address disposal of excess water into GMW channels and onto public land could be addressed with a program of advice and targeted incentives for farm dams and reuse systems or extended through consultation with landholders to establish the need for a constructed drain or DCD solution based on the needs of the catchment.

Agriculture Victoria delivered a pilot extension program called the Drainage Reuse On-farm Project (DROP)⁸ in 2019-20 which provided landholders advice and financial incentives to construct farm dams and reuse systems effectively capturing water that potentially would have flowed onto public land. This could be extended with funding to continue to build farm reuse and dams in undrained areas. In terms of reducing GMW's water quality risks, the collection of the first flush of runoff, which tends to be the most polluted, can be encouraged by installing additional farm reuse systems.

This recommended action aligns with the VIDP priority to manage offsite impacts of irrigated agriculture within agreed targets and, where possible, further reduce environmental and third-party impacts of irrigation.

4.8 Transitional arrangements for existing drainage schemes in areas not irrigated

In areas where irrigation has ceased for a period of time (the season or longer term), the beneficiary of drainage shifts from agriculture to roads and other public assets.

An analysis of non-irrigated land (absence of WUL) in drained catchments shows there are no major spurs that solely service dryland areas. The area with a WUL that is not irrigated each season will expand and contract with seasonal allocation. However, regardless of whether there is irrigation or not, the road networks and public assets are reliant on these drains being maintained at a level to protect roads and other public assets. Therefore, at this stage, existing drains remain in place and the beneficiary of these drainage services should be involved in the arrangements for ongoing management and would occur under the recommended action calling for a co-ordinated approach to drainage management.

For land within the irrigation region that does not have a WUL, the Victorian Rural Dryland Strategy states that rural water corporations, in this case GMW, will "continue to provide drainage services, mostly in northern Victoria, where dryland rural drainage infrastructure drains into irrigation district infrastructure, or where dryland rural drainage has been established in or near an irrigation area, and existing arrangements are in place for landholders to pay for these services". In parts of the irrigation region where GMW does not provide drainage services and land does not have a WUL landholders are responsible for "Managing private dryland rural drainage and develop dryland rural drainage management plans" (DELWP 2018).

In these areas that are no longer irrigated (i.e., do not have a WUL), and consistent with the Land and Water Management Plan, one option could include repurposing drains and reinstating wetlands to enhance ecological values of high ecological sites. This option is documented further in the enhancing environmental values recommended actions (Section 4.5.1).

4.9 Rationale of new drainage

This section considers the likelihood of development of new drains for agriculture, alternative options to manage excess surface water and who else may benefit from new drains.

There may be some undrained areas where an increase in intensive irrigated enterprises, such as horticulture and dairying, may benefit from drainage services to provide protection of land from salinity and waterlogging.

An analysis of the gross value of irrigated agricultural production for different agricultural industries in the irrigation region showed a fluctuation in the annual value of enterprises due to volume of irrigation water used. Only 10% of the irrigation region is irrigated at high intensity levels (> 3 ML/ha) which is generally associated with dairying and horticulture. Drainage costs represent a low percentage of the profit for horticulture, but a very high percentage of costs for mixed grazing and cropping, which would make the cost of new drainage unaffordable for the main irrigation land use. This suggests around 90% of the area would not be able to afford new drains.

During seasons with low rainfall and water allocation, there is low or no landholder willingness to pay for the provision of new constructed drains in undrained catchments. This conclusion is also supported by the findings of the consultation regarding the extension of drains in the Benwell catchment and the water service committees in the development of this

⁸ Agriculture Victoria delivered a pilot extension program called the Drainage Reuse On-farm Project (DROP) to service irrigators in areas without access to formal off-farm drainage. This 12-month project (2019-20) provided advice and financial incentives to construct farm drains and reuse systems. The project enabled participating landholders to reduce off-site impacts of irrigation drainage, reduce potential yield loss from waterlogging of crops and improve their irrigation management and water use efficiency. Of the nine participating farmers, seven properties installed reuse dams and wetlands to capture 278.4 ML potentially flowing onto public land, including Guttrum State Forest, Leaghur floodway, Johnson Swamp Wildlife Reserve, Dartagook Forest and Ghow Swamp.

strategy. However, it is noted that the agricultural industry is always changing and future landholders may be willing to pay for a higher level of service from the drains.

However, there are catchments and sub-catchments of new high intensity irrigation development in the Wandella Creek and Boort West catchments which are not serviced by community or GMW schemes. Under the Northern Victorian New Irrigation Development Guidelines (NVIDG), delivered collaboratively through AgVic, CMAs, DEECA and GMW, approvals are granted on the condition that developers are responsible for managing drainage water, in accordance with the arrangements specified in the endorsed Irrigation and Drainage plan and any terms and conditions that apply to a drainage service that is employed. If there is interest in improving drainage management on a sub-catchment in these areas to reduce the risk of salinity, waterlogging or water quality as a result of irrigation, landholders can work together to form an agreement on how drainage is managed, including the establishment of a DCD.

The drainage system also benefits stakeholders and partners across the irrigation region, including local government, VicRoads and VicTrack and can also hold important cultural values. Clear management arrangements should be established with these stakeholders and partners for the protection of their assets, agriculture, environmental and cultural values if new drains or DCDs are developed.

