ROUS
COUNTY COUNCIL

BULK WATER SUPPLY | WEED BIOSECURITY | FLOOD MITIGATION

Bora Creek
Active Floodgate Management Plan

2019-2022

Management Plan operational summary

Bora Creek is located south of Coraki in Northern New South Wales. It is a left-bank tributary of Bungawalbyn Creek. Bora Creek is a natural waterway, 2kms long, and is surrounded by agricultural land used for cattle grazing and some tea tree cropping. A single floodgate structure is located within an artificial levee constructed across the creek mouth.

The Bora Creek floodgate has been actively managed since 2001, and has been predominately open since that time, except during floods.

Opening the floodgate to allow tidal exchange, during non-flood periods, has improved the environmental condition of the creek. Water quality in Bora Creek has improved and attempts have been made by landowners, the former Richmond River County Council, Far North Coast Weeds and Richmond Valley Council to manage aquatic weeds in the creek.

Although active floodgate management has improved the environmental condition of the creek, it is important to recognise flood mitigation continues to impact upon its natural functions and condition. Likewise, it is important to acknowledge that active floodgate management does not resolve all water quality issues in the creek, e.g. tidal exchange does not reduce deoxygenation (blackwater) events after flooding.

While acknowledging the limitations, the environmental impact of the Bora Creek floodgate has been reduced through its active management. This Plan outlines how management will continue into the future and suggests additional management strategies to improve the creek's environmental condition.

Environmental goals and strategies

The goals and strategies listed here specifically relate to Bora Creek and identify the desired outcome from actively managing the floodgate. Goals are listed in priority order.

Goals

1. Improve dissolved oxygen and nutrient levels within the creek.
2. Create an unfavourable environment for aquatic weeds.
3. Allow for fish passage upstream of the floodgate.

Strategies

Continue with current opening strategy for the creek's floodgate.

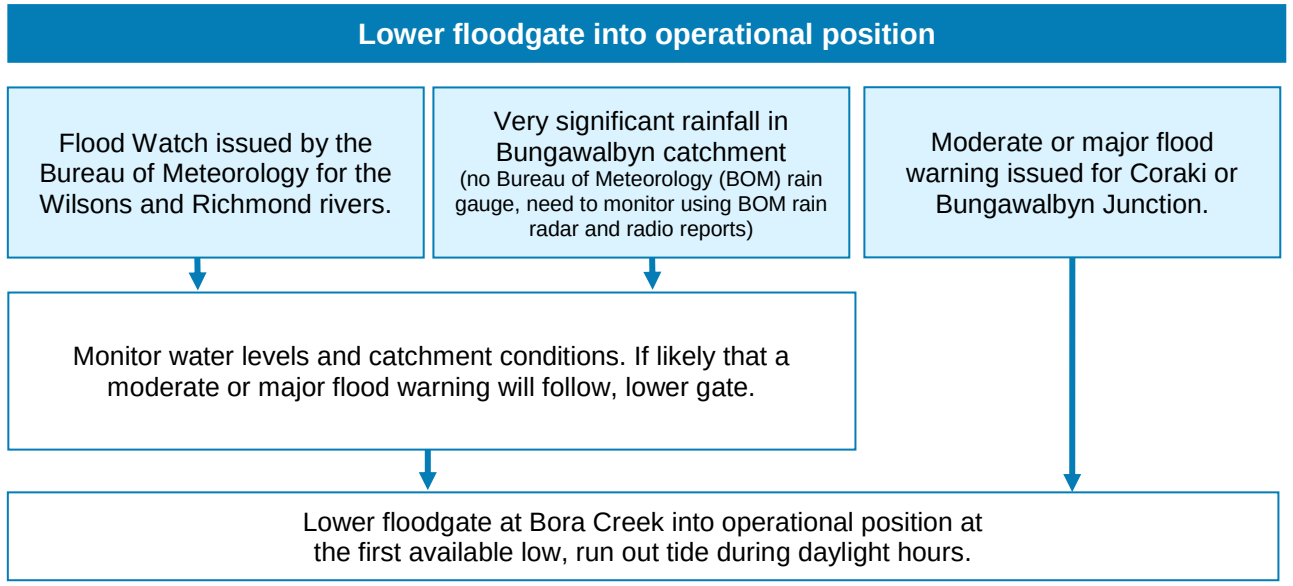
Facilitate the adoption of best management practices and additional remediation strategies to further enhance the environmental condition of the creek.

