Toorale water infrastructure project: A case study in loaves and fishes

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Key Points

- Toorale National Park in north west NSW, formerly part of Toorale Station, has historic water management infrastructure including several dams across the Warrego River.
- The dams are set to be removed or modified as part of a funding agreement, primarily to divert more flow to the Darling River.
- However, any modifications to infrastructure must meet fish passage, ecological, hydrological cultural, funding and time constraints.
- Finding a solution that meets the project objectives and constraints has been a challenge.

Abstract

The Toorale Water Infrastructure Project (the Project) seeks to modify historic embankments constructed across the Warrego River in north-western NSW. The purpose of the proposed works is to protect and maintain the values of the property, while also enabling greater capacity to divert flow through the Warrego River to the Darling River. The Toorale Water Infrastructure Project is required under a 2008 funding agreement between the NSW and the Commonwealth Governments for the purchase of Toorale Station from Clyde Agriculture. The property has been gazetted as Toorale National Park and Toorale State Conservation Area and is administered by NSW National Parks and Wildlife Service (NPWS). The water access entitlements acquired have been transferred to the Commonwealth and are administered by the Commonwealth Environmental Water Holder (CEWH) in consultation with NPWS. Meeting the competing and complementary objectives and constraints for the site and project has proved challenging. These objectives and constraints include the retention of pre-existing ecological values and those established over the last century as a result of the constructed embankments, passage of environmental water to the Darling River, fish passage through the Warrego River, protection of historic and cultural values, and limiting impacts on NPWS operations.

Keywords

Toorale, Warrego River, Darling River, water management infrastructure, dams, environmental water, water entitlements

Introduction

Toorale Station is a large and historic pastoral station in north-western NSW. It is located at the confluence of the Warrego River and Darling River; the Warrego River is an ephemeral tributary of the Darling River. The floodplain soils of the Warrego and Darling Rivers support Michell River Grasslands, the basis of an extensive sheep grazing and wool production agricultural enterprise. Water access licences were held for both rivers, which were used to enhance large areas of pasture production (Warrego River water) and irrigate more than 2,000 ha of cropped area (Darling River water). The historic infrastructure utilised for this watering includes five embankments, referred to as dams, across the Warrego River. These dams were built up to and above the floodplain elevation and both stored water and diverted river flows onto the Warrego and Darling River floodplains. Such alteration of the landscape for agricultural development has been ongoing for at least 130 years at Toorale.

In 2008, Toorale Station was purchased from Clyde Agriculture by the NSW and Commonwealth Governments. The property has now been gazetted as Toorale National Park, managed by the NSW National Parks and Wildlife Service (NPWS). The National Park covers an area of 30,800 ha, approximately one third of the property's former area in 2008. The remaining two-thirds of the property has become a state conservation area (Toorale State Conservation Area).

Securing the water access licences was a key driver for the purchase of Toorale; these licences have been transferred to the Commonwealth and are administered by the Commonwealth Environmental Water Holder (CEWH), in consultation with NPWS. The now Commonwealth-held water will be used to achieve environmental benefits on, and downstream of, Toorale.

Management of the environmental water held for Darling River flows is relatively straightforward. However, the infrastructure used to harvest water from the Warrego River is more complex. The dams across the Warrego River were initially installed in the 1880s and have been the subject of numerous modifications, failures, rebuilds and upgrades. Five dams across the Warrego River remain and significantly impact on the flow of water into the Darling River. However, the dams have established water bodies and floodplain wetlands that have important ecological, cultural and social values in their own right. In addition to the dams, the water management infrastructure at Toorale includes irrigation and drainage channels constructed across the Warrego and Darling River floodplains.

As part of the 2008 funding agreement between the NSW and Commonwealth Governments, the dams and other water infrastructure are to be decommissioned or modified as part of the Project. The purpose of the Project is to protect and maintain the values of the property, while also enabling greater capacity to divert flow through the Warrego River to the Darling River. The project is currently in a design phase and there is a complementary Review of Environmental Factors underway.