4.10 Feasibility of Drainage Course Declarations

A DCD allows obstructions to be removed or modified to restore flow paths and allows water to move through a drainage course as it would under more natural conditions. Better drainage provides agricultural benefits such as reduced inundation, waterlogging, and salinity impacts. Increasing the capacity for productive land to drain under more natural conditions leads to other benefits such as increasing the life of road assets and may improve opportunities for water to reach environmental assets such as wetlands.

An option in the irrigation region is to declare existing community drains, possibly private drainage lines, and designated waterways in the Bullock Creek catchment as DCDs under the *Water Act 1989*.

The implementation of a DCD and associated obstruction removal programs requires thorough engagement with landholders involved and/or impacted by the DCD, extensive field inspection, LiDAR, on-ground survey, extensive catchment modelling and engineering review. It is also vital to engage First Nations People to ensure the protection of any cultural values associated with the drainage line. Under the *Water Act 1989*, the creation of a DCD and associated management plan must be approved by the Victorian Government Minister for Water administering the *Act* (or delegate).

Importantly, a DCD provides future protection from works that will affect flow in the drainage course and gives a responsible authority the authority for its ongoing management.

Suggested priorities, recognising the immediate limitations of implementing DCDs are:

- 1) Protect the functioning of designated waterways managed by North Central CMA in the Bullock Creek catchment, community drains and possibly private drains (that serve more than one landholder) by implementing DCDs, which provides future protection of natural drainage lines. Investigations (additional to postal survey results discussed in Section 4.4) would determine the level of landholder interest, how many DCDs would be required, and this would be based on catchment outfall availability and topography.
- 2) Investigate the practicalities of implementing DCDs on natural drainage lines that may exist in “undrained” areas. Undrained catchments with a high level of benefit, i.e., intensive irrigation application should be the highest priority. The economic analysis identified undrained parts of the Loddon, Barr Creek, and Wandella catchments (Figure 4-5) as areas where DCD implementation would be most economic. The status of existing drainage lines in undrained areas warrants extensive field investigation to identify the extent of possible works (e.g., road culverts), if any are needed to improve drainage.

Therefore, when there is community support, a process will be developed with a responsible authority to work with the community and the Victorian government to increase the area and length of natural drainage lines protected with a DCD and would also include existing drains to ensure passage of flow. It is proposed that a pilot project is established to test the process in one area of the irrigation region.

This process aligns with the VIDP strategic priority to ensure proposed irrigation drainage activities are supported by the community.