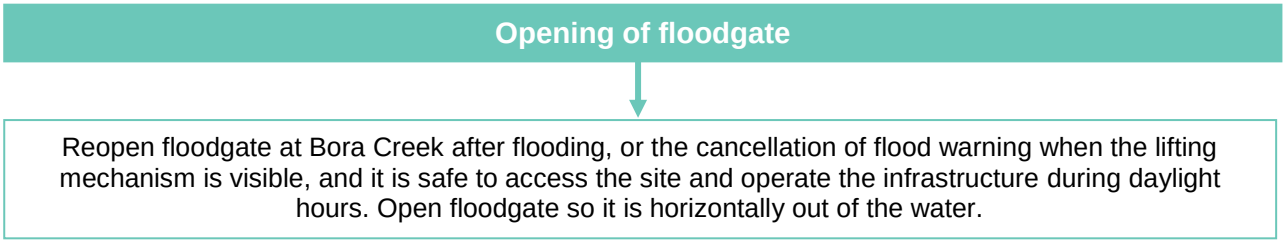
Opening strategy for floodgates

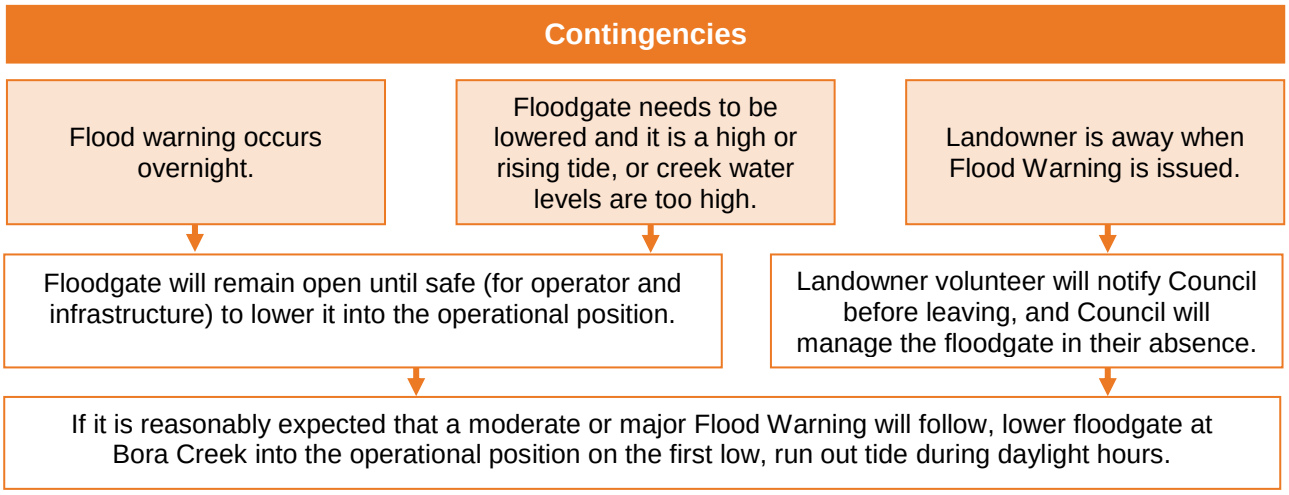
Currently, the floodgate is opened with a winch and fixed with a cable so it is horizontally out of the water. This allows for the floodgate to be opened fully for maximum tidal exchange. The floodgate is open all year, and only lowered into an operational position before flood events to protect upstream areas from riverine inundation. The operational position is when the floodgate hangs free to allow water from upstream to discharge on low tide or prevent river flooding from moving upstream, depending on water levels. This is the optimal strategy for the existing floodgate structure and no improvement can be suggested at this time for future management of it.

The current opening strategy has had a key role in improving the environmental condition of the creek and has proven to have had no adverse impact on upstream areas.

The floodgate will be opened and lowered into the operational position, in accordance with the details below by the nominated landowner volunteer. Council and the landowner volunteer acknowledge there are many variables during flood events and will be guided by the details below. This Plan will not restrict Council from taking emergency actions outside of those listed, taking into consideration safe work procedures.