This paper discusses the challenges in addressing the objectives and constraints for the site, focusing on:

1. Passage of water to the Darling River
2. Protection of existing ecological values
3. Provision of fish passage through the Warrego River
4. Protection of historic and cultural values
5. Limiting impacts on NPWS operations
6. Meeting agreed budget and project timeframes

This paper draws primarily on the business case, developed for the Project in 2016, prepared by Alluvium Consulting Australia Pty Ltd (Alluvium) for the NSW Office of Environment and Heritage and more recent investigations undertaken for the functional design of the proposed works (Alluvium 2018).

Existing water management infrastructure

The existing water management infrastructure at Toorale is shown in Figure 1 and comprises

- Boera Dam: the major structure used to divert water to the Western Floodplain of the Warrego River
- Booka Dam: with an adjoining private landholder
- Homestead Dam: located at the Homestead Precinct of Toorale National Park, currently breached
- Dicks Dam: on which the Louth Road has been constructed
- Peebles Dam: a recently constructed storage to service irrigated cotton production

Boera, Booka, Homestead and Peebles Dams each contain low flow pipe outlets with a capacity of approximately 600ML/day. Under the *NSW Water Sharing Plan for the Intersecting Streams Unregulated and Alluvial Water Sources*, the dams must be operated in accordance with works approval conditions.

