REFERRAL OF A PROJECT FOR A DECISION ON THE NEED FOR ASSESSMENT UNDER THE *ENVIRONMENT EFFECTS ACT 1978*

REFERRAL FORM

The *Environment Effects Act 1978* provides that where proposed works may have a significant effect on the environment, either a proponent or a decision-maker may refer these works (or project) to the Minister for Planning for advice as to whether an Environment Effects Statement (EES) is required.

This Referral Form is designed to assist in the provision of relevant information in accordance with the *Ministerial Guidelines for assessment of environmental effects under the Environment Effects Act 1978* (Seventh Edition, 2006). Where a decision-maker is referring a project, they should complete a Referral Form to the best of their ability, recognising that further information may need to be obtained from the proponent.

It will generally be useful for a proponent to discuss the preparation of a Referral with the Department of Planning and Community Development (DPCD) before submitting the Referral.

If a proponent believes that effective measures to address environmental risks are available, sufficient information could be provided in the Referral to substantiate this view. In contrast, if a proponent considers that further detailed environmental studies will be needed as part of project investigations, a more general description of potential effects and possible mitigation measures in the Referral may suffice.

In completing a Referral Form, the following should occur:

- Mark relevant boxes by changing the font colour of the 'cross' to black and provide additional information and explanation where requested.
- As a minimum, a brief response should be provided for each item in the Referral Form, with a more detailed response provided where the item is of particular relevance. Cross-references to sections or pages in supporting documents should also be provided. Information need only be provided once in the Referral Form, although relevant cross-referencing should be included.
- Responses should honestly reflect the potential for adverse environmental effects. A Referral will only be accepted for processing once DPCD is satisfied that it has been completed appropriately.
- Potentially significant effects should be described in sufficient detail for a reasonable conclusion to be drawn on whether the project could pose a significant risk to environmental assets. Responses should include:
    - a brief description of potential changes or risks to environmental assets resulting from the project;
    - available information on the likelihood and significance of such changes;
    - the sources and accuracy of this information, and associated uncertainties.
- Any attachments, maps and supporting reports should be provided in a secure folder with the Referral Form.
- A CD or DVD copy of all documents will be needed, especially if the size of electronic documents may cause email difficulties. **Individual documents should not exceed 2MB.**

- A completed form would normally be between 15 and 30 pages in length. Responses should not be constrained by the size of the text boxes provided. Text boxes should be extended to allow for an appropriate level of detail.
- The form should be completed in MS Word and not handwritten.

The party referring a project should submit a covering letter to the Minister for Planning together with a completed Referral Form, attaching supporting reports and other information that may be relevant. This should be sent to:

Postal address

Minister for Planning
GPO Box 2392
MELBOURNE VIC 3001

Couriers

Minister for Planning
Level 7, 1 Spring Street
MELBOURNE VIC 3001

In addition to the submission of the hardcopy to the Minister, separate submission of an electronic copy of the Referral via email to ees.referrals@dpcd.vic.gov.au is encouraged. This will assist the timely processing of a referral.

PART 1 PROPONENT DETAILS, PROJECT DESCRIPTION & LOCATION

1. Information on proponent and person making Referral

Name of Proponent:	**Goulburn Murray Water**
Authorised person for proponent: **Position:** **Postal address:** **Email address:** **Phone number:** **Facsimile number:**	Dr Ian Rodgers **Connections Project A/Director** **P.O. Box 165, TATURA, 3616** Ian.rodgers@gmwater.com.au
Person who prepared Referral: **Position:** **Organisation:** **Postal address:** **Email address:** **Phone number:** **Facsimile number:**	Scott Morath **Project Manager, Swan Hill Modernisation Project** **Goulburn-Murray Water** **PO Box 165, TATURA, 3616** scottm@g-mwater.com.au **0408026944**
Available industry & environmental expertise: (areas of 'in-house' expertise & consultancy firms engaged for project)	**In house skills and expertise:** ▪ Civil Engineering ▪ Project Management ▪ Environmental Management ▪ System Operation **Consultancies engaged and area engaged for:** **Sinclair Knight Merz** ▪ Project Management ▪ Civil Engineering ▪ Environmental Management **North Central Catchment Management Authority** ▪ Environmental Management **Fluvial Systems** ▪ Hydrology/hydraulics **Ecological Associates** ▪ Vegetation Assessment **Environous** ▪ Aquatic Fauna Assessment **D&G Consulting** ▪ System Operation **URS** ▪ Business Case Development/Options Assessment **SMEC** ▪ Weir structure condition assessment and design **RPS Aquaterra** ▪ Hydrogeology **Seran Consulting** ▪ Environmental Referral advice