- If the nominated landowner volunteer requires assistance with the floodgate, or any associated infrastructure, they are to contact Council.
- Council are to be notified by either phone or email within 24 hours if the floodgate is opened or closed for any reason other than what is outlined above.
- If Council has not been notified of any action outside of what is outlined above, they will return the floodgate to the agreed upon state and aperture (open or closed) for the current conditions.
- All notifications should be directed to Council Reception on 6623 3800 or council@rous.nsw.gov.au

Rous County Council contact details

Rous County Council
PO Box 230, Lismore NSW 2480
218-232 Molesworth Street, Lismore NSW 2480

(02) 6623 3800
council@rous.nsw.gov.au
www.rous.nsw.gov.au

Authorisation

This Plan has been endorsed by Council and the landowners within the immediate catchment, whose land is influenced by the management of floodgates.

Landowners have signed a letter of endorsement stating they understand the management strategy for the floodgate, including the triggers for opening and lowering into the operational position.

The nominated landowner volunteer has agreed to operate the floodgate on behalf of Council, as outlined in this Active Floodgate Management Plan and in accordance with the Workplace Health and Safety advice and directions provided to them.

Disclaimer and copyright

Version control

Version	Description	By	Date
0.1	Draft developed before landowner consultation	Chrisy Clay	5/3/2019
0.2	Final draft incorporating landowner feedback	Chrisy Clay	9/4/2019
1.0	Final version – issued to landowners	Brenda Ford	3/05/2109

Rous County Council File 2547.1/17

Contents

1. Overview

Many coastal floodplains in New South Wales have been extensively modified by networks of constructed drains, altered water courses and floodgates. These are designed to mitigate the impacts of floods and large rainfall events.

Constructed drains reduce inundation after flooding and floodgates prevent flood waters and tidal brackish water from inundating low areas of the floodplain. This in many cases has converted prior wetlands and low-lying floodplain areas into dryland farming areas. While these developments have enhanced rural settlement and agricultural industries, they have also caused unintended adverse impacts to fisheries, the ecology of estuaries and downstream water users.

Rous County Council ('Council') is the Flood Mitigation Authority operating across the local government areas of Ballina, Lismore and Richmond Valley. Council is responsible for the construction, replacement and routine maintenance of flood mitigation infrastructure, including floodgates and some pipes, levees, rural drains and canals. Council's natural resource management function relates to the environmental consequence resulting from the operation of this infrastructure. Council has the responsibility to reduce the environmental impact of these floodgates and drainage systems, while retaining their benefits for flood mitigation.

The flood mitigation directive that Council operates under in the *Local Government Act 1993* is *'Prevent and mitigate menace to the safety of life or property from floods and natural resource management issues arising therefrom'.*

Purpose of a Floodgate Management Plan

Council has an Active Floodgate Management Plan ('the Plan') for each of its floodgates that are actively managed. Active management is the opening of floodgates during non-flood periods when the floodgate is otherwise operating passively. Opening floodgates and allowing tidal exchange can reduce their environmental impact by improving water quality and enhancing aquatic habitat and fish passage.

These Plans document and communicate:

- how active management can assist in reducing the environmental impact of the floodgate,
- a strategy for how that will be monitored and achieved,
- appropriate and consistent strategy for opening the floodgate and returning it to the operational position or state and by whom,
- safe operating procedures for volunteers and Council staff,
- how adverse effects on current land use will be identified and prevented, and
- additional management strategies for the drainage system that would further reduce the environmental impact of flood mitigation.

Each Plan is tailored for the individual floodgate, considering its location, purpose and function.

Guiding principles for management

- Rous County Council is the Flood Mitigation Authority, and acts in consultation with stakeholders on the management of its infrastructure.
- The primary function of Council's infrastructure is for flood mitigation.
- The intention of active floodgate management is to reduce environmental impact without causing adverse effect on current land use.
- All landowners behind the floodgate whose property may be impacted will be invited to participate in reviewing and updating the Plan and will be sent a final version of the Plan for their records. Where property ownership changes, the new landowner will be involved at the time the Plan is reviewed unless their location and role is critical to the management strategy.
- Active floodgate management is a cooperative exercise between Council, as the Flood Mitigation Authority, and the surrounding landowners. Council appreciates landowners' continued support of this important activity.

Stakeholder involvement

This Active Floodgate Management Plan is a formal agreement between Rous County Council and landowners on how the identified floodgate will operate. The Plan has been developed in consultation with landowners whose property may be impacted from the floodgate's operation.

Rous County Council seeks the input and support of other stakeholders for their Active Floodgate Management program and its delivery.