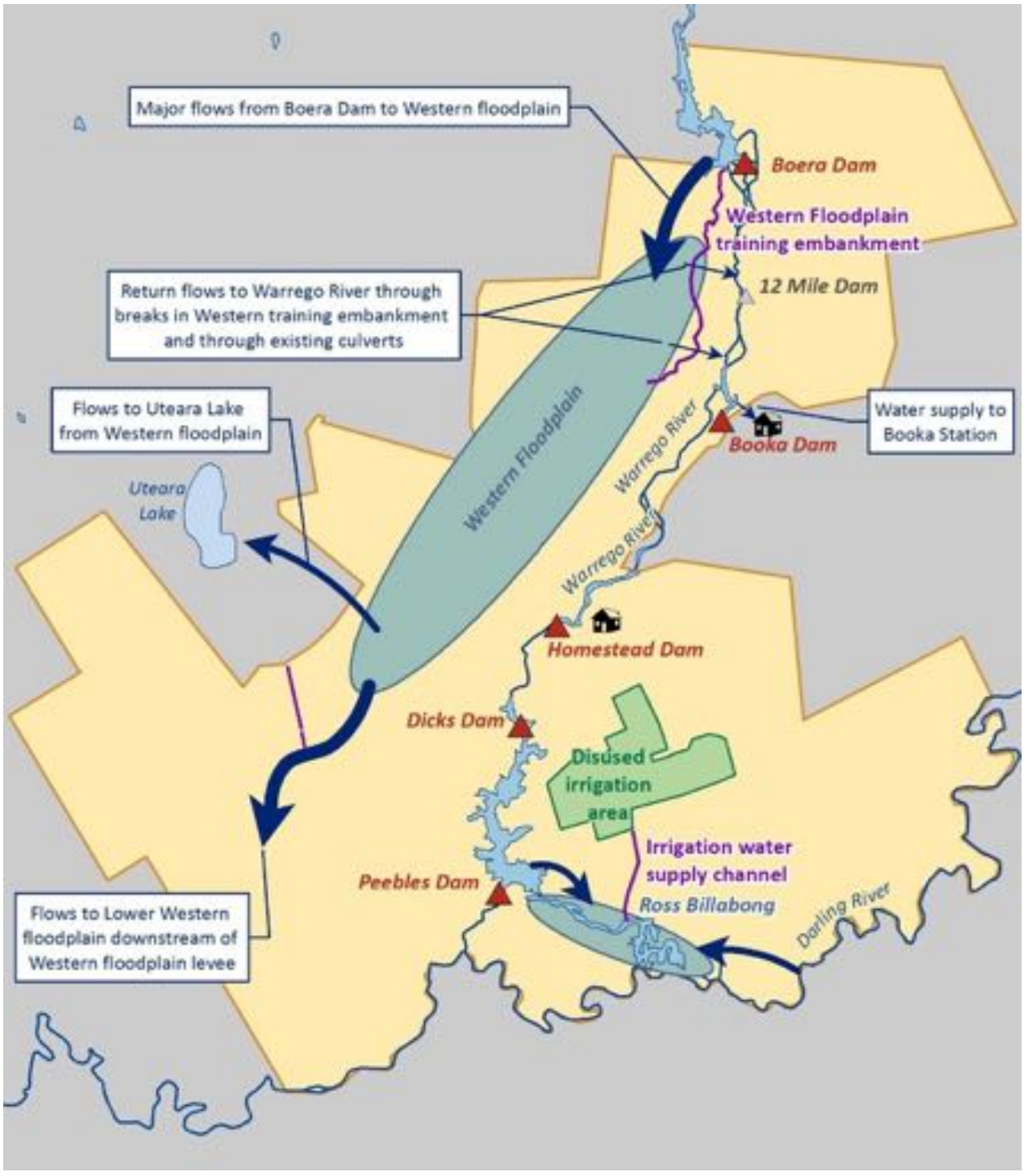

Figure 1. Existing system site infrastructure configuration

Passage of environmental water to the Darling River

The first objective of the Project is to provide for the efficient discharge of water through the Warrego River to the Darling River: up to the 95th percentile flow event (i.e. the flow event that is exceeded on 5% of days), or 1,500 ML/day, whichever is the greater. This capacity has more recently been revised down to a flow rate of 900ML/day. The existing arrangements do not permit any flow in excess of the capacity of the existing

storage pipe outlets (approximately 600ML/day) to be discharged through the Warrego River. All flow that exceeds the 600ML/day low flow pipe capacity is currently diverted at Boera Dam to the Western Floodplain.

Any changes to the flow regime arising from the Project should not adversely impact on the occurrence, timing or duration of low flow events in the Darling River.

Ecological values

The retention of both pre-existing ecological values and those established through dam construction is one of the key objectives, and challenges, for the Project. Toorale now includes a mix of natural habitat (e.g. natural waterways and billabongs) and highly modified habitat (e.g. created wetlands and modified floodplain vegetation communities). With 130 years of landscape alteration, the current ecological values at Toorale are a result of progressive adaptation and changes in the pre-existing species and communities.

The ecological values of Toorale National Park include:

- Coolibah-black box woodlands
- Inundation-dependent flora (e.g. winged peppercress, squash bush)
- Waterbirds (e.g. Australian painted snipe, Australasian bittern, freckled duck, blue-billed duck, brolga)
- Aquatic biota (e.g. silver perch, freshwater catfish, Darling River snail)
- Other taxa such as the red-tailed black-cockatoo, greater long-eared bat, and koala

Increasing the flow rates to the Darling River will inevitably require a reduction in the water retained in the Warrego River storages and that diverted to the Western Floodplain. Reducing the volume of water in the Warrego River storages and diverted to the Western Floodplain without adversely impacting on the ecological values of Toorale National Park is one of the challenges of the Project.

Modification of infrastructure that lowers the full supply level of the existing storages will also impact on the ecological values established at the dams.

Fish passage through the Warrego River

The third objective of the Project is to improve fish passage through the Warrego River system, including meeting regulatory requirements for fish passage. The dams alter and impede flow, reduce connectivity, and inhibit fish movement between refuge habitats. On the other hand, the dams themselves are now important fish habitats, particularly as nursery areas during flooding and as refuges during drought.