Drainage Course Declaration

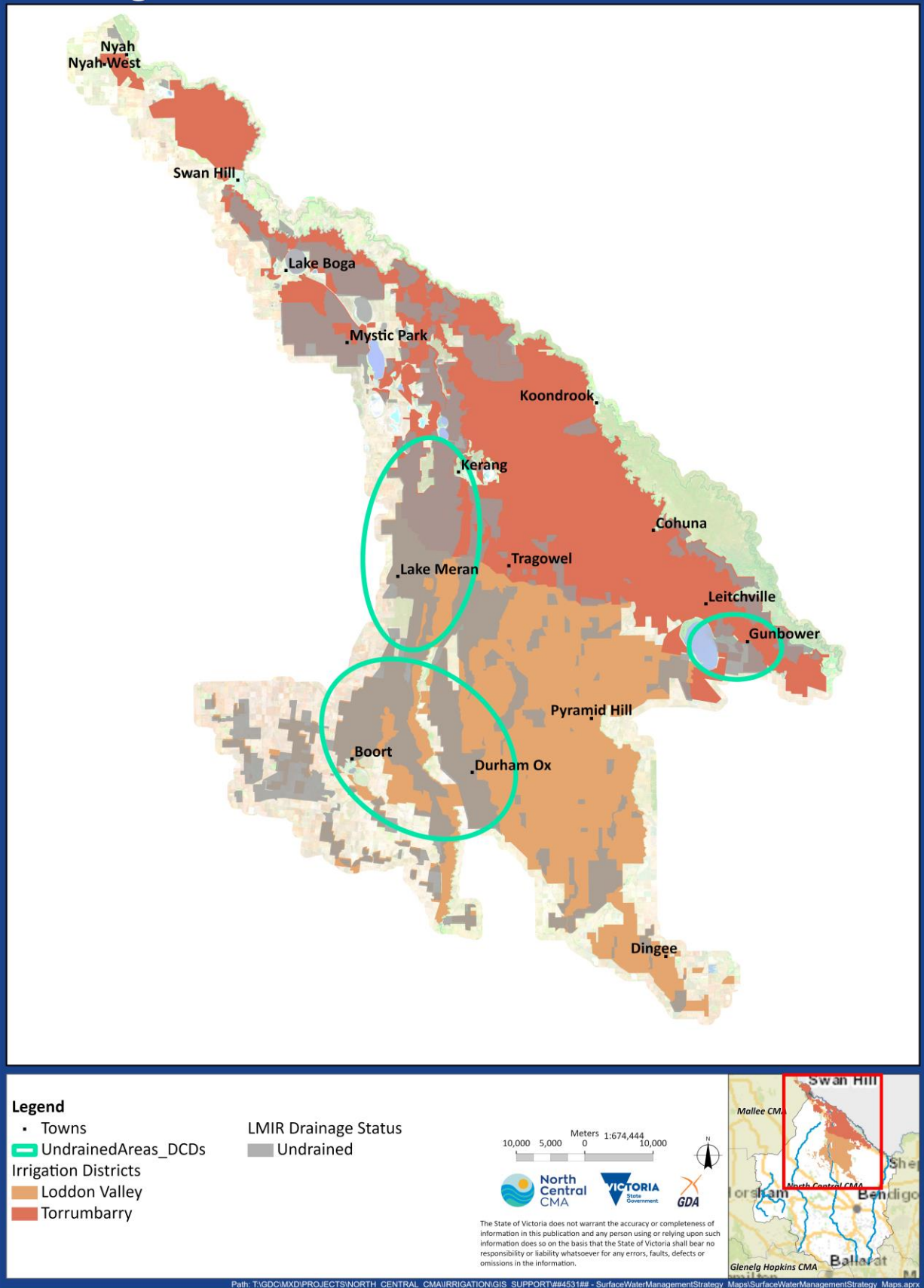


Figure 4-5: Potential location of DCDs across the irrigation region

4.11 Improving on-farm management of drainage

Private landholders are responsible for managing a significant proportion of land in the irrigation region. They contribute to the movement of surface water through the application of irrigation water and through on-farm developments which may change drainage flows. An important component of this strategy is an extension program to support farmers to improve the on-farm management of drainage risk.

With the number of agencies overseeing different aspects related to drainage and the complex drainage issues that have arisen over the past 20 years (based on anecdotal evidence), an Irrigation Drainage Toolkit for irrigators in the region, with the potential to be extended to the whole of the GMID, would provide landholders with practical information to make informed choices and will also ensure agencies have oversight to support these choices. The toolkit would be a key part of the range of extension activities delivered in the region.

In addition, the toolkit along with the following approaches identified, will help ensure irrigation landholders can make informed choices regarding drainage on their property:

- Encouraging farm reuse to manage irrigation tailwater incorporated into the whole farm planning process.
- Provide the DROP program in areas where there is no formal drainage system and there is a risk to public land assets from irrigation drainage.
- Work with government agencies and councils to help landholders resolve drainage issues.
- Understanding the impact of salinity across the landscape, using the guidelines on Salinity Risk Assessment Guidelines for Wetlands developed by North Central CMA.
- Shared knowledge with First Nations People.

Delivery of the information would be most appropriate through the Whole Farm Planning program – a key part of this strategy.

The toolkit approach aligns with the VIDP strategic priority to empower irrigators to make informed decisions about best practice irrigation drainage management.

5 The Strategy

5.1 Recommended actions

This section outlines the recommended actions determined from the analysis of the driver's influencing drainage in the irrigation region. The priority actions will go a long way to clarifying roles and responsibilities and resolving many of the historic ad hoc responses to drainage management that have occurred in the past while also providing a clear approach to managing drainage in a contemporary setting.

Each of the recommended actions are allocated a priority rating and timeframe. This approach will inform an annual practical work plan that will prioritise funding submissions and manage expectations of stakeholders, particularly landholders, about potential delivery time.

The logic for action ratings is as follows:

Priority:

- High: core obligation to meet legislative requirements, including monitoring and reporting, and where there is a strong need identified by community and agency stakeholders.
- Medium: where there is a substantial need recognised and identified by the community.
- Low: the community and agency stakeholders have not identified an immediate need for action.

Timeframe for action and funding:

- Immediate: seek funding and undertake action in the next three years.
- Medium term: 3 to 10 years pending further investigation and/or community and agency interest.
- Ongoing: Meeting statutory responsibilities and ongoing partnerships.

Table 5-1: Findings, recommended actions and proposed priority and timeframes for each action in the LMIR Irrigation Drainage Strategy

Outcome	Finding	VIDP Strategic Directions	LCIR LWMP actions	Recommended actions	Priority	Action timeframe
1. Drainage is managed with a coordinated approach across the irrigation region	As drainage can impact land and assets across the region, stakeholders or beneficiaries of drainage should be involved. Currently there is no coordinated approach when a drainage issue arises.	SD7 SD9 SD10	4.1 7.3	1.1 Clearly defining roles and responsibilities of all stakeholders in the region (completed and outlined in Section 2.3.1).	High	Immediate
				1.2 Based on these recommended actions develop an annual practical work plan that will address these recommended actions, timelines and requirements for future funding and review the value of the strategy.	High	Immediate

Outcome	Finding	VIDP Strategic Directions	LCIR LWMP actions	Recommended actions	Priority	Action timeframe
				1.3 Provide a coordinated approach with a position or main contact point on drainage issues, who are supported by a committee, the Irrigation Drainage Co-ordination Group, representing all stakeholders. This committee will be supported with appropriate tools such as the Drainage Information Management System (DIMS).	High	Immediate
				1.4 Communicate the recommended actions of this strategy to the community, including their obligations under the GED, increase the stakeholders understanding of the community's drainage needs and incorporate into the development of an Irrigation Drainage Toolkit.	High	Immediate
				1.5 Work with programs delivered by the North Central CMA and stakeholders that improve irrigation practices and reduces irrigation-induced rainfall runoff and irrigation tailwater leaving the property.	High	Ongoing
				1.6 Keep DIMS updated to capture drainage records with input from all the stakeholders, including drainage assets and who is responsible for them.	High	Immediate
2. Extension programs assist on-farm management of drainage risk.	Providing clarity to landholders on their obligations to manage drainage issues on-farm, and what action they can take, with support from key stakeholders. This is needed across the region including irrigated areas that are drained and undrained, and areas that dispose to GMW channels or public land.	SD3 SD5 SD6 SD8	3.5	2.1 Consider a longer-term approach to working with community and landholders to manage drainage requirements, including clear communication to all stakeholders, particularly landholders about requirements of managing drainage on their property.	Medium	Ongoing
				2.2 Develop an Irrigation Drainage Toolkit to assist farmers with their management of on-farm drains, including a clear description of the statutory processes and requirements.	High	Immediate