Organisation	Role
Rous County Council	Owns, develops and uses individual Active Floodgate Management Plans.
Relevant landowners	Endorses and uses individual Active Floodgate Management Plans.
Lismore City Council Ballina Shire Council Richmond Valley Council	Supports active floodgate management and provides input on general program where relevant.
NSW Department of Primary Industries	Supports active floodgate management and provides input on general program where relevant. Regulatory role under *Fisheries Management Act 1994*

Plan review frequency

The Plan will be formally reviewed every three years (from the date of adoption) and the effectiveness of the outlined strategy assessed.

Feedback on the Plan and active floodgate management matters

Feedback and comments should be referred to Council by telephone on (02) 6623 3800, or by email at: council@rous.nsw.gov.au

2. Bora Creek

Asset number and description

A reference in this section to ‘asset number’ is to a unique reference that Council has assigned to the specified asset.

Asset number 1980 – Bora Creek floodgate

- One, 1800mm round style floodgate, operated with a horizontal lifting gear and winch

Asset number 1975 – Upper Bora Creek floodgates

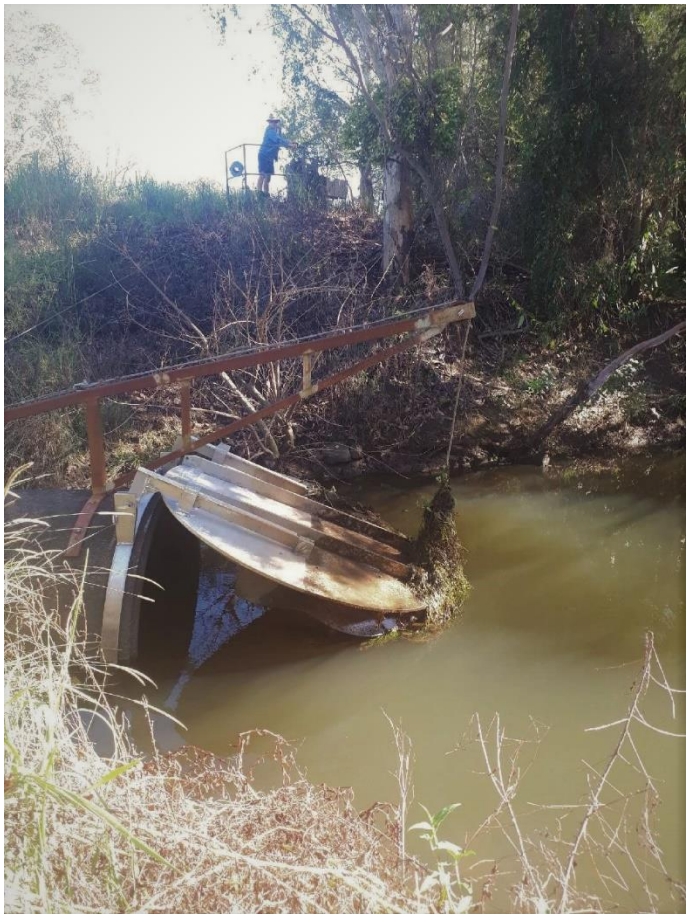
- Two, 900mm round style floodgates

Asset No.	Description	Number
1980-031	Aluminium floodgate (1800mm)	1
1980-035	Steel Lifting gear	1
1980-100	Pipe	1
6600-410	Bungawalbyn West Levee	1
1975-031	Aluminium floodgate (900mm)	2

Aerial photograph of asset location and images of asset

1: Bora Creek locality map.

2: Bora Creek floodgate and lifting gear in operational position.



3: Bora Creek floodgate open for tidal exchange.

4: Bora Creek winch.

Drainage system characteristics

Location in estuary.	Mid-upper estuary.
Location in landscape.	Floodplain and riverine natural levee.
Land elevation.	1.9m – 3.5m AHD.
Land use.	Agriculture: cattle grazing and some tea tree cropping.
Vegetation.	Grasses and pastures. Near continuous riparian zone of native and introduced species. Small-leaved myrtle (*Gossia fragrantissima*), which is listed as Endangered under the Federal *Environment Protection and Biodiversity Conservation Act 1999* has been previously found in the Creek's riparian zone. (RRCC, 2009)
Salinity levels and estuary dilution capacity.	Low.
Tidal range.	Low.
Land elevation adjacent to drains.	Very high, natural creek levee banks.
Soil type.	Alluvial clays and some sands. (RRCC, 2009)
Acid sulfate soils.	Very low risk.
Hydraulic conductivity.	Unknown.
Acid export.	Thought to be very low or non-existent. (RRCC, 2009)
Water quality issues.	Stagnant water, low in dissolved oxygen. Eutrophication from nutrients. Can discharge deoxygenated water (blackwater) after flooding (RRCC, 2009).