2. Project – brief outline

Project title: Swan Hill Modernisation Project (SHMP)

Project location: (describe location with AMG coordinates and attach A4/A3 map(s) showing project site or investigation area, as well as its regional and local context)

The Swan Hill Modernisation Project (SHMP) is located within the Swan Hill Irrigation Region. The Swan Hill Irrigation Region is located within the Torrumbarry Irrigation Area and comprises some 31,480 ha. The Torrumbarry Irrigation Area is one of the six Irrigation Areas that make up the Goulburn-Murray Irrigation District which is managed by Goulburn-Murray Water (G-MW).

The project area extends from Fish Point Weir (located approximately 35 kilometres south-east of Swan Hill), along the Little Murray River to the Little Murray Weir (approximately 13.5 kilometres south-east of Swan Hill). From the Little Murray Weir, the project follows the No. 9 irrigation Channel north through the Swan Hill township and extends north-west to the south end of the Woorinen pressurised pipeline (approximately 10 kilometres north west of Swan Hill).

Attachment 1 shows the location of the key components of the project, including where the project area sits within the broader Goulburn-Murray Irrigation District.

Short project description (few sentences)**:**

The Swan Hill Modernisation Project (SHMP) proposes to upgrade the key irrigation infrastructure in the Swan Hill Irrigation Region resulting in an efficient, state of the art irrigation system. The SHMP reconfigures the irrigation system, and modifies its operation, from Fish Point Weir through to the Tyntynder Flats area in order to match changing water demand while enhancing the environmental values of the Little Murray River and reducing public safety risks through the City of Swan Hill.

There are four primary construction components to the program of physical works:

C1) Installation of automated gate and fish passage at Fish Point Weir.
C2) Lowering the crest height of the Little Murray Weir Structure, and construction of fish passage and a pump station and landholder connections along the Little Murray River between Fish Point Weir and Little Murray Weir.
C3) Construction of a pump station, and approximately 9.5 kms of pipeline through the City of Swan Hill.
C4) Construction of a pump station and an extension to the Woorinen pressurised pipeline scheme (approximately 8.5 km), North West of Swan Hill.

The key operational change will be the lowering of the Little Murray Weir pool to 67.3m AHD, enabling the re-establishment of the Little Murray River as a functioning anabranch of the Murray River.

3. Project description

Aim/objectives of the project (what is its purpose / intended to achieve?):

The SHMP is one of the "Special Projects" identified in the Stage Two Business Case for the Goulburn-Murray Water (G-MW) Connections Project (formerly the Northern Victoria Irrigation Renewal Project).

The overarching objectives of the SHMP are to:

- Address the structural and operational concerns associated with the Little Murray Weir;
- Align delivery capacity in the No. 9 Channel with the future water delivery share requirements;
- Address the concerns associated with the passage of the open No. 9 Channel through the City of Swan Hill;
- Enhance environmental values in the Little Murray River; and
- Secure long-term water savings through a range of mechanisms.

Background/rationale of project (describe the context / basis for the proposal, eg. for siting):

Context

The Little Murray Weir was constructed in the early 1900's to raise the water level in the Little Murray River such that it could be supplied by gravity via the No 9 channel to Swan Hill and further north and west. The No 9 channel has a design capacity of around 500 ML/d and is currently used to convey 100% of the irrigation water supply to the Swan Hill area. Current and long-term irrigation water demand is 230 ML/d, less than one third of the No 9 channel capacity.

The main components of the current infrastructure are:

- Fish Point Weir
- Little Murray Weir
- No 6/7 Channel (intake)
- No 9 channel (off-take)
- Woorinen pressurised pipeline system
- No 10 channel (off-take)
- 13/9 channel (off-take)

These are explained in more detail below.

Fish Point Weir

Fish Point Weir is located at the upper end of the Little Murray River, immediately downstream of the Loddon River confluence (see **Attachment 2**). Fish Point Weir consists of two weir structures, a drop bar structure that spans the Little Murray River and a drop door structure which is a manually operated undershot gate (see **Attachment 8)**. No changes are proposed to the drop bar structure as part of the SHMP.