Outcome	Finding	VIDP Strategic Directions	LCIR LWMP actions	Recommended actions	Priority	Action timeframe
				2.3 Encourage installation of farm reuse for irrigation tailwater and excess rainfall runoff through extension and targeted incentive programs like Whole Farm Plans and DROP.	Low	Medium term
				2.4 North Central CMA to coordinate/support drainage issues, including establishing beneficiaries. The complexities and obligations will be communicated to each party.	High	Ongoing
				2.5 Understand and communicate the changing impact of salinity across the landscape, including using the Salinity Risk Assessment Guidelines for Wetlands developed by North Central CMA.	High	Ongoing
3. Contemporary management of irrigation drainage in the Bullock Creek catchment.	<p>The management of waterways, in particular, those in the Bullock Creek catchment, has progressed since BCIT, to consider cultural, ecological, and recreational values, as well as drainage.</p> <p>North Central CMA continues to manage movement of water according to its statutory obligations to ensure waterways in Bullock Creek catchment are maintained with a drainage function.</p>	SD3		3.1 The Irrigation Drainage Co-ordination Group to provide direction on program development and delivery in Bullock Creek catchment (part of action 1.3).	High	Medium term
				3.2 Acknowledge the drainage function of the designated waterways of the Bullock Creek catchment.	High	Immediate
				3.3 Establish the extent of the arrangements of CSD in the Bullock Creek catchment still exist and the level of drainage they are providing.	Medium	Medium term
				3.4 Promote the Irrigation Drainage Toolkit to farmers and stakeholders in the Bullock Creek catchment (part of action 2.2).	High	Immediate
				3.5 Manage the impact irrigation drainage has on environmental and cultural values in Bullock Creek catchment.	Medium	Ongoing

Outcome	Finding	VIDP Strategic Directions	LCIR LWMP actions	Recommended actions	Priority	Action timeframe
4. DCDs are implemented based on community interest and feasibility.	<p>DCDs are a feasible and practical option for future protection of natural drainage lines and private drain alignments that currently have no formal arrangements such as private community drains.</p> <p>There are currently areas within the region with productive crops, with little to no formal drainage service such as Wandella and West Boort areas. The feasibility of DCDs in these areas to be explored.</p>	SD4 SD1	7.2 7.4	4.1 Upon the request of the farming community, investigate the protection of private drains, community drains and designated waterways in the catchment or sub-catchment of Bullock Creek through a DCD process. The first step is to establish who is the responsible authority to lead the process.	High	Medium term
				4.2 Investigate potential implementation of DCD in consultation with community in undrained areas (Wandella Creek, Barr Creek and Loddon) that support intensive irrigation activities by establishing the economic viability, community and farmer interest and public benefit.	Medium	Medium term
				4.3 Undertake a pilot investigation with a group of interested landholders to test the process of establishing a DCD.	High	Immediate
5. Environmental values are protected and enhanced.	<p>This landscape was heavily impacted by waterlogging and salinity as a result of irrigation prior to the installation of drainage. The changing climate and reduced water use in this area has reduced this risk, however natural features have been lost or degraded since colonisation. Opportunities to identify parts of the landscape to reinstate environmental values could be supported by this strategy.</p>	SD4	4.7 6.3	5.1 Undertake a desktop analysis to identify and monitor environmental values associated with irrigation drainage and prioritise on-ground works to rehabilitate or enhance, including actions like reinstating wetlands along drainage courses.	High	Medium term
				5.2 Complete and promote the Salinity Risk Assessment Guidelines for Wetlands for all stakeholders to assess the risk of salinity when holding water in the landscape.	High	Immediate
				5.3 Incorporate the protection of environmental values within the Irrigation Drainage Toolkit (refer to Action 2.2).	High	Immediate
				5.4 Continue analysing data on surface and groundwater salinity and the role of drainage in reducing this risk of salinity impact.	High	Ongoing