Water quality

Since installation, the floodgate on Bora Creek has prevented tidal flow and exchange with Bungawalbyn Creek and as a result water quality within the creek has deteriorated.

Very little water quality monitoring has occurred at Bora Creek, and it's not known how water quality varies under different weather conditions. Previous spot water quality readings and visual observations have identified a number of likely issues.

Before the floodgate was actively managed, the creek was observed to usually be stagnant. The creek would regularly become enriched with nutrients that would produce excessive growth of plants and algae (RRCC, 2009). This process is called eutrophication and often depletes dissolved oxygen from the water.

Council records include an observation of deoxygenated water (blackwater) discharging from the creek after flooding (RRCC, 2009). However, acid discharge from acid sulfate soils is very low or non-existent at Bora Creek (RRCC, 2009).

Since the floodgate has been actively managed water quality in Bora Creek has improved. Tidal exchange has reduced stagnant conditions, lessening the accumulation of nutrients and improving dissolved oxygen levels.

Although active floodgate management has improved the environmental condition of the creek, it is important to recognise flood mitigation continues to impact upon its natural functions and condition. Likewise, it is important to acknowledge that active floodgate management does not resolve all water quality issues in the creek, e.g. tidal exchange does not reduce deoxygenation (blackwater) events after flooding.

Aquatic habitat values

Being a natural waterway, Bora Creek would have provided aquatic habitat prior the floodgate being installed. Installing a floodgate on the mouth of the creek has reduced water quality but also altered the habitat within the creek.

The floodgate has restricted water flow, creating a stagnant environment with excessive nutrients, which has created favourable conditions for very large infestations of aquatic weeds like high priority weed Water lettuce (*Pistia stratiotes*) and other environmental weeds like Water hyacinth (*Eichhornia crassipes*) and Salvinia (*Salvinia molesta*) to grow (RRCC, 2009).

Previous infestations of aquatic weeds have been so severe that they covered the majority of the waterway (see photos below). In around 2006, the former Richmond River County Council and Far North Coast Weeds (with financial assistance from Northern Rivers Catchment Management Authority) used a weed harvester to mechanically remove the weeds and open up the channel. Since then tidal flushing and Council's spraying program has managed aquatic weeds within the system.

5: Bora Creek almost completely covered with aquatic weeds in around 2006.

6: The weed harvester used to mechanically remove the weeds and open the creek channel.

7: Bora Creek after mechanical removal of weeds in 2006.

8: Bora Creek looking upstream from the floodgate 13 years on from mechanical cleaning (2018).

Landowners also suggest that the creek floor has risen over the past 40 years through sedimentation, lack of adequate scouring following rainfall / flood events and restricted tidal exchange (RRCC, 2009).

Despite the changes made to Bora Creek through flood mitigation, it retains considerable biodiversity value and provides habitat for aquatic and terrestrial flora and fauna. Bora Creek is one of the few creeks on the floodplain with near continuous riparian zone of reasonable condition, which consists of regrowth that began re-establishing in the 1920s (RRCC, 2009). Trees found along the creek include Foambark (*Jagera pseudorhus*), Red kamala (*Mallotus philippensis*), and the endangered Small-leaved myrtle (*Gossia fragrantissima*), as well as Camphor laurel (*Cinnamomum camphora*) (RRCC, 2009). Broglas (*Grus rubicunda*), which are listed as Vulnerable under the *Biodiversity Conservation Act 2016*, have also been seen along the creek.

A fish survey was conducted at Bora Creek as part of the NSW DPI Fisheries Floodgate Project in 2004 (NSW DPI, 2004). Twelve different species of fish were caught in the creek including: Australian Bass (*Macquaria novemaculeata*), Freshwater Catfish (*Tandanus tandanus*) and Longfinned Eels (*Anguilla reinhardtii*) (NSW DPI, 2004). The survey commented that active management of the floodgate at Bora Creek had increased the species diversity and abundance within the creek, compared to nearby systems that did not have tidal flow (NSW DPI, 2004). A Freshwater Pipefish (*Hippichthys heptagonus)* was also recorded, which is significant as the Clarence River is the most southerly point of their habitat range, and they are a protected species in NSW (NSW DPI, 2004).

