Explanatory Guide

To support consultation on the:

Draft Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin 2024-31

Queensland Government

Prepared by: Healthy Waters and Wetlands, Department of Environment, Science and Innovation

The Department of Environment, Science and Innovation acknowledges Aboriginal peoples and Torres Strait Islander peoples as the Traditional Owners and custodians of the land. We recognise their connection to land, sea and community, and pay our respects to Elders past and present.

The department is committed to respecting, protecting and promoting human rights, and our obligations under the Human Rights Act 2019.

Acknowledgements

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- Cotton Australia
- Smartrivers
- Border Rivers Food and Fibre
- Queensland Farmers Federation

Other key stakeholders consulted are also acknowledged for their input:

- Darling Downs Environment Council Inc.
- Australian Floodplain Association
- Lower Balonne Working Group
- Lower Balonne Water Network
- Northern Basin Aboriginal Nations
- Southern Queensland Landscapes
- Department of Regional Development, Manufacturing and Water (DRDMW)
- Department of Agriculture and Fisheries (DAF)
- Department of Climate Change, Energy, the Environment and Water – Office of the Commonwealth Environmental Water Holder (CEWH).

Version	Date	Description
1.0	29/04/2024	Consultation version

Contents

The following is an explanatory guide accompanying the *Code of practice for the release of stored water from privately owned farm storages to receiving waters in the Queensland Murray-Darling Basin 2024-31*.

1 The activity

The activity is the release of stored water from privately owned farm storages to receiving waters. Initial impetus for the activity was based on consideration by the Commonwealth Environmental Water Holder (CEWH) of the use of private irrigation infrastructure to divert, store, supply and/or redirect environmental water as part of event-based mechanisms applied in the Northern Unregulated Rivers of the Queensland Murray-Darling Basin.

Since the concept was originally raised, release of stored water for purposes other than those of the CEWH have been identified. These could include:

- request by a State agency to satisfy a State purpose
- to allow a landholder to move water from one location to a nearby location, or
- to lower the water level in a storage which was in urgent need of repair.

Other approvals may be needed to support these purposes and they are not part of this code of practice. The code of practice is concerned with the potential impacts of releasing water on the environmental values of the receiving waters (Section 2), and those impacts and values are essentially the same irrespective of the purpose of release.

It has also been suggested that the code of practice could apply throughout the State rather than just to the watercourses within the Queensland Murray-Darling Basin. This would require a risk assessment to be conducted with respect to the potential for impact on environmental values within each catchment. Given the variation in values and possible sources of impact across the State (Reef catchments, Wet Tropics watercourses, Gulf catchments etc.) it has not been possible to undertake such assessment in this document. As a result, the applicability of this document is restricted to the Queensland Murray-Darling Basin.

1.1 Relationship to the needs of the Commonwealth Environmental Water Holder

In northern Murray-Darling Basin catchments, there are six toolkit measures designed to complement environmental outcomes achieved through other aspects of the *Basin Plan 2012* (such as water recovery). One such toolkit measure is termed ‘event-based mechanisms’, which includes the release of stored water from privately owned farm storages to receiving waters (i.e store and release). Store and release arrangements are implemented by the Commonwealth Environmental Water Holder to extend the duration of a flow event to support a specific environmental outcome or expand an event to help increase the area of vegetation that is effectively watered (Marsden Jacob Associates, 2020). The Commonwealth Environmental Water Holder has worked with the Queensland Government and New South Wales Government on the implementation of event-based mechanisms in the northern Murray-Darling Basin via the Intergovernmental Agreement (IGA) on Implementing Water Reform in the Murray-Darling Basin. Store and release offers the Commonwealth Environmental Water Holder a number of operational advantages for environmental watering as the mechanism is flexible, strategic, targeted and cost-effective (when used occasionally under specific flow scenarios) (Marsden Jacobs Associates, 2020).

1.2 What has been updated in the Store and Release Code of Practice (2024-31)?

In the seven years that the Store and Release Code of Practice 2016-23 was in effect, there were two monitoring events conducted (of both storages and receiving waters in the Lower Balonne) and one successful store and release event to support successful bird breeding outcomes at the Narran Lake Nature Reserve Ramsar site (Dharriwaa). The information gained from these events was used support the review that produced the Store and Release Code of Practice 2024-31. The following table presents the key updates conducted for the new version of the document:

Table 1: Details of updates conducted for the Store and Release Code of Practice (2024-31)