The purpose of the structure is to isolate the Loddon River and historically saline Barr Creek flows from the Little Murray Weir pool. The current operating level of the Fish Point Weir is 68.41 m AHD. Historically, the weir has been closed about 85-95 per cent of the time. In times of flood, the weirs are overtopped. When flows at Torrumbarry Weir reach 12,000 ML/d Fish Point Weir is opened and flows are allowed to pass through the Little Murray River.

As a result of improved environmental flows in the Murray River, improved irrigation management in the Barr Creek catchment and infrastructure improvements to the Barr Creek salt interception scheme it is expected that the historic requirement to keep Fish Point Weir closed for instream salinity purposes will be significantly reduced.

Little Murray Weir

The Little Murray Weir is located on the Little Murray River approximately 13.5km south east of the township of Swan Hill. It is a concrete structure, approximately 110 m long and has drop bars which are manually operated to regulate water flow and six large gates, two of which are automated (see **Attachment 9**). The primary function of the weir is to hold water in the Little Murray River for diversion into the No. 9 Channel. The original design capacity of the offtake for the No. 9 Channel at

the Little Murray Weir was 500 ML/d however, given the reduction in demands the four day average peak flow is around 230 ML/d.

Since the construction of the weir, over 100 years ago, it has had major repairs carried out on a number of occasions over its lifetime. The structure was significantly modified in 1928 and in the 1940s after flood damage. The original butterfly doors on the weir were replaced by drop bars in the 1980s. During 1995/1996 the weir almost failed after a 6 metre deep scour-hole downstream of the weir extended under the apron. Tests revealed that the apron was undermined by up to 30%. Repairs were carried out in 1997 to stabilise the structure.

A structural assessment of the weir was completed in 2012, indicating that:

- Ongoing deterioration of the weir is occurring;
- The weir is expected to have 10 to 20 years of life remaining. This could be extended to up to 25 years should the weir be lowered and a stringent surveillance and maintenance program implemented; and
- The structure has major occupational, health and safety issues that need to be addressed as a matter of priority.

No 6/7 Channel
The 6/7 Channel enters the Little Murray Weir pool approximately 30 km upstream of Little Murray Weir. It supplies customers on the Little Murray River as well as customers on the No. 9 Channel.

No 9 Channel
The No 9 channel commences at the Little Murray Weir and terminates at Tyntynder Homestead near the Murray River. It consists of around 23 km of main channel and a similar length of secondary and tertiary spur channel. The channel supplies some 400 irrigation and Domestic and Stock (D&S) customers including the Tyntynder Flats area and the part of the Mallee fringe horticultural area that was not incorporated into the Woorinen pipeline scheme. The Channel passes through the City of Swan Hill as an open waterway.

The No 9 channel is at the extreme periphery of a long and complex gravity supply system and has historically been subject to constraints on supply capacity. As a consequence, in more recent times, initiatives have been undertaken to improve the supply system, including construction of:

- The No 10 channel pump station on the Murray River just north of Swan Hill in the 1970s. This provided an independent supply to the No 10 channel which was then disconnected from the No 9 channel.
- The Woorinen pipeline scheme in the early 2000s. This scheme replaced the lower end of the No 9 channel with a pressurised pipeline supplied directly from the Murray River. As a result of the Woorinen scheme the No 9 channel was terminated upstream of Woorinen.
- A pump station at Pental Island in the 1970s to increase the water supply into the Little Murray River, and therefore the No 9 channel, during historic peak demand periods.

Woorinen pressurised pipeline system
The Woorinen pressurised pipeline system was installed in the early 2000s to replace the old concrete lined channel system at the end of the No. 9 system. The pipeline is supplied via a 300ML/d pump station directly off the Murray River approximately 15km north of Swan Hill.

No 10 Channel
The No. 10 Channel system, which supplies the Tyntynder Flats area to the north of the Rural City of Swan Hill, is supplied from the No. 10 Pump Station on the Murray River just north of the city.

13/9 Channel
The 13/9 channel branches off the No 9 channel approximately 4 km's north of Swan Hill and runs north terminating near the Murray River approximately 15 km from Swan Hill.

Current operation

Since the installation of the Little Murray Weir, over 100 years ago, the Little Murray River has been regulated for irrigation. This has resulted in the weir pool being held at a relatively constant level

through the regulated season (August to May) and dewatered during the non-irrigation season (May to August). During the regulated season (August to May) water that enters the weir pool generally comes via the 6/7 Channel, except during high Murray River flows greater than 12,000ML/d and flood events.