The lower Warrego River and Darling River have similar fish communities. The most abundant and widespread species are bony herring, golden perch and Australian smelt. Several other native fish species are predicted to occur, or once occurred but are now no longer present in the Warrego system, which is symptomatic of a broader decline across the Murray-Darling Basin. Meanwhile, non-native carp are widespread and abundant, with goldfish and gambusia also present. Overall, native fish populations are currently in relatively poor health, with several native species missing and a high biomass of non-native fish.

The current arrangements at Toorale do not provide for fish passage along the Warrego River, and are inconsistent with both state and national objectives for the recovery of native fish species. The *Fisheries Management Act 1994* (NSW) requires the provision of fish passage in any reconstructed or modified waterway structure. The modification to structures at Toorale Station presents an important opportunity to enhance the local fish ecology and provision of fish passage. Fishway structures) have been proposed at three of the dams (Boera Dam, Booka Dam, and Homestead Dam), and it is proposed that Peebles Dam be removed.

Modification of the structures to enable an increase in the flows to the Darling River while retaining the storages for the protection of ecological values will necessitate the construction of fishways at the dams. The

fish in the lower Warrego system which are expected to utilize fishways at Toorale are characterised by limited fish movement within waterholes during zero flows, but major fish movement during flow events and flooding. During such events, the upstream and downstream movement of medium and large-bodied fish – such as golden perch, Murray cod, spangled perch, Hyrtl's tandan and bony herring – enables these fish to recolonise newly inundated areas, followed by return movements to permanent waterholes.

Protection of historic and cultural values

In addition to securing water entitlements and environmental values, Toorale was purchased to secure the site's significant Aboriginal and historical cultural values. The protection of existing cultural and historic values forms the fourth major objective of the Project.

Toorale is located within the traditional lands of the Kurnu-Baakindji people of the Darling River. Aboriginal cultural heritage material is located within or in close proximity to all five dams and the Western Floodplain, as well as Ross Billabong and the irrigation area. According to the Aboriginal Heritage Information Management System (AHIMS), 791 Aboriginal heritage sites are recorded within Toorale, and observations indicate that many more are unrecorded. There is huge variance in the type and condition of these sites, and they are particularly dense around the fringes of wetlands and swamps.

While artefacts, camp sites and culturally modified trees are found at Toorale, there are also intangible heritage values which are important to the local Aboriginal community.

The history of the site as Toorale Station is also important, as it was one of the legendary large stations along the Darling River. It operated as a pastoral station from 1850, and among its workers in 1892 was Henry Lawson, one of the best-known Australian poets and writers. Toorale is also linked to early unionist movements in NSW.

Generally, the current arrangements at Toorale meet the objectives and criteria for the cultural and historic values. The main exception is Homestead Dam, where the current breached condition of the embankment fails to provide for both Aboriginal values and the historic values of Toorale Station.

While the modification of watering infrastructure to increase the discharge of water to the Darling River protects the ecological values and achieves fish passage outcomes, it must be achieved in a manner that protects and maintains these cultural and historic values in accordance with legislation and policy and considering the values and concerns of the local Aboriginal community.

Limiting impacts on NPWS operations

In addressing the many ecological, hydrological and cultural considerations above, the Project also needs to reduce and limit the operation and maintenance liabilities for NPWS. One of the main concerns is limiting adverse impacts on park access, particularly access across the Warrego River via the existing dams. The current infrastructure provides access across the landscape, but it is built to a low standard and is subject to regular failure, particularly in large flood events. NPWS is unlikely to have the funds available for major reconstruction following failures, and therefore the current arrangements are unlikely to meet NPWS objectives into the future.

Other concerns for NPWS that are relevant to the proposed works include the need to limit maintenance demands and liabilities, and to consider the recreational and aesthetic values of Toorale National Park. There are also other stakeholders and council interests to consider, including maintaining water supply opportunities for adjoining properties and avoiding impacts on public roads.

The modification of watering infrastructure to increase the discharge of water to the Darling River, must be achieved in a manner that protects and maintains these cultural and historic values of the site, while not adversely impacting on the maintenance and operation demands placed on the NPWS.