Section	Details of update
Foreword	Following the consultation draft period, an updated foreword will be supplied by the Chief Executive Officer of Cotton Australia in support of the *my*BMP initiative being utilised within the control measures of the code of practice.
Section 7 Environmental Management Plan	Cotton Australia conducted an update to this section to ensure it remained in line with the current practices identified in the *my*BMP. The edits were reviewed by the Department of Environment, Science and Innovation to ensure they still met the requirements of a code of practice under the *Environmental Protection Act 1994* (EP Act).
Appendix 3 Description of monitoring to be conducted during the release of water from privately owned farm storages to receiving waters	The Store and Release Code of Practice 2016-23 included Appendix 2 which provided a description of monitoring programs to be conducted during the initial releases of water from privately owned farm storages to receiving waters. As the monitoring was designed for the initial test of the efficacy of the control measures in the code of practice, a precautionary approach was taken in which a comprehensive suite of monitoring requirements was included. For the Store and Release Code of Practice 2024-31, the recommended monitoring program has incorporated feedback from the CEWH and has been refined to be fit for purpose for store and release events. In the Store and Release Code of Practice 2024-31 the following requirements have been removed: • To monitor the discharge channel both before and after the event as it is likely to be dry prior to a store and release event and, even if a sample could be collected, the usefulness of the results for decision-making purposes are limited. • To sample from the watercourse approximately 5km downstream from the discharge point both before and after the event, as there is already a requirement for sample collection at a site 500 metres downstream of the discharge point which is a more relevant sampling location to evaluate the activity. • To resample the storage after the release, as the low water level in the storage would not be indicative of what was released and the focus would be on the water quality of the receiving waters after the release, rather than in the storage. • To collect monitoring samples shortly after, and during, the event, as the results would not be received from the laboratory in time to inform any sort of decision-making that would be relevant to the operation of the store and release. The exception to this would be if a store and release event lasted longer than three (3) weeks, which is unlikely based on advice from the CEWH (the store and release event in 2023 lasted 19 days). Store and release events last until the maximum contracted volume has been released. However, if this does occur, the updated code of practice recommends that the sampling regime conducted before the release is repeated. Note that changes to the timing and location of sample collection are the only refinements made to the monitoring program. The list of recommended analytes has not changed. A key addition to the monitoring requirements of the Store and Release Code of Practice 2016-23, is the clarification that water quality samples should be collected within 3 weeks prior to a scheduled release of stored water. This requirement considers the time to collect the samples, as well as the laboratory turnaround times which dictate the availability of results for decision-making purposes. The code of practice stipulates that the storage must receive no contaminated water in the time between sample collection and the release. A further clarification in the updated version of the code of practice is the recommended number of samples to collect per storage. This was based on feedback from 2Rog Consulting, who was contracted by CEWH to collect the pre-release water quality samples in 2022 and 2023. 2Rog Consulting noted that there was variability in the water quality between storages and suggested that 2-3 samples should be collected per storage to improve confidence in the results and inform the selection of the optimal storage to use for a store and release event. As a result, the Store and Release Code of Practice 2024-31 now states that a minimum of 2 samples should be collected per storage, with the samples collected from different sites within the storage.

	Additional information was also included in the Store and Release Code of Practice 2016-23 to guide the collection of in situ water quality parameters. These requirements were checked for consistency with the Monitoring and Sampling Manual 2018. Claydon (2023) recommended a longer-term water quality monitoring approach that ramps up in light of a potential store and release event. Given the most recent sampling data would be most relevant to inform the suitability of a storage for release, as well as the conditions in the receiving waters, a long-term water quality monitoring program has not been recommended under the code of practice at this stage. This also helps to retain the efficiency and cost effectiveness of the monitoring program implemented under the code of practice, as only one store and release event occurred in the last seven years.
Section 5.9 Risks to Aboriginal Values and Uses	This section was updated to reflect the completion of an Aboriginal Waterways Assessment during the term of the Store and Release Code of Practice 2016-23. A commitment to complete an additional Aboriginal Waterways Assessment has been included in the Store and Release Code of Practice 2024-31. Note that all Intellectual Property in the Aboriginal Waterways Assessment reports rests with the Euahlayi Nation. As a result, this section will be further updated following consultation with the Yuwaalaraay Euahlayi Aboriginal Corporation on the draft Store and Release Code of Practice 2024-31.
Throughout document	General edits to improve document clarity and updates to references.

2 Environmental Values

Under the Environmental Protection Act 1994, we all have a general environmental duty to not carry out an activity that causes, or is likely to cause, environmental harm unless all reasonable and practicable measures are taken to prevent or minimise the harm. In looking at the activity of releasing stored water to receiving waters, environmental harm could potentially occur to the environmental values of the receiving waters if measures are not in place to prevent the risk of harm from occurring. Environmental values refer to the qualities that make water suitable for supporting aquatic ecosystems and human uses. These qualities need to be protected from the effects of habitat alteration, waste releases, contaminated runoff and changed flows to ensure healthy aquatic ecosystems and waterways that are safe for community use. All tidal and non-tidal waters, including wetlands, lakes and groundwater, have environmental values. Aquatic ecosystem health is an environmental value of all Queensland waters.