Water is delivered to the Little Murray River via the 6/7 channel. This water is sourced from the Murray River at Torrumbarry. It travels to the 6/7 channel as follows:

- From the Loddon River and Pyramid Creek via a number of the Kerang Lakes including First, Middle and Third Reedy Lakes
- Third Reedy Lake supplies the No. 7 Channel
- The No 7 channel flows to Little Lake Charm, Racecourse and Kangaroo Lakes
- Water is diverted from the No 7 Channel to the 6/7 channel
- The 6/7 channel discharges into the Little Murray River.

Water can also be pumped from the Murray River to the Little Murray River via the Pental Island Pumps, although the pumps have been operated very infrequently over the last 10 years. There is no plan to decommission the Pental Island Pumps.

Attachment 7 shows a schematic of the current configuration of the Torrumbarry Irrigation Area.

Project rationale

Water demand in the project area has reduced over recent times. This impacts on the commercial viability of the No 9 channel system and Little Murray Weir, as a result of:

- Under-utilised infrastructure
- Increased cost basis of the infrastructure
- Excess water losses

Considering the irrigation system holistically, the sustainability of the irrigation system is further influenced by:

- Environmental status of the Little Murray River.
- Public safety issues through Swan Hill

In addition, if the SHMP is implemented, there are potential cost savings for the Victorian Mid-Murray Storages Project through avoided infrastructure.

Reduced water demand

Since the 1980s, there has been significant change in land use in the Tyntynder Flats area. The area's once-thriving dairy industry has been significantly reduced via permanent outward water trade and land conversion from irrigated farms to hobby farms and rural residential blocks. The decline in irrigation has been attributed to the small uneconomic landholding sizes in Tyntynder and the proximity of Swan Hill, making the area attractive to hobby farms.

Results of Farm Irrigation Assessments, completed as part of the G-MW Connections program (formally known as NVIRP), have indicated that many landowners in the area have a preference to retire from irrigation. The implementation of the G-MW Connections program in the Tyntynder Flats area and further outward water trade is expected to result in an additional significant reduction in irrigation demand on the No 9 channel below 2009 levels.

Under-utilised Infrastructure

The No. 9 channel and the No. 10 pump station now have significant excess capacity as a result of:

- reduction in water demand from Tyntynder
- reduction in water demand as a result of the Woorinen Pipeline scheme.

A review of water usage on the channel in 2009 found that the 4 day average peak flow on the No 9 channel was 230 ML/d, less than half of its capacity.

Increased cost basis of the infrastructure

The decline in demand increases the cost burden of maintaining the No 9 channel system and the

Little Murray Weir across a shrinking irrigator base. The major cost issues for G-MW customers include:

- Pending replacement of road bridges and subways that cross the No. 9 Channel within the City of Swan Hill with a combined replacement cost of in excess of $1.2 million;
- Replacement of Little Murray Weir;
- Pending renewal of the No 10 pump station of which the financing is problematic given the fall in irrigation demand on the No 10 channel.

Excess Water Losses

Reduced demand also impacts on the water supply efficiency of the system with fixed losses in the No 9 channel and Little Murray Weir pool remaining constant even as demand falls.

It is estimated that the implementation of the Swan Hill Modernisation project will save up to 2,360 ML/year of water. Table 1 provides a summary of annual water savings generated by the Swan Hill Modernisation Project.

Table 1 – Summary of annual water savings generated by the Swan Hill Modernisation Project

Source	Savings (ML/year)
Lowering of the Little Murray Weir pool (evaporative losses)	490
Decommissioning of the No. 9 Channel through Swan Hill – 9.6 km of backbone and spurs rationalised	1140
Reduced conveyance losses in the southern No. 9 Channel section (allowing for additional losses associated with the proposed link channel)	160
Decommissioning of 6.6 km of backbone and spur channel along the No. 9 Channel west of 13/9 Channel towards Woorinen	580
Total Savings	**2360**

Note – the water savings associated with the decommissioning of the No. 9 Channel and the 13/9 Channel and the reduced conveyance losses are related to the Connections Project however, these components are being funded by the Swan Hill Modernisation Project and therefore the water savings are being claimed by the Swan Hill Modernisation Project.

Note that the operation of the Kerang Lakes won't change as a result of implementing the Swan Hill Modernisation Project. The water savings are achieved solely downstream from where the 6/7 Channel enters the Little Murray River.