9: A pair of Brolgas seen at Bora Creek.

Whole of system management

If improvements to water quality and biodiversity (beyond what has already been achieved) are desired, additional works or changes will be required within the Bora Creek system. The following table outlines what management changes have already been made and what could be explored in the future. A cooperative approach that balances the needs of current land use and environmental benefits is promoted by Council. Bora Creek has benefitted from the willingness of landowners to trial and adopt different management strategies to improve the creek and Council acknowledges their efforts.

Council provides this information for landowners and other organisations that are responsible for promoting and facilitating natural resource management on private freehold land. This information identifies a range of relevant strategies for improving water quality, aquatic habitat and biodiversity based on the characteristics of the system and are consistent with current best management practice.

On the Bora Creek system, Council has management responsibility for the main floodgate structure and associated infrastructure, as well as two secondary floodgates in the upper reaches. Under all management strategies outlined below Council maintains its flood mitigation service.

All drains and other flood mitigation structures in the system are owned by others.

Management strategy	Works	Undertaken	Location	Recommendation	Responsibility
Increase water exchange and flush between Bora and Bungawalbyn Creek.	Actively manage floodgate.	Yes, by RRCC in 2001.	Creek mouth.	Continue with current management strategy.	Private landowners. Rous County Council.
	Investigate potential benefit of larger floodgates to enhance fish passage and water quality, while still providing flood mitigation service.	No.	Creek mouth.	Explore possibility with landowners and Council. Assess cost versus benefit.	Rous County Council.
	Explore role and function of historical levees that cross the upper creek.	No.	Upper section of creek on north-west arm and south-west arm.	Explore possibility with landowners. Recommendation for future management.	Private landowners. Local Government: • Richmond Valley Council. • Rous County Council. State Government: • North Coast Local Land Services. • Department of Primary Industries. • Office of Environment and Heritage. • Marine Estate Management Authority.
Detailed site assessment and hydrologic options study.	Obtain information on the system's soils, groundwater, potential for acid sulfate soils, hydrology, drainage, flooding patterns and vegetation to identify any local water quality issues and provide guidance on how they could be addressed without impacting upon current land use.	No.	Whole system.	Explore possibility with landowners and Council. Assess cost versus benefit.	Rous County Council. Private landowners.
Enhance riparian habitat.	Weed control and strategic revegetation along creek banks.	Yes, 2002 by Wetland Care Australia under Rivers Alive project.	Vegetation rehabilitation and fencing on both sides of creek bank.		Private landowners. Local Government: • Richmond Valley Council. • Rous County Council. State Government: • North Coast Local Land Services. • Department of Primary Industries. • Office of Environment and Heritage. • Marine Estate Management Authority.
		Yes, 2004 by Wetland Care Australia under Fish Unlimited project (funding assistance from Envirofund).	Vegetation rehabilitation and fencing on a further 3km.		
		On-going into the future.	Along creek banks and around floodgate on Bungawalbyn Creek.	Review previous works with landowners, identify further actions and regular maintenance routine.	

Management strategy	Works	Undertaken	Location	Recommendation	Responsibility
Control aquatic weeds.	Aquatic weed harvester used to restore open water in the lower half of the creek.	Yes, ~2006 FNCW & RRCC (funding assistance from NRCMA.	Main channel of creek.	Tidal flushing and herbicide treatment has since kept channel open.	Private landowners. Local Government: • Richmond Valley Council. • Rous County Council.
	On-going maintenance with herbicides.	Yes, by RCC with financial support from Richmond Valley Council.	Main channel of creek.	Under current financial arrangements, continue with regular aquatic weed control program.	Private landowners. Local Government: • Richmond Valley Council. • Rous County Council.
Management Plan.	Collation of site information, identification of management options.	Yes, 2009 by RRCC and FNCW (funding assistance from NRCMA and Natural Heritage Trust).	Whole system.	Review and update if any further detailed assessments are undertaken.	Private landowners. Local Government: • Richmond Valley Council. • Rous County Council. State Government: • North Coast Local Land Services. • Department of Primary Industries. • Office of Environment and Heritage. • Marine Estate Management Authority.
Water quality monitoring.	Monitoring program to identify any water quality issues and confirm benefits of managing floodgate.	No, only spot samples and observations.	Creek mouth.	Program developed to determine success of Active Floodgate Management Plan. Identify resources required and assess cost versus benefit.	Rous County Council.