2.1 Queensland Murray-Darling Basin catchments

The environmental values of the Queensland Murray-Darling Basin catchments are included in Schedule 1 of the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019*. They are also reflected in the Healthy Waters Management Plans for the following areas:

- Warrego, Paroo, Bulloo and Nebine
- Queensland Border Rivers-Moonie
- Condamine
- Maranoa-Balonne.

The environmental values that are mapped and scheduled for the Queensland Murray-Darling Basin catchments vary depending on location and may include:

- aquatic ecosystem values
- cultural and spiritual values (modified to ‘cultural, spiritual and ceremonial values’ at the request of Traditional Owners for the purposes of the Healthy Waters Management Plans)
- agriculture (including irrigation, stock and domestic)
- aquaculture
- human consumption of aquatic foods
- drinking water (suitable for treatment before supply as drinking water)
- industrial use; and
- recreation (primary, secondary and visual/aesthetic).

For each environmental value, water quality objectives under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* are provided. Water quality objectives are measurements, levels or narrative statements of particular indicators of water quality that protect identified environmental values. Once scheduled under the

Environmental Protection (Water and Wetland Biodiversity) Policy 2019, environmental values and water quality objectives inform statutory and non-statutory water quality management planning and decision-making.

The Healthy Waters Management Plans prepared under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* also contribute to meeting the requirements of a Water Quality Management (WQM) Plan under Chapter 10, Part 7 of the *Basin Plan 2012* (Cth). Healthy Waters Management Plans fulfil select requirements of a WQM Plan and were developed for all Queensland Murray-Darling Basin drainage basins in collaboration with the natural resource management organisation for the region – currently Southern Queensland Landscapes. For each Commonwealth Water Resource Plan package accredited by the Murray-Darling Basin Authority under the *Basin Plan 2012* (Cth), the Queensland Government included a Healthy Waters Management Plan for the relevant water resource plan area to address water quality considerations.

The environmental values and water quality objectives of the Lower Balonne river system are of particular interest in the context of event-based mechanisms applied by the Commonwealth Environmental Water Holder, such as store and release. This is due to the connectivity of the Lower Balonne river system from Queensland to New South Wales, flowing to the ecologically significant Narran Lake Nature Reserve Ramsar site (Dharriwaa). The Narran Lake Nature Reserve (Dharriwaa) is a significant bird breeding wetland that requires sufficient inflows to maintain suitable conditions for the success of these events. This is a key driver of store and release events conducted to date by the Commonwealth Environmental Water Holder. Consideration of the environmental values and water quality objectives under the code of practice at the time of release ensures water quality has also been a key component of the decision-making process, alongside the benefits that additional water flows would generate to the wetland.

3 Matters the Minister must have regard to when approving a code of practice under section 551 of the *Environmental Protection Act 1994*

Section 551 of the EP Act states that the Minister may, by gazette notice, make codes of practice stating ways of achieving compliance with the general environmental duty for an activity that causes, or is likely to cause, environmental harm. In making a code of practice, the Minister must have regard to the following matters addressed below.

3.1 The nature of the harm or potential harm

3.1.1 Identification of potential risks

Section 440ZG of the EP Act states that a person must not unlawfully deposit a prescribed water contaminant in waters. Prescribed water contaminants are listed in Schedule 10 of the *Environmental Protection Regulation 2019* (see **Appendix 1**) and of most relevance to this activity are:

- biocides (including herbicides, fungicides and pesticides)
- chemical toxicants
- suspended or dissolved solids
- a substance that has a pH outside the range of 6.5 to 8.5
- a liquid that has a temperature difference by more than 2°C from ambient water temperature organic or inorganic matter
- plant matter, including, for example, bark and leaves.

The other prescribed contaminants relate to various solid and liquid wastes which are very unlikely to be present in the stored water but control measures have been included in the code of practice to ensure this is the case.

The water in storage originates from river flows and / or overland flow, extracted under licence and primarily during elevated flow events. As such, whatever the quality of this water, the initial level of risk associated with extracted water is consistent with that offered by the passive management option of the CEWH (allowing the water to pass down the river without being extracted). The prescribed water contaminants that are biocides or toxicants may be present in the water when initially extracted but may also enter the water while in storage through direct deposition from surrounding land uses (e.g. spray drift during application of farm chemicals) or indirectly if the storage collects farm runoff (tailwater or stormwater which drains from actively cropped areas).

The remaining prescribed water contaminants occur naturally but may alter and become a “contaminant” as a result of the period of time that the water is in storage and the particular characteristics of the storage and its release mechanisms. For example, a deep storage which has held water for an extended period of time may

stratify such that the deeper water is substantially colder than surface water and may be anoxic. The act of releasing the water may also cause erosion of the discharge channel which in turn will raise the level of suspended solids. Erosion of the discharge location or bed and banks of the watercourse receiving the discharge may also occur if the discharge point is not adequately engineered.