Environmental Status – Little Murray River

The current condition of the Little Murray River is poor due to river regulation, over-grazing, and limited instream habitat. The river has been assessed as characteristic of an environment with constant water levels evident by the prolific growth of aquatic vegetation and willows.

Under natural conditions, the hydrology of the Little Murray River would have demonstrated a strong seasonal pattern due to its close connectivity with the Murray River. Low summer flows would have occurred between November and April with the lowest flows over January and February. High winter flows would have generally commenced in May with the highest flows over August to October.

With the operation of the Little Murray Weir as a part of the irrigation supply system and the construction of weirs at both ends, the natural water regime of the Little Murray River has been completely altered. The river currently has its highest flows in summer and lowest flows in winter to accommodate irrigation. During the irrigation season water levels are kept constant at 69.21 m AHD and during the non-irrigation season the weir pool is dewatered.

Given Fish Point Weir is closed most of the time, there is generally no flow from Fish Point Weir down to where the 6/7 channel outfalls into the Little Murray River. This has historically resulted in significant water quality issues such as blue green algal blooms. Water quality issues are also experienced downstream of the Little Murray Weir as the current regulated operation means that

only limited water is passed into the downstream section of the Little Murray River (between the weir and where it returns to the Murray River).

Downstream of the Little Murray Weir, the river is significantly affected by the lack of river flows as a result of the weir. There is no fish passage at either Fish Point Weir or the Little Murray Weir.

As part of the SHMP, installing fish passage structures at both Fish Point Weir and the Little Murray Weir will ensure unimpeded fish passage between the Little Murray River and the Loddon and Murray Rivers.

Public Safety
The City of Swan Hill is located centrally within the project area. The City is a major service centre for the Murray Mallee and the NSW Southern Riverina. It has a population of around 10,000 people and is expected to grow to 13,000 people by 2030.

The No 9 channel currently runs through the centre of the residential area of Swan Hill bordering on high density housing and public facilities. The channel poses a range of public risks including drowning's, vehicles ending up in the channel, flooding claims, seepage claims and damage to public assets.

Victorian Mid-Murray Storages
The Victorian Mid-Murray Storages (VMMS) are used to capture and re-regulate unregulated flows occurring in the Murray which result from the decommissioning of Lake Mokoan in the Broken River basin. As part of the VMMS operation, water from Lake Boga will be released via the Lake Boga outfall into the Little Murray River and further downstream to Murray River water customers.

Currently the Lake Boga Outfall can only discharge to the Little Murray Weir Pool when the weir pool is at a low level. Originally the VMMS proposed to construct an alternative gravity outfall channel to the Little Murray River downstream of the weir pool. The cost of constructing this outfall is significant with current estimates in the order of $6 million. If the SHMP proceeds a new VMMS outfall will not be required as the weir pool will be permanently lowered.

Summary of rationale
Therefore the rationale for the project is to match irrigation infrastructure to the long-term irrigation demand in the area in order to:

- effectively utilise the infrastructure
- manage the cost basis of the infrastructure
- minimise water losses from the operation of the system

while at the same time:

- enhancing the environmental status of the Little Murray River
- reducing public safety issues through the City of Swan Hill
- avoiding the requirement to install additional infrastructure for VMMS operation.

Main components of the project (nature, siting & approx. dimensions; attach A4/A3 plan(s) of site layout if available):

The SHMP consists of a construction and an operational component, as described below.

Construction

The construction component of the SHMP includes:

C1) Installation of automated gate and fish passage at Fish Point Weir. This will involve a construction footprint of approximately 20m x 30m (see **Attachment 12**);

C2) Lowering the crest height of the Little Murray Weir Structure, and construction of fish passage and a pump station. The lowering of the structure will involve a construction footprint of approximately 20m either side of the structure. The construction of fish passage will involve a construction footprint of approximately 15m x 20m and the pump station will involve a construction footprint of approximately 60m x 60m (with a permanent footprint of 15m x 15m). Landholder connections will involve 25 landholders completing a combination of pump

upgrades and pipeline extensions and new pump stations. Existing pump stations will have construction footprint of approximately 15m x 15m and a permanent footprint of 5m x 5m. New pump stations will have a construction footprint of approximately 20m x 20m and a permanent footprint of 5m x 5m (see **Attachment 13**);