Outcome	Finding	VIDP Strategic Directions	LCIR LWMP actions	Recommended actions	Priority	Action timeframe
				5.5 Ongoing water quality monitoring (phosphorus) on Barr Creek in line with an updated IDMOU.	Medium	Ongoing
6. Improved outcomes for First Nations People through partnerships.	This irrigation region is rich with cultural heritage and values, of which can be better protected and valued with First Nations People supporting self-determination through partnership in drainage management.	SD2		6.1 Engage with First Nations People to understand their aspirations for cultural values associated with the irrigation region and identify opportunities to enhance these cultural values.	High	Immediate
7. The implications of channel disposal and pumping to public land are understood including feasibility of alternate practices.	Irrigators without access to drains may dispose excess surface water to GMW channels or other infrastructure with appropriate licence and approval from the local area Customer Service Manager or pump onto public land. Alternative arrangements need to be planned for in case the availability of a pumped outfall changes in the future.	SD4	3.5	7.1 The extent and impact of disposal of drainage water into GMW channels will be reviewed by GMW to determine if the risk is acceptable.	Medium	Medium term
				7.2 Disposal onto public land should be identified and determine if the risk is acceptable through discussion with relevant agencies.	Medium	Medium term
				7.3 Farm reuse to be encouraged through whole farm planning and targeted incentives through an expanded DROP program (a target area for Action 2.3).	Low	Medium term
8. Beneficiaries of future drains are involved in the planning and implementation of the drains.	An analysis of non-irrigated land in drained catchments identified none of the major spurs solely service land no longer irrigated. These drains also protect roads and other public assets and therefore should include the relevant stakeholders who benefit from the drainage service provided.	SD3 SD4	7.1 7.5	8.1 Periodically undertake an analysis of where the risk of salinity, waterlogging or decline in water quality may occur.	High	Medium term
				8.2 New drains, including constructed drains or DCDs, will be considered when there is a risk of salinity, waterlogging or to water quality as result of irrigation and catchments or sub-catchments are found to be viable and proposed by a group of landholders.	High	Medium term
				8.3 In areas of new irrigation developments, or where there is significant or a renewed interest	Medium	Medium term

Outcome	Finding	VIDP Strategic Directions	LCIR LWMP actions	Recommended actions	Priority	Action timeframe
				in improving drainage management in a sub-catchment, landholders can work together and with the North Central CMA to reach an agreement on how drainage is managed, including considering putting a DCD in place.		
				8.4 Seek resources to provide ongoing management arrangements for all existing drains in line with agricultural, environmental, and cultural values. Management arrangements will include beneficiaries of drainage work, including local government, VicRoads and VicTrack.	Medium	Ongoing

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Water-use licences – Water Register

Appendix 1 Glossary

Term	Definition
Adaptive management	A procedure for implementing management while learning about management actions most effective for achieving specified outcomes. (Environment NSW website)
Annual Use Limit (AUL)	The maximum volume of water that may be used on a parcel of land in an irrigation season based on all sources of water on the property, annual crop irrigation requirements, soil hydraulic conductivity and uniformity of water application. The AUL is described in a water-use licence or water-use registration. (Vic Water Register)
Assets	Resources (both public and private) that provide benefit. Drainage assets can include, for example, infrastructure such as pipes and pumps, culverts, dams, bores and table drains. (VRDS, 2018)
Community	Includes individuals, First Nations People, private landholders (person or business that owns or leases land and is responsible for its management), cohort of people who share commonality e.g., location or interest and business owners.
Cultural Heritage Management Plan (CHMP)	A written report prepared by a Heritage Advisor. It includes results of an assessment of the potential impact of a proposed activity on Aboriginal cultural heritage. It outlines measures to be taken before, during and after an activity to manage and protect Aboriginal cultural heritage in the activity area. The Registered Aboriginal Party (RAP) will choose to evaluate the plan and in areas without a RAP, the First Peoples – State Relations (FPSR) within the Department of Premier and Cabinet will assess.
Community Surface Water Management Schemes	Term previously used for Community Surface Drains (CSDs), managed by either GMW or privately. This term has been removed from the renewed GMID Drainage Management Strategy and replaced with Community Surface Drains. (C Nigro pers comms)
Designated waterway	Named or unnamed, permanent, or seasonal waterways that, range in size e.g., river or natural depression. Designated waterways are declared under the <i>Water Act 1989</i>
Designated Irrigation Area	A specifically designated area of irrigated and non-irrigated land which is part of an Irrigation District, e.g., Shepparton Irrigation Area. (IDMOU, Oct 2010)
Drainage	The removal of water from the surface of a paddock, either by natural means or by artificial surface or subsurface drainage. (Rendell, 2020) The source of water may be rainfall or excess irrigation water applied to the landscape.
Drainage disposal	The mechanical removal of drainage water using a natural drainage line or constructed drain.
Drainage construction standard	GMW and CSD design for surface drainage - based on five days for the removal of irrigation-induced rainfall runoff generated by a 24-hour rainfall event of 75 mm. This event was estimated to occur on average once in every 10 years.
Drainage Course Declaration (DCD)	A natural drainage line formally declared by the Minister under section 218(1) of the <i>Water Act 1989</i>
Drainage scheme	Consists of natural drainage courses and both surface and subsurface constructed drains. The scheme includes both on-farm and off-farm drainage.
Dryland Rural Drainage	As defined in the Victorian Rural Drainage Strategy (2018) - works and functions related to the collection, and timely removal, of excess water generated by high rainfall, i.e.. drainage from dryland. It involves enhancing the hydraulic capacity of drainage lines and soils and increasing the rate at which water will flow off (or through) and away from land to support increased agricultural production in dryland areas.
Floodplain	Low-lying land adjacent to a river or stream with unique ecosystems dependent on inundation from flood events. (VRDS, 2018)
Irrigation District	An area of land defined in the <i>Water Act 1989</i> . (IDMOU, Oct 2010)