With regard to potential fisheries impacts, the issues relate to changes to the flow regime, protection of the well-being of fish, and to the possible release of pest fish species from the storages into the watercourse. These issues are considered very low probability of occurrence and of minimal likely consequence. For example, the release, if at the direction of the CEWH, may specifically be targeted at achieving a positive outcome for native fish species or if not directly related to fisheries, is at least targeting a positive environmental outcome which has indirect benefits for fisheries. For example, during a store and release event conducted in February 2023 under the Store and Release Code of Practice 2016-23, in situ monitoring found that dissolved oxygen conditions in the receiving waters were poor and did not meet water quality objectives prior to the release of stored water. Once the store and release event had concluded, the results of in situ monitoring showed that dissolved oxygen levels had improved significantly and subsequently achieved water quality objectives (2rog Consulting, 2023). The store and release event therefore would have had an indirect benefit to the aquatic habitat in the receiving waters, beyond the core objective of the event which was to supplement flows in Narran Lake Nature Reserve Ramsar site (Dharriwaa) to ensure the success of bird breeding.

With respect to the activity and pest fish species, carp, goldfish and mosquito fish are known to occur in all catchments in the Queensland Murray-Darling Basin.

3.1.1.1 Risks to Aboriginal Values and Uses

Aboriginal people have a strong spiritual, physical and cultural connection to land and water. Rivers and waterholes have significant value to the Aboriginal community for cultural, spiritual and ceremonial purposes. These aquatic ecosystems are important for people of the Aboriginal Nations in the Queensland Murray-Darling Basin for many activities, including, but not limited to, recreation, storytelling, fishing, singing and ceremonies, as well as water for economic development.

Consultation conducted for the purposes of the Store and Release Code of Practice 2016-23 with representatives from the Northern Basin Aboriginal Nations identified that the release of stored water from privately owned farm storages to receiving waters presents potential risks to downstream Aboriginal values and uses. The activity should be managed in a way that ensures the quality of water is suitable to support cultural, spiritual and ceremonial values and uses; as demonstrated by maintaining the current water quality of the receiving waters.

An Aboriginal Waterways Assessment[1] in the Lower Balonne river system was undertaken in 2019 by the Euahlayi Nation to assess the Cultural Health Index of the waterways prior to any store and release events occurring. The Cultural Health Index documents and maps cultural status and use, animals and plants of cultural significance, and provides an assessment of stream health including, for example, catchment land use, riparian vegetation, riverbed condition and sedimentation, channel modification, flow and habitat variety (pools, runs and rapids), water clarity and water quality. The methodology is outlined in the Aboriginal Waterways Assessment Program report (2015) published by the Murray-Darling Basin Authority in conjunction with the Northern Basin Aboriginal Nations and the Murray Lower Darling Rivers Indigenous Nations.

The Aboriginal Waterways Assessment Technical Report was provided to the Department of Environment and Science – however its use to inform water quality planning and management is by agreement with the Euahlayi Nation. All Intellectual Property in the report rests with the Euahlayi Nation.

3.1.2 Risk pathways and likelihood of occurrence

Prescribed water contaminants as listed in Schedule 10 of the *Environmental Protection Regulation 2019* may:

- be present in the water when initially extracted
- be added to the stored water via farming activities
- develop as a result of changes to the quality of the stored water, and
- result from erosion of the discharge pathway.

If the extracted water was immediately released from storage back to the river it was extracted from, the risk to environmental values would be essentially the same as if it had not been extracted in the first place. As part of the

[1] Refer to the Murray-Darling Basin Authority website for more information.

planning process for the Store and Release Code of Practice 2016-23 , the former Department of Environment and Heritage Protection engaged the former Murray-Darling Basin Committee (now Southern Queensland Landscapes) to sample a range of river and private storage environments for over 120 toxicants, including farm chemicals commonly used in the region. Data at the time showed that although contaminants do occur in the river water, the majority were within guideline levels for the protection of 95% of species (based on median result). The median result for only one contaminant (Metolachlor) exceeded the freshwater low reliability trigger value under the former ANZECC 2000 guidelines at baseflow conditions. Note that this trigger value was revised in 2020 under the new Australian and New Zealand guidelines for fresh and marine water quality. In comparing the median result for metolachlor based on the monitoring conducted previously for the development of the Store and Release Code of Practice 2016-23, the value would now be within the trigger value for the protection of 95% of species based on the very high reliability revised trigger value. More recent technical knowledge to inform the activity is detailed in Section 3.3.

The potential to add prescribed water contaminants via farming activities relates to either:

- direct contamination from spills during transport or mixing of chemicals,
- incorrect use,
- poor control of application leading to drift, or
- indirect contamination via the farm water management system.