3. Risks of actively managing floodgates

Work Health and Safety

- The floodgate is fitted with a winch and large forces can be involved in winch and cable systems.
- The floodgate should only be opened on a low or falling tide. This will reduce the risk of the wire rope or chain breaking and the floodgate bowing.
- The floodgate is opened and lowered by nominated landowner volunteer or Council operator, who should consult and follow the approved Safe Work Procedure and Floodgate Fact Sheet relevant for the activity and undertake their own risk assessment before operating the floodgate.
- Operating the floodgate during and after heavy rain or flooding can require working in wet and slippery conditions. Safe access to the site should be assessed after events.
- The floodgate is only to be operated during daylight hours.

Environmental / Agricultural

Flooding

There is a risk of flooding to land upstream of the floodgate, if it is not lowered to its operational position before a flood arrives and water from the Bungawalbyn Creek backs up the system.

Increased salt levels in creek

Salinity levels are low in Bungawalbyn Creek, even during droughts and periods of low flows. There is no risk posed by tidal water overtopping banks in low-lying areas or of lateral salt seepage into the banks.

4. Monitoring, evaluation and reporting

Council will explore whether water quality monitoring can occur at Bora Creek. However, if resources are not available for monitoring, scientific principles and visual observations support the assumptions made that implementing the outlined management strategy will improve water quality.

An evaluation of the success of the Management Plan will be made at the three-yearly review, and a report provided by Council to landowners and relevant stakeholders.

5. Historical context

History of when and why asset was installed

During the 1960s, as part of a broader flood mitigation strategy, a levee was constructed along the western bank of Bungwalbyn Creek and across the mouth of Bora Creek. A floodgated pipe was then installed at the mouth of Bora Creek to mitigate the impacts of flooding from Bungawalbyn Creek on agricultural lands and regulate tidal flows (RRCC, 2009).

Private drainage history

Historically two blocks were constructed in the upper arms of the creek to prevent flooding upstream.

During the 1920s, a levee was constructed on the north-west arm approximately 1km from the creek's mouth to prevent flooding from the Haughwood area, inundating the upper Bora Creek catchment and to drain lands behind the levee. It is not known who constructed the levee.

To connect the upper and lower sections of the creek a 1500mm pipe with floodgate was installed in the levee where the creek intersected (RRCC, 2009). In 2009, Council recorded that the pipe had collapsed, and the floodgate dislodged, allowing only a minimal amount of flow through the pipe in either direction. The suggestion at the time was to replace the pipe and a modified floodgate be installed, to allow tidal flushing. During a site visit in 2018 the pipe could not be seen in the levee.

10: Historical levee on north-west upper arm of creek.

A second levee, with a two-pipe, concrete culvert, exists on the south-west arm approximately 1.5km from the creek's mouth. It is not known who constructed the levee and installed the structure, or when that occurred. Previously, two floodgates, possibly wooden, were located on the downstream face, seemingly facilitating drainage from the Haughwood Road area and preventing ingress of waters from the creek further upstream. These floodgates no longer exist, and two floodgates that Council manages are located upstream.

11: Historic culvert and levee on south-west upper arm of creek, looking upstream.

12: Historic culvert and levee on south-west upper arm of creek, looking downstream.

History of active floodgate management

The floodgate on Bora Creek has been actively managed since 2001 by a landowner volunteer. The floodgate has been predominately open since that time, except during floods.

When the first Active Floodgate Management Plan was developed in 2001, two 900mm floodgates were installed by Council above the historic culvert on the south-west arm to address landowner concerns. These floodgates were installed instead of the historic culvert floodgates being replaced. These new floodgates prevent flood water from Bora Creek moving upstream into low-lying areas and facilitates drainage of water off surrounding paddocks.

13: Council managed floodgates (asset number 1975) on upper south-west arm of Bora Creek.

6. References

Richmond River County Council (2009) Creek Rehabilitation Bora Creek. Unpublished Management Plan.

NSW Department of Primary Industries Fisheries (2004) North Coast Floodgate Project. Final report 2002-2004. Unpublished

Appendix: Bora Creek drainage system