Irrigation Drainage	Activities (excluding flood mitigation) that remove excess water from irrigated land in a designated irrigation areas and has a Water-use Licence. (adaptation of VIDPSD, 2021 – 2024)
Irrigation and Drainage Plan (IDP)	Accompanies an application of a new or varied WUL or T&UL. If the area is covered by a Land and Water Management Plan, approved by the Victorian Government Water Minister, then an appropriate overlay from a certified Whole Farm Plan is acceptable. It will include a farm map, topographical survey, soil assessment, irrigation design and management, arrangement for drainage disposal and biodiversity protection arrangements (Goulburn Broken CMA et al. (2021)) The standards for an IDP are described in Schedule 1 of Ministerial Determination for Standard Water Use Conditions .
Irrigation-induced rainfall runoff	Refer to Runoff
Irrigation redevelopment	Occurs in an existing Designated Irrigation Area and may result in a change in the conditions of the existing WUL and T&UL, i.e., increase in the AUL or an application to add land from outside the GMID to a current WUL. In these cases, an irrigation redevelopment will trigger the application of the Northern Victoria Irrigation Development Guidelines, Goulburn-Murray Water Region, 2021 (Goulburn Broken CMA et al, 2021)
Light Detection and Ranging (LiDAR)	Light Detection and Ranging is a remote sensing method that uses light in the form of pulsed laser to measure ranges (variable distances) to Earth and can be viewed using GIS. It is helpful to detect possible drainage lines.
Local council approvals for earth and drainage works	Local councils require landholders to apply for a planning permit if intending to change the use of the land, or carry out works, including drainage and removal of native vegetation.
Natural drainage line or course	The course or route drainage water takes across the landscape when unimpeded by structures or barriers.
Non-irrigated land	Land that is within a designated irrigation district, which: <ul style="list-style-type: none"> • is not irrigated as it does not have a WUL or T&UL or • has a WUL or T&UL, however the landholder has chosen not to irrigate for one or multiple seasons.
Opportunistic irrigation	Landholders have land set up to irrigate when allocation, price of water and other input costs allows the landholder to make a return. Therefore, irrigation may not occur each irrigation season.
Outfall	Discharge points from gravity-fed irrigation systems that allow excess water to exit the supply system, either to a creek or drain. (Rendell et al, 2020)
Regional drain	Previous drainage works undertaken in a catchment that service more than one property and are not regarded as farm works, e.g., surface water management systems or primary drains. (IDMOU, Oct 2010) The term regional drain is no longer used in relation to drainage.
Reuse system	A constructed drainage system including storage and pumps enabling irrigation and rainfall runoff of a farm to be captured and reused through the on-farm irrigation system.
Runoff (refer to Figure A1 1)	Term for excess surface water from rainfall or irrigation that drains into the surface drainage network to become streamflow or drain flow. Tailwater or Direct irrigation runoff: caused by over-irrigation or the practical consequence of border-check irrigation. It can occur at time when there is rainfall runoff. Irrigation-induced rainfall runoff: caused by soils being wetter than normal due to irrigation, which reduces rainfall infiltration and therefore increases rainfall runoff. Rainfall runoff: Natural surface water flow from the land. (EPA 2022)

Surface water	Water on the surface of the landscape, including streams, rivers, lakes, wetlands and oceans along with temporary water on low-lying private land.
Subsurface drains	Drains installed underground to remove vertical drainage. Disposal must comply with current guidelines administered by the approval organisation.
Table drains	Normally earthen drains excavated next to roadways to ensure the road drains properly.
Tailwater	Refer to Runoff
Take and Use Licence (T&UL)	A fixed term entitlement to take and use water from unregulated water systems such as a waterway, catchment dam, spring, soak or aquifer. Each licence is subject to conditions set by the Victorian Government Minister for Water and specified on the licence.
Water-use licence (WUL)	An entitlement to irrigate a specific parcel or parcels of land. The licence sets out the conditions for use, such as how much water you can use on your land in a single irrigation season (AUL). The licence is tied to the land. If a landholder sells a property, the water-use licence automatically transfers to the new owner unless part of the property is sold separately. (WUL – Water Register)
Water-use registration	Allows the use of water for purposes other than irrigation. This entitlement is attached to a specific parcel or parcels of land. (GMW brochure: Your irrigation area water entitlements)
Works on waterways	Any works and activities in, under, on or over the bed and banks of Designated Waterways (see definition) in Victoria require a Works on Waterways Permit from the relevant Catchment Management Authority.