Chemical use on farms is a significant component of cost so it is common sense that landholders aim to maximise the intended benefit and minimise wastage. Any chemical which finds its way into storages has essentially been wasted. Many of the industry best practice guidelines are aimed at addressing these issues and coincidentally minimise environmental risk. Sampling conducted to support the development of the Store and Release Code of Practice 2016-23 showed metolachlor as the only pesticide to exceed the former ANZECC 2000 trigger value in storages, noting that it also did so in the river. A comparison of the median result for metolachlor within each storage against the updated Australian and New Zealand guidelines for fresh and marine water quality shows that the storage values would now be within the trigger value for the protection of 95% of species based on the very high reliability revised trigger value. This monitoring suggested that on-farm practices do not add significantly to the contaminant load within stored water.

Higher levels of various chemicals and metals were obtained from storages which were sampled at very low water levels. This has influenced the current estimate of the median result. Control measures have been included within the code of practice to directly address such circumstances – though it is unlikely that releases would be requested when the storages hold little water as such small volumes would be unlikely to provide the desired environmental benefits. The water management systems on irrigation farms include means to recover tailwater (excess irrigation water which drains from the fields after delivery) and to capture stormwater runoff. Both tailwater and stormwater (from the active fields) are acknowledged as potentially containing higher levels of farm chemicals or other contaminants (e.g. suspended solids). The design of the systems aims to prevent discharge of such water, or at least the first flush of stormwater, to natural watercourses and to allow recycling to the fields.

Similarly, farm management systems aim to minimise the production of tailwater as this also represents wasted irrigation water. Some water management systems are designed to entirely separate tailwater and stormwater from the initial water storage system, while others may use the storages to capture the runoff water. The code of practice recognises this and places emphasis on proving the suitability for discharge from storages which capture tailwater and / or stormwater. Without any specific controls, but assuming a modern approach to farm management, the risk of additional contamination from on-farm activities could be considered low to moderate so the code of practice formalises control measures which aim to reduce that risk to very low levels.

The quality of stored water may change as a result of the time the water is held in storage and aging effects related to stratification (affecting temperature and other attributes), large surface areas open to sunlight or interaction with storage sediments (primarily anaerobic oxidation). The likelihood of stratification occurring will vary greatly with storage design parameters. Deeper, more stable storages (not easily influenced by wind driven circulation or some other form or disturbance) are more likely to stratify. Stratification is most likely to occur in the warmer months from October to May and if the water has sat in storage over winter. In Queensland, waterbodies are considered to be strongly thermally stratified if the difference in temperature between upper and lower layers is greater than 5°C (DRDMW, 2022). As most storages release from the bottom, the released water from a stratified storage is likely to be relatively cold, low in dissolved oxygen and potentially high in nutrients and sulphides.

Stratification can be avoided or reduced by not leaving the water in storage for long periods before releasing or by actions which circulate the water or increase the interaction between the water and the atmosphere. Thermal stratification, if present, would be broken down in on-farm storages through refilling from a spring or summer flow event or aggregation of water across storages (moving the water between storage cells to minimise the surface area and hence evaporation). The code of practice includes monitoring to test for stratification and controls to minimise the effects of water released from stratified storages.

Storages and channels are often constructed from compacted local soil, and in the irrigation areas of the Lower Balonne, or Lower Border Rivers, this usually comprises various forms of cracking clays which generally provide suitable construction material. However, they can erode as a result of heavy rainfall, or, from the forces associated with the flow of water in the channels, particularly at bends or other areas where the force is directed toward a fixed location. Erosion generates sediment which can be entrained within the discharge water. The risk of compromising an environmental value is considered low because background turbidity in many of the watercourses in the region is commonly relatively high, particularly during flow events. There is a high probability that water would be released in association with a natural flow event, and water which has been in storage for some time is likely to show reduced turbidity as a result of settling. The code of practice includes control measures to minimise the likelihood of erosion and to ensure adequate repairs are undertaken to riverbanks should erosion occur.

3.1.3 Likely timing of releases

The event-based management options nominated by the CEWH all relate to enhancing (or supplementing) a naturally occurring flow event, i.e., “each action is appropriate to a specific flow situation, and will only be viable if there is suitable trigger unregulated flow event” (Commonwealth of Australia, 2016).

There were two instances during the term of the Store and Release Code of Practice 2016-23 where flow conditions were suitable to conduct a store and release event (February 2022 and February 2023). These two instances were the first time since 2013 that large scale bird breeding events in the Narran Lakes Ramsar site (Dharriwaa) had occurred (CEWH, 2023). The intended store and release event in February 2022 was cancelled as further rainfall extended flow conditions at the Narran Lakes Ramsar site (Dharriwaa), negating the need for an event-based mechanism. The store and release event in February 2023 (securing 6.5 gigalitres) proceeded and supported successful breeding outcomes for thousands of birds including straw-necked ibis, royal spoonbills, glossy ibis, egrets and cormorants (CEWH, 2023). Therefore, the timing of store and release events is most likely to coincide with the bird breeding season at Narran Lakes Ramsar site (Dharriwaa), which typically occurs in the summer months. The timing of releases for purposes other than event-based mechanisms conducted by CEWH cannot be specified.