C3) Construction of a pump station, and approximately 9.5 kms of pipeline through the City of Swan Hill. The pump station will have a construction footprint of approximately 40m x 40m and permanent footprint of 10m x 10m. The pipeline will have a construction footprint of approximately 20m either side of the channel (contained within the existing G-MW easement) (see **Attachment 14**);

C4) Construction of a pump station and an extension to the Woorinen pressurised pipeline scheme, North West of Swan Hill. The pump station will have a construction footprint of approximately 40m x 40m and permanent footprint of approximately 10m x 10m. The pipeline will be approximately 8.5 kms in length and will have a construction footprint of approximately 20m either side of the channel to be decommissioned (see **Attachment 15**). The option is subject to detailed design.

Items C3) and C4) require the decommissioning of sections of the No. 9 Channel and spur channels. An interconnector channel will be constructed to connect with existing channels in the Tyntynder Flats area. Whilst part of the SHMP package of works, these activities are covered under existing approvals for GM-W connections program (refer to section 5 'Exclusions').

Operation

The reconfigured system, with Little Murray Weir pool lowered to 67.3m AHD, will operate as follows:

O1) Controlled diversion of Murray River flows at Fish Point Weir through the Little Murray River, over the Little Murray Weir and back to the Murray River at Swan Hill.

O2) The pump station at Little Murray Weir will supply water from the Little Murray River to customers on the No 9 Channel from the weir to the southern boundary of Swan Hill.

O3) The pump station and pipeline in the City of Swan Hill will supply water from the Little Murray River to rural and residential customers within the City of Swan Hill.

O4) The pump station and extension to the Woorinen pressurised pipeline scheme will supply water from long-term spare capacity in the Woorinen system to all of the customers on the No 9 channel and its spur channels to the north of Swan Hill and in the Tyntynder Flats area.

Ancillary components of the project (eg. upgraded access roads, new high-pressure gas pipeline; off-site resource processing):

Power upgrades

The existing single phase power lines, which run directly past the site of the pump station that will be built adjacent to the Little Murray River at the No. 9 offtake, will need to be upgraded to three phases and a new transformer required to service approximately 250 kW. Power upgrades are also expected at Fish Point Weir.

Access road upgrade

Access from the Little Murray Weir Road may be needed to be upgraded to allow suitable vehicle access for construction activities including installation of crushed rock roadways and may also require a culvert crossing over the No. 9 Channel to ensure continued access to the landowners on the east side of the channel.

Key construction activities:

- **Automated Gate and Fish Passage Installation at Fish Point Weir – C1**

The construction footprint at Fish Point Weir is approximately 20m x 30m (see **Attachment 12**).

The main construction activities include:

- Removing the existing manual gate, as it is not viable to automate this gate.

- Lowering the sill level and installing a new automated gate at Fish Point Weir and this will enable the controlled diversion of Murray River flows through the Little Murray River and back to the Murray River. The existing sill at the base of the structure will be lowered from 68.4m AHD to 67.8m AHD, a reduction of 600 mm. An automated gate structure will be fitted within the existing concrete structure. Access to the site will be via private property to the south of the site. An excavator will be used to remove materials.

- Constructing a standalone fish passage structure just north of the existing regulator at Fish Point Weir. This will enhance the project's environmental impacts by ensuring unimpeded fish passage between the Little Murray River and the Loddon and Murray Rivers.

The main construction techniques include:

- Fish Point Weir gate automation
    - Construct crushed rock access and parking
    - Construct coffer dam on upstream side of existing structure
    - Removal of existing gate structure
    - Upgrade existing power supply (to be confirmed as part of detailed design)
    - Lowering of existing sill
    - Installation of automated gate and scada controls.
- Fish passage
    - Construction of a coffer dam on upstream side.
    - Excavation and removal of soil for fish passage through bank
    - Construct concrete wet well for fish passage
    - Installation of fish passage.

- **Lowering of the Little Murray Weir Structure, construction of fish passage and No. 9 Pump Station and landholder connections along the Little Murray River between Fish Point Weir and Little Murray Weir – C2**

The construction footprint at the Little Murray Weir will be approximately 20m either side of the structure. The construction of fish passage will involve a construction footprint of approximately 15m x 20m and the pump station will involve a construction footprint of approximately 60m x 60m (see **Attachment 13**).