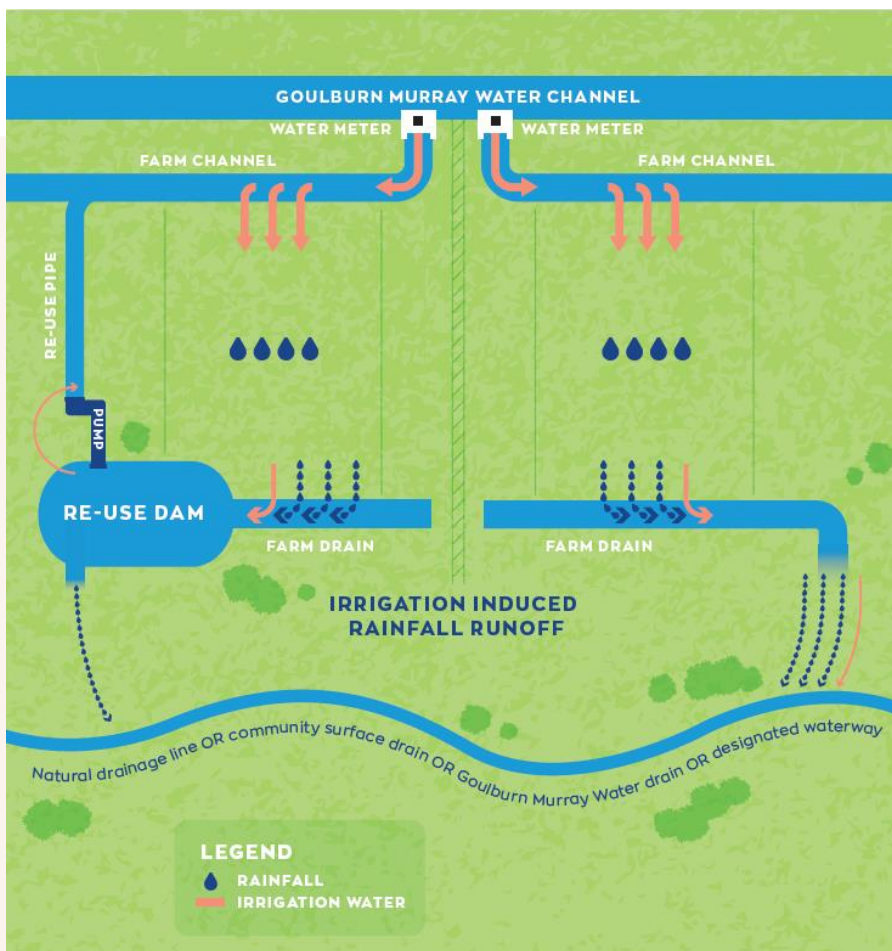


Figure A1 1: Defining irrigation-induced rainfall runoff and irrigation tailwater from farms in the irrigation region.

Appendix 2 Acronyms

AgVic	Agriculture Victoria
AUL	Annual Use Licence
BCIT	Bullock Creek Improvement Trust
BSM2030	Basin Salinity Management 2030 Strategy
CHMP	Cultural Heritage Management Plan
CMA	Catchment Management Authority
CSD	Community surface drain
DCD	Drainage Course Declaration
DEECA	Department of Energy, Environment and Climate Action
DELWP	Department of Environment, Land, Water and Planning
DIMS	Drainage Information Management System
DTP	Department of Transport and Planning
DROP	Drainage Reuse On-farm Project
EPA	Environmental Protection Authority
FPSR	First Peoples – State Relations
GED	General Environmental Duty
GL/y	Gigalitre per year
GMID	Goulburn-Murray Irrigation District
GMW	Goulburn Murray Water
ha	hectare
IDMOU	Irrigation Drainage Memorandum of Understanding
IDP	Irrigation and Drainage Plan
IDS	Irrigation Drainage Strategy
km	kilometre
LCIR	Loddon Campaspe Irrigation Region
LiDAR	Light Detection and Ranging
LMIR	Loddon-Murray Irrigation Region
LVIA	Loddon Valley Irrigation Area
LWMP	Land & Water Management Plan
MDBA	Murray Darling Basin Authority
ML	Megalitre

NVIDG	Northern Victorian Irrigation Development Guidelines
O&M	Operation and maintenance
R&D	Research and development
RAP	Registered Aboriginal Party
RCS	Regional Catchment Strategy
TIA	Torrumbarry Irrigation Area
T&UL	Take and Use Licence
VIDP	Victorian Irrigation Drainage Program
VRDS	Victorian Rural Drainage Strategy (2018)
WUL	Water-use licence

Appendix 3 Victorian Irrigation Drainage Program Strategic Directions 2021 – 2024, excerpt from Executive Summary

The Victorian Irrigation Drainage Program (VIDP) seeks to mitigate the risk of salinity, waterlogging and water quality impacts to surface water and groundwater, from irrigation activities in Victoria, by removing excess water from irrigated areas.

The VIDP Strategic Directions 2021 – 2024 sets priorities for the VIDP, provides strategic guidance for the regional implementation of the VIDP, and establishes a framework to prioritise fit-for purpose irrigation drainage activities. Irrigation drainage refers to activities (excluding flood mitigation) which remove excess water from irrigated areas. Irrigation drainage (e.g. subsurface drains, primary and community surface water drains, tile drainage, groundwater pumping, DCD and on-farm drainage reuse) is a critical component of sustainable irrigation and delivers several environmental benefits.

The VIDP will (referred to and numbered as VIDP Strategic Direction in Table 4.1):

1. Adapt irrigation drainage activities to balance environmental benefits and community benefits, and to build resilience to climate change, while continuing to support the Victorian irrigation sector;
2. Recognise, understand and protect, Indigenous water values and interests by collaborating with First Nations People in planning and delivering irrigation drainage activities and projects;
3. Ensure proposed irrigation drainage activities are supported by the community;
4. Manage offsite impacts of irrigated agriculture within agreed targets and, where possible, further reduce environmental and third-party impacts of irrigation;
5. Promote agriculture adaptation practices to build resilience to climate change within the irrigation sector;
6. Empower irrigators to make informed decisions about best practice irrigation drainage management;
7. Increase responsiveness and uptake of rural water policy across the irrigation sector;
8. Undertake research and monitoring activities to address knowledge gaps;
9. Ensure compliance and consistency with relevant statutory obligations, policies and strategies; and
10. Promote appropriate long-term governance, operation and management of irrigation drainage investment.