3.1.4 Potential consequences

The code of practice is primarily concerned with reducing the risk that stored water contains prescribed water contaminants that may cause environmental harm if released to the aquatic ecosystem or may adversely affect other environmental values of the waterbody. Monitoring associated with the development of the Store and Release Code of Practice 2016-23 showed that the possible contaminants associated with the release of stored water are already present at some level in the receiving environment, though typically remaining under trigger values for the protection of 95% of species. Table 2 outlines the potential consequences of water quality indicators or contaminants known to occur in the region.

Table 2: Potential consequences of water quality indicators or likely contaminants

Potential contaminant	Consequence
Atrazine	Atrazine is widely used and applied to broadleaf and grassy weeds in cropping areas. It has been known to affect reproduction of aquatic flora and fauna, as well as inhibit photosynthesis in aquatic environments (Graymore et al., 2001). It has a low potential for bioaccumulation.
Metolachlor	Metolachlor is a herbicide known to inhibit the growth of plants and algae. Studies have shown it impacts both phototrophic (“light fuelled”) and non-phototrophic species. It has a low potential for bioaccumulation (DAWE, 2020).
Tebuthiuron	Tebuthiuron is used for total control of herbaceous and woody plants, typically in areas not used for cropping. It can be highly toxic to aquatic plants (ANZG, 2000). Bioaccumulation is not expected to occur.
Diuron	Diuron is used to control weeds and grasses in many agricultural and non-agricultural settings. It is a herbicide that exerts toxicity by inhibiting photosynthesis and therefore can affect algae, macrophytes, plants. Bioaccumulation is limited (APVMA, 2011).
pH	The pH of water refers to its acidity or alkalinity. A slight change in pH may trigger algal blooms, the loss of sensitive species, leaching of toxic metals and the loss of biota in mass mortality events. pH can also affect nutrient dynamics in waterways (DES, 2023b).
Electrical conductivity	Electrical conductivity is a measure of how much salt is present in a waterway. Changes in electrical conductivity can lead to a loss of sensitive aquatic species, mortality events and

	altered community structure (DES, 2013a).
Turbidity	Turbidity is known to reduce sunlight in the water column as the level of sediments increase. This can lead to a reduction of photosynthesis and dissolved oxygen in the waterways, as well as lowered water temperatures (DES, 2013b).
Dissolved Oxygen	Dissolved oxygen is the amount of oxygen in water and can come from either the atmosphere or the photosynthesis of plants within a waterway. The level of dissolved oxygen in the water determines which plants, animals and bacteria are able to survive (DES, 2023a).
Nitrogen	High levels of nitrogen can cause excessive growth of aquatic plants and algae – which can deplete waterways of dissolved oxygen as they decompose (DES, 2020).
Phosphorus	As the availability of phosphorous is limited in natural systems, an excess amount of it from surrounding land uses (typically applied as fertiliser) can be harmful. Phosphorus can speed up primary production, leading to excessive weed growth and eutrophication of water in wetlands (DES, 2023c).
Water temperature	Water temperature influences the ecology of rivers and wetlands in multiple ways. Cooler temperatures reduce growth rates and lower primary and secondary production. As water temperature rises, dissolved oxygen diffuses out of the water into the atmosphere leaving less oxygen available for aquatic organisms to breathe (DES, 2023d).
Various heavy metals	Heavy metals are transported to waterways attached to sediments or dissolved in the water. Heavy metals can be added to the system as they are often included as components of fertilisers. They can be assimilated by aquatic biota and move through the food chain. Toxicants, such as heavy metals, can cause mortality events, disruption to the food chain and loss of photosynthetic efficiency (DES, 2013c)

With the implementation of the control measures included within the Code, any consequence as a result of releasing stored water would likely be similar to the existing risks to the environment from surrounding land uses and therefore the activity is likely to be localised, minor or inconsequential to the system. Considering the purpose of an event-based mechanism is to support a beneficial environmental outcome, the operator must consider the risk (including likelihood and consequence of prescribed water contaminants) of a release from storage to receiving waters before proceeding.