The supply points (pipeline rather than channel) and delivery mechanism (pump rather than gravity-fed) for a range of customers will change, with no impact to their level of service. Up to 25 landholders will be required to upgrade their existing pump and extend their suction line or construct a new pump station.

The main construction activities include:

- Lowering the crest height of the Little Murray Weir from 69.2m AHD to 67.3m AHD.

- Constructing a new pump station adjacent to the existing No 9 channel off-take. The pump station will be located on Crown Land at Little Murray Weir Road at the No.9 Channel offtake. The concept is based on using up to five pumps to cover a range of flows (15-200 ML/d), see **Attachments 3** and **4**.

- Providing fish passage at the Little Murray Weir. It is envisaged that it will be a standalone structure that runs through the bank on the eastern side of the structure (see **Attachment 13).**

- Up to 25 landholders will require an upgrade to their existing pump and extension of their suction line or a new pump station.

The main construction techniques include.

- Little Murray Weir
    - Form a haulage road on the upstream side of the weir within reach of the weir wall
    - Demolish the existing piers, headwall and deck using an excavator
    - Trim the piers with a concrete saw
    - Cast the concrete sill in situ

- No 9 Pump Station
  - Strip and stockpile topsoil
  - Excavate a concrete wet well structure
  - Excavate within the Little Murray River and Channel No. 9 offtake to ensure adequate supply levels within the wet well
  - Construct an inlet and outlet structure within the existing no 9 Channel bank
  - Upgrade existing power supply and install underground power connection
  - Construct crushed rock access and parking
- Fish passage
  - Construction of a coffer dam on upstream side.
  - Excavation and removal of soil for fish passage through bank
  - Construct concrete wet well for fish passage
  - Installation of fish passage.
- Landholder connections
  - Removal of existing suction lines
  - Extension of suction lines with larger diameter pipe
  - Replacement of foot valves
  - New anchor points
  - Excavation of well for pipeline
  - Installation of meter and switchboard

- **Decommissioning of the No. 9 Channel and spur channels through the City of Swan Hill, pump station and alternative and pipeline supply – C3**

The pump station will have a construction footprint of approximately 40m x 40m. The pipeline will have a construction footprint of approximately 20m either side of the channel (see **Attachment 14**).

The main construction activities include:

- Construction of a pump station (15 ML/d capacity) at Werril St in the south of Swan Hill and a pipeline network to supply rural/residential customers within the City of Swan Hill who are currently supplied from the No 9 channel. The pipeline runs north through Swan Hill following the decommissioned channel easement, see **Attachment 5**.

The main construction techniques include:
- Strip and stockpile topsoil
- Excavate and install a concrete wet well structure
- Construct an inlet structure within the existing no 9 Channel bank
- Construct an underground pipeline in the bed of the decommissioned channel

- **Construction of pump station and alternative pipeline supply from the Woorinen scheme north west of Swan Hill – C4**

The construction footprint for the proposed pump station will be approximately 40m x 40m. The construction footprint for the pipeline will be 20m either side of the existing channel. (see **Attachment 15**).

The main construction activities include:

- Constructing a relift pump station at the lower end of the Woorinen pipeline system and constructing a pipeline to the south east principally through the existing G-MW easement of the No 9 channel and along Road Reserve.

The main construction techniques include:
- Strip and stockpile topsoil
- Excavate a concrete wet well structure
- Excavate pipeline trench
- Construct an underground pipeline in the bed of the decommissioned channel

Key operational activities:
Refer to detailed description (above).

The lowering of the Little Murray Weir pool will result in a changed operational (flow) regime in the Little Murray River.

Fish Point Weir will be able to operate automatically at a range of levels (lowered from 68.4 m AHD to 67.8 AHD). It will remain open for the majority of time to allow flows from the Murray River to pass through the Little Murray River (agreement has been obtained from Department of Environment and Primary Industries (DEPI) for this 'natural' diversion of Murray River water through Fish Point Weir). The weir will only be closed when salinity levels reach unacceptable levels, which given significant operational and structural improvements will only occur occasionally. Overall, this will enable a more natural flow regime to be established in the Little Murray River with consequent environmental and river health benefits. Note that this will not require changes to water entitlements.

A draft Operational Plan has been developed for the Little Murray River. This is based on the proposed reconfigured operation of the system, coupled with the preliminary guidelines for the environmental requirements of the Little Murray River prepared in March 2012 by Environous and Streamline Research (2012).