The VIDP Strategic Directions 2021 – 2024 also provides guidance on how proposed irrigation drainage activities will be prioritised for investment.

Appendix 4 Brief history of drainage in the irrigation region

Table A31 Timeline of drainage management in the region

Date	Description	Area of relevance
1950 & 1960	Poor irrigation practices and surface drainage contributed to high groundwater	Region
prior to 1970	Clearing of land, irrigation resulted in creeks siltation and weed growth	Region
20 May 1970	Formation & approval of constitution of the Bullock Creek Improvement Trust (BCIT)	Region
1970 – 1990	Drainage works on 347km designated waterways and construct 650km CSDs	BCIT
1997	BCIT dissolved and responsibility passed to NCCMA	BCIT
1999	Designated waterways and CMA responsibilities published in Victorian Government Gazette	Region
2001	Loddon-Murray Surface Water Management Strategy	Region
2004	Loddon-Murray Irrigation Region Surface Water Management Implementation Plan Outlined the proposed on-ground drainage works to be undertaken in each catchment	Region
2010	Stage 1 construction of the Benwell CSD, included 6km of primary drain, pump station and 700 metres of pipe. No further stages were completed	Region
2010	Tragowel Plains surface water management situation analysis. This report assesses the condition of the designated waterways that North Central CMA has responsibility for. The assessment showed that 10km of 329km waterways assessed needed desilting or weed control to be undertaken.	BCIT
2010/11	<i>Floods</i>	<i>GMID</i>
2010	GMW completes repair work in the Tragowel Plains for North Central CMA as part of the flood recovery. It included desilting of 172km of drains, weed removal on 30km and reinstatement of 20 culverts.	BCIT
2010	<i>Irrigation Drainage MoU Covering the GMW irrigation areas (final v2) Oct 2010</i>	<i>GMID</i>
2013	<i>Victorian inquiry into rural drainage</i>	<i>State</i>
2018	<i>Victorian Rural Drainage Strategy (VRDS)</i>	<i>State</i>
2018	Pilot study undertaken in Bullock Creek catchment as part of the VRDS and IDP. This study involved surveying farmers about the level of management of waterways and the funding of, and transfer of ownership of upgraded culverts at Pyramid Hill to improve movement of water.	BCIT
2018	Review of the region's surface water management strategy undertaken by RMCG	Region
2020	Initial consultation completed by Mal Brown - created an engagement plan and did some consultation	Region
2021	<i>Victorian Irrigation Development Program Strategic Directions</i>	<i>State</i>
2022	<i>GMID Drainage Management Strategy</i>	<i>GMID</i>
2022	Update of the region Irrigation Drainage Strategy	Region

Appendix 5 Surface Water Management in the LCIR LWMP

The Loddon Campaspe Irrigation Region Land and Water Management Plan 2020–2030 outlines seven programs, of which one is the Drainage Infrastructure Development and Operations Program. Five of the other programs have actions related to drainage that either Agriculture Victoria, North Central CMA or GMW have responsibilities to deliver these. The LWMP can provide further detail regarding the monitoring framework and related provisional SMART targets and MERI indicators identified to measure the success of the following actions.

Table A41 The LWMP programs and actions related to drainage

Program	Action Ref. No.	Action	Priority	Delivery responsibility
2. Planning & Governance	2.1	Monitor progress of the Plan, measuring indicators of - Off-site impacts of irrigation on downstream users	High	North Central CMA
	2.3	Planning and reporting support for implementing the Plan and achievement of outcomes of - Improved irrigation drainage	High	North Central CMA
3. Adoption	3.5	Extension and incentive support for the construction of farm reuse systems where there is substantial public benefit	Medium	Agriculture Victoria
	3.7	Provide extension and incentives for environmental stewardship projects (e.g. Riparian and wetland restoration)	Medium	North Central CMA, Agriculture Victoria
4. Regulations & Standards	4.1	Partner with key organisations (EPA) to ensure the SEPP (Waters)/GED obligations are adhered to. For example, no impact on the beneficial users of groundwater	High	North Central CMA
	4.7	New irrigation developments and environmental watering within the BSM2030 guidelines consistent with salinity register	High	North Central CMA
5. Education and Training	5.4	Educate agency staff and wider community about impacts of irrigation on downstream users using a wide range of communications media	Medium	North Central CMA
6. Research & Catchment Monitoring	6.2	Investigations and monitoring of impacts of irrigation on downstream water users and recreation values of irrigation	Medium	North Central CMA
	6.3	Improving the groundwater monitoring network across northern Victoria consistent with meeting the reporting needs under BSM2030 through the adoption of digital technology including telemetry	High	North Central CMA, Agriculture Victoria
7. Drainage Infrastructure Development & Operations	7.1	Assess need for regional drainage infrastructure upgrades such as community surface drains with guidance from the surface water management plan	High	North Central CMA, Agriculture Victoria
	7.2	Develop projects to execute regional irrigation drainage infrastructure upgrades	Medium	North Central CMA, Agriculture Victoria
	7.3	Implement the Irrigation Drainage MOU with all partners	Medium	North Central CMA, GMW
	7.4	If identified, DCDs will be implemented on North Central CMA drains with guidance from the SWMP	Medium	North Central CMA, GMW
	7.5	Support construction of new drains (only where needed)	Medium	North Central CMA, GMW