3.2 Sensitivity of the receiving environment

The hydrology of the lower floodplain region of the northern unregulated rivers of the Queensland Murray-Darling basin is seasonal and naturally highly variable. This results in aquatic ecosystem components that are both tolerant and flexible with respect to their relationship to hydrology and the physico-chemical characteristics that vary with it, such as temperature, dissolved oxygen, pH, turbidity and conductivity. Adverse effects of excess nutrients are also reduced by background turbidity levels in stream (2Rog Consulting, 2022). The ANZG provides guidelines on toxicants that apply to species or organism types (algae, crustaceans, fish etc) rather than to locations (other than separating freshwater from marine environments). To date, the key driver for store and release events has been to improve flow conditions at the Narran Lakes Ramsar site (Dharriwaa) to aid successful bird breeding and enhance the wetland habitat. Waterbird populations have been in decline across the Murray-Darling Basin for the last 40 years, based on surveys conducted by the University of New South Wales and reports from the Murray-Darling Basin Authority (MDBA) and others (Claydon, 2023).

3.3 Current state of technical knowledge

The current state of technical knowledge for the activity has been informed by water quality monitoring conducted by 2Rog Consulting on behalf of CEWH for the planned store and release events in 2022 and 2023. Only the February 2023 store and release event proceeded, as wet weather conditions negated the need for a store and release event in February 2022 following the pre-release sampling.

The monitoring by 2Rog Consulting showed that temperature stratification occurs both in the storages and receiving waters, but it may be variable across sampled sites. This also coincided with reductions in dissolved oxygen within the storages, but concentrations remained within ANZG values. Conversely, dissolved oxygen conditions in the receiving waters were poor due to a lack of natural inflows. The store and release event had an indirect environmental benefit of improving habitat in the local receiving waters by increasing the dissolved oxygen

levels.

> *"Dissolved oxygen was 36.2% at Receiving Channel Site #5 on the Narran River, upstream of the Event-based Mechanism (EBM) delivery point. This was below the guideline range of 60 – 110% and was considerably lower than downstream sites on the Narran below the EBM delivery point. Dissolved oxygen at these sites were 80.5% and 85.4%, at Receiving Channel Site #6 and Receiving Channel Site #7 respectively. These improved water quality conditions downstream of the delivery point suggests an extended benefit of the EBM release."*
>
> *2Rog Consulting, 2023*

The monitoring by 2Rog Consulting also showed that some parameters were outside or above the ANZG values and/or Queensland Water Quality Objectives. In considering the environmental risks and benefits of the activity, the monitoring report (2Rog Consulting, 2023) recommended that the store and release proceed as exceedances were not considered sufficiently large enough to be considered a concern. All herbicides and pesticides tested in the storages in 2023 were below detection limit, however some herbicides were detected in the receiving waters due to surrounding and upstream land uses. In 2022, exceedances of Metolachlor were detected in both the storage and river samples. The monitoring shows that pH was generally consistent between storages and receiving waters. Of note, the alkaline conditions were considered to mitigate the impact of higher Total Aluminium levels detected in storages during the 2022 pre-release sampling – albeit this store and release event did not proceed due to rainfall occurring (2Rog Consulting, 2022). The monitoring has also noted that phosphorus can be higher in the storages than receiving waters.

An important finding from the 2Rog Consulting reports is that if monitoring shows that one storage has better water quality readings than another sampled, then the storage with better water quality should be prioritised for release to minimise potential environmental impacts. This requirement has been added to the Store and Release Code of Practice 2024-31

The current state of technical knowledge of the activity has also been informed by the Independent Review of the Narran Lakes (Dharriwaa) Release from Private Storage Event Based Mechanism Grant 2023 – Final Report to the Commonwealth Environmental Water Holder (Claydon, 2023). This review confirmed the environmental benefit of conducting store and release events in the Murray-Darling Basin. Following the release of 6.5 GL of stored water in February 2023 via a contracted agreement with a landholder, available data and observations indicated that on-going habitat and food resources were provided for many waterbird species to successfully finish breeding activities in the Narran Lakes Ramsar site (Dharriwaa) (Claydon, 2023). The initiative also led to increased wetland health and resilience, which is likely to have long-term environmental benefits (Claydon, 2023).

3.4 Likelihood of successful application of control measures

The control measures included within the code were drawn largely from the *my*BMP program of Cotton Australia. The program began nearly 20 years ago, has undergone several reviews and is widely accepted as industry best practice for broadacre irrigation. The control measures are equally applicable to any crop. The primary modules from which control measures were drawn are mirrored in the Grains BMP (Agforce, Fitzroy Basin Association, Department of Agriculture, Fisheries and Forestry and Queensland Government).

There is no requirement for participating landholders to be accredited for *my*BMP because while many of the control measures were drawn from it, the code of practice is a stand-alone document. The measures are practical, directly targeted at avoiding or minimising contamination of storages or erosion and are relatively easily implemented. Landholders who will be required to implement the control measures largely already do so due to the long existence and acceptance of *my*BMP. Approximately 89% of cotton farms formally participate in the *my*BMP program with many others known to implement the measures without formally participating.

Between 1994 and 2019, a 95% reduction in insecticide applied per hectare was achieved, as well as 52% less water needed to grow a bale of cotton now compared to 1997 (2021/22 Sustainability Snapshot, Cotton Australia). The code of practice includes control measures in addition to those contained within the current *my*BMP framework These measures address issues specifically related to the release of stored water.