Budget and timeframe

The Project is subject to a funding agreement between the NSW and Commonwealth governments. The project must be delivered within an agreed budget and completed by 30 June 2019.

Agreement must be sought on a set of infrastructure modifications that achieve the hydrologic outcomes, without adversely impacting on ecological values, while meeting fish passage, cultural heritage and historic heritage objectives within a limited budget and timeframe.

Proposed works

A set of proposed modifications to the existing Toorale water infrastructure has been developed in response to the project objectives and constraints. The proposed arrangements are set out in Figure 2 and include:

- Boera Dam: Increased flow capacity at Boera Dam through the establishment of a new spillway structure and integrated fishway. The final form of the infrastructure is currently under development and assessment. The proposed arrangements currently comprise a set of up to 20 culverts with vertical lift gates and accompanying rock ramp fishway. The arrangement has required a lowering of the full supply level by 0.5 m. The form of fishway and spillway has required a compromise between the width and height of the gates to achieve the hydraulic target (900ML/day) prior to discharges entering the Western Floodplain, while limiting any reduction in full supply level of the storage
- Booka Dam: Lowering of the full supply level at Booka Dam by approximately 0.5 m, enabling passage of increased flow rates via a combined rock spillway and fishway – like the proposed works at Boera Dam, this will improve discharge of flows down the Warrego River and provide for fish passage
- Homestead Dam: Installation of a 1 m high embankment to store water at Homestead Dam, which would include an integrated rock overflow spillway and fishway – this will protect established ecological values, meet cultural objectives and improve the recreation experience at the site
- Removal of Peebles Dam to improve discharge of flows down the Warrego River and fish passage

It is proposed that the current operating arrangement for the infrastructure also be modified. It is proposed that the retained dams be largely operated as fill and spill structures. This fill and spill arrangement is required to simplify operations for NPWS staff and to ensure fish passage during flow events.

Other works required at the site but lying beyond the project scope include

- Provision of improved fish passage at Dicks Dam
- Installation of additional breaches in Darling River floodplain infrastructure
- Provision for controlled releases of water on the Western Floodplain back to the Warrego River.

Discussion

The Toorale Water Infrastructure Project objectives and constraints are challenging. The existing arrangements fail to meet the hydrologic and fish passage objectives for the site. However, arrangements that seek to address these objectives can adversely impact on the existing ecological and cultural heritage objectives. As such the project objectives are both complementary and competing.

- Modifications that increase the discharge of water to the Darling River will have some adverse impacts on the existing ecological values of the site
- Works that result in significant ground disturbance have the potential to adversely impact on the significant cultural values of the site.