It is also noted that while *my*BMP is occasionally updated to reflect current best practice, the code of practice will not necessarily be amended to reflect these changes. An operator can implement these updated control measures (which are not the same as those in the code of practice) and still comply with the general environmental duty if the updated measures represent an alternative course of action that achieves the same or a better environmental outcome.

Although the turnaround time for laboratory based analysis of water for biocide contaminants is usually 10 working days, some laboratories may offer faster turnaround times on a case-by-case basis. The timing and availability of water quality data prior to a decision being made to release stored water needs to be considered. “Quick-test” strips have been developed for some chemicals (such as Atrazine and Diuron), through the Faculty of Agriculture & Environment, The University of Sydney and provide an instantaneous, in-field result which is of suitable accuracy. Such tests could be viewed as sentinels or indicators of other possible contamination. The monitoring program within the Store and Release Code of Practice 2024-31 has been reduced (both in terms of scale and cost) to promote successful application of this control measure in the decision-making associated with store and release events.

3.5 Financial implications of the control measures

The control measures included in the code of practice are relatively commonplace on major irrigation farms, so compliance with the code of practice represents little additional burden for most operators. The code of practice has mirrored the structure of *my*BMP to make it easier for landholders to relate to their current practices, but compliance with *my*BMP per se is not required in order to comply with the code of practice – which is a stand-alone document. However, for those who wish to participate in the *my*BMP, refer to the website for further details: https://www.mybmp.com.au/. In many cases, the physical infrastructure is currently in place in the region that the CEWH is targeting to implement event-based mechanisms, though it is possible that operators may wish to construct new infrastructure or modify existing infrastructure in order to be able to undertake the activity. This will generate costs related to approvals and construction. The viability of undertaking such works will depend on the contractual agreement between the CEWH (or other party) and the landholder.

The refinement of the monitoring program included in the Store and Release Code of Practice 2024-31 will result in greater cost efficiencies, as the number of samples requiring collection and analysis has been reduced. Timeframes and sample locations have also been clarified, which provides clearer direction for CEWH to plan store and release events. To date, the cost of monitoring under the code of practice has been borne by the CEWH as a component of facilitating each store and release event. As the concept of store and release evolves through time, negotiations between the CEWH and the landholder conducting the release will dictate the most efficient and effective financial arrangements to address the monitoring requirements of the code of practice.

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Appendix 1: Prescribed water contaminants as listed in Schedule 10 of the *Environmental Protection Regulation 2019*

1. a chemical, or chemical waste containing a chemical
   Examples—
   - biocide, including herbicide, fungicide and pesticide
   - chemical that causes biochemical or chemical oxygen demand
   - per and poly-fluoroalkyl substances (PFAS)
2. a gas other than oxygen
3. a liquid containing suspended or dissolved solids
4. a liquid that has a temperature different by more than 2ºC from ambient water temperature
5. animal matter, including dead animals, animal remains and animal excreta, and water used to clean animals, animal enclosures or vehicles used for transporting animals
6. ashes, clay, gravel, sediment, stones and similar organic or inorganic matter
7. a substance that has a pH outside the range 6.5 to 8.5
8. building and construction materials, including bitumen, brick, cement, concrete and plaster
   Examples—
   - cement washed to create exposed aggregate treatment
   - coloured powder used to create stencilled concrete features
9. building, construction and demolition waste, including bitumen, brick, concrete cuttings, plaster and waste water generated by building, construction or demolition
10. clinical waste
11. glass, metal parts, paper, piping, plastic and scrap metal
12. industrial waste
13. oil, including, for example, petroleum or vegetable based oil
14. paint, paint scrapings or residues, paint sludge, water used for diluting paint or washing painting utensils, and waste from paint stripping
15. plant matter, including, for example, bark, lawn clippings, leaves, mulch, pruning waste, sawdust, shavings, woodchip and other waste from forest products
16. putrescible waste, including, for example, food scraps
17. regulated waste
18. sewage and sewage residues, whether treated or untreated, and any other matter containing faecal coliforms or faecal streptococci, including, for example, waste water pumped out from a septic tank
19. vehicles and components of vehicles, including, for example, batteries and tyres
20. waste and waste water, generated from indoor cleaning, including, for example, waste from carpet or upholstery cleaning and steam cleaning
21. waste and waste water, generated from outdoor cleaning, including, for example, waste generated from high pressure water blasting of commercial or industrial premises, fuel dispensing areas, plant or equipment, roofs, streets, vehicles and wharves
22. waste generated from repairing or servicing motor vehicles, including, for example, engine coolant, grease, lubricants and oil
23. waste water, including backwash from swimming pools, condensate from compressors, water from air-conditioning or cooling systems and waste water from grease traps.