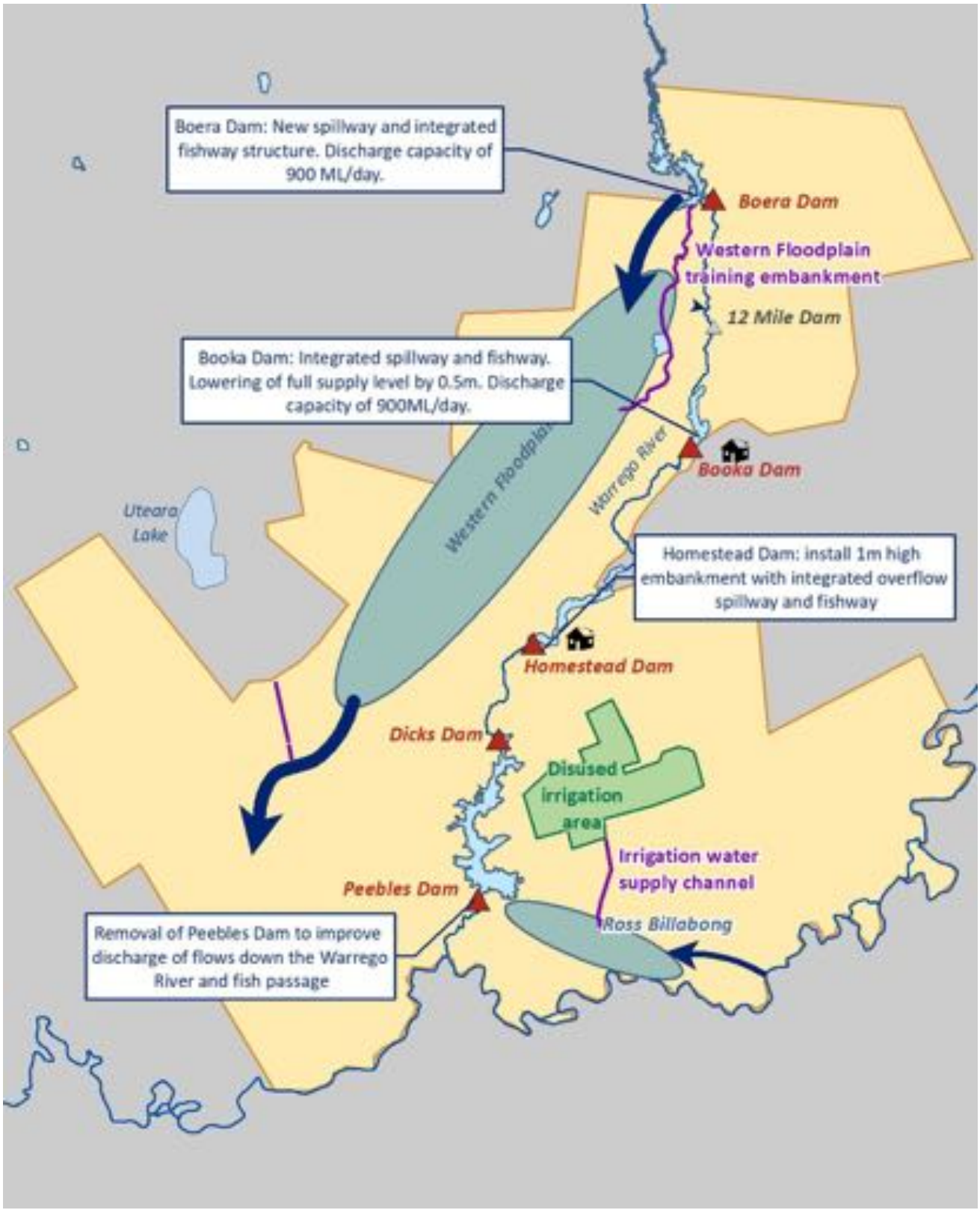

Figure 1 Proposed works

A set of works have been proposed that provide a set of shared compromises to these objectives. The proposed works do not meet the full extent of each objective. However, the works go some way to meeting each objective:

- The works provide for an increase in the discharge of water to the Darling River and the fill and spill operations have been found (through hydrologic modelling) to not adversely impact low flows in the Darling River.
- The change in the flow regime reduces the occurrence of water diversion to the Western Floodplain. However, the pattern of Western Floodplain inundation has been retained and the period between future inundation events retained within the range found to occur under the current arrangements.
- The arrangements provide for fish passage for most species in most flow events. However, fish passage arrangements that have the most reliable performance are likely to adversely impact on cultural values, while those fish passage arrangements that meet cultural outcomes may constrain fish passage outcomes.
- The scale and location of works have been limited to areas that are not likely to contain significant cultural assets. However, some adverse impacts on cultural and historic values will be inevitable.
- The proposed arrangements exceed available budget and finalisation of engagement and approval processes may result in works not being completed within agreed timeframes.

The project has not yet received all necessary approvals. The establishment of a project that meets the project objectives and constraints has been a challenge. The compromises present in the proposed works, presents a challenge to project stakeholders. The extent to which the Project compromises are accepted by all stakeholders including adjoining landholders, park managers, regulators and funding bodies will dictate the implementation and success of the project.

References

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