A draft operational plan has been prepared to provide a clear description of how the system may be operated in future should the SHMP proceed, in particular the purpose of the plan is to:

- Confirm that the modernised system can provide services that are fit for purpose and will be able to meet current and likely future water demands from the system.
- Provide an understanding of future operational arrangements.
- Provide a management tool for system operators.

Key decommissioning activities (if applicable):
Refer to detailed description (above).

The decommissioning activities are excluded from the referral as they are covered under existing approvals. See Section 5.

Is the project an element or stage in a larger project?

☒ No ☒ Yes If yes, please describe: the overall project strategy for delivery of all stages and components; the concept design for the overall project; and the intended scheduling of the design and development of project stages).

While it is being funded under Stage 2 of the Northern Victoria Irrigation Renewal Project (NVIRP), (now Goulburn-Murray Water Connections Project), the SHMP is a "Special Project". The viability of the SHMP is not dependent on the implementation of the G-MW Connections Project.

Is the project related to any other past, current or mooted proposals in the region?

☒ No ☒ Yes If yes, please identify related proposals.

4. Project alternatives

Brief description of key alternatives considered to date (eg. locational, scale or design alternatives. If relevant, attach A4/A3 plans):

The options that have been considered are:

- Do nothing
- Modify Swan Hill Irrigation System, primarily through the lowering of the Little Murray Weir pool (a number of depth scenarios have been considered).

Do nothing
The 'do nothing' option is not an acceptable outcome given the functional life of the existing infrastructure and the need for the necessary efficiency improvements demanded by current and

future operating environments.

Reduced water demand from the Tyntynder area coupled with a reduction in water demand of the Woorinen Pipeline scheme and the construction of the No 10 Pump Station has resulted in the No. 9 Channel having significant excess capacity.

In addition to this, the implementation of the GM-W Connections Program in the Tyntynder Flats area (with many landholders indicating a preference to retire from irrigation) and further outward trade of water is expected to result in an additional reduction in demand on both the No. 9 and No. 10 systems. The decline in demand increases the cost burden of maintaining the No. 9 channel system and the Little Murray Weir across a shrinking irrigator base. The major cost issues include pending replacement of road bridges and subways in Swan Hill (a combined replacement cost of $1.2m), and renewal of the Little Murray Weir (estimated to be in the vicinity of $19m). The weir also has major occupational, health and safety issues that need to be addressed as a matter of priority. There are also major safety issues with an open channel running through an urban centre such as Swan Hill. There have been three drowning's in the channel in the last 30 years.

Reduced demand also impacts on the water supply efficiency of the system with fixed losses in the No. 9 Chanel and the Little Murray Weir pool remaining constant even as demand falls.

The current condition of the Little Murray River is poor due to river regulation, over grazing, and limited instream habitat. With the Little Murray Weir being part of the supply system and the construction of weirs at both ends, the natural water regime of the river has been completely altered. The river will continue to have its highest flows in summer and lowest flows in winter to accommodate irrigation.

Modify Swan Hill Irrigation System
Modification of the Swan Hill Irrigation System was initially identified in a feasibility assessment completed by URS (see **Attachment 16**), which recommended a scenario involving:

- Lowering of the Little Murray structure on the Little Murray River from a crest height of 69.2m AHD to 66.8m AHD and constructing a new pump station adjacent to the weir to pump into the Torrumbarry No. 9 Channel necessitated by the lowered weir level;
- Decommissioning of approximately 9 km of the Torrumbarry No. 9 Channel and spur channels through the City of Swan Hill. Construction of two small pressurised pipeline systems to supply rural/residential customers currently supplied directly from the section of channel to be decommissioned; and
- Removal of 90 ML/d Delivery Share to enable supply downstream of the decommissioned channel to be provided by augmentation of the No 10 Pump Station via a relift station pumping into a 3km pipeline.

The initial hydraulic investigations on this scenario identified that the reduced crest height of 66.8 m AHD at the Little Murray Weir would result in a series of large pools with limited connectivity through parts of the river. The preliminary guidelines for the environmental requirements of the Little Murray River prepared in March 2011 by Environous and Streamline Research (2011) (**Attachment 17**) recommended minimum depth requirements of 300 to 500 mm.

G-MW therefore refined the design to:

- Increase the crest height from 66.8m AHD to 67.3m AHD, based on a detailed assessment of the hydraulics in the Little Murray Weir pool (see **Attachment 18**). This would achieve a minimum depth of 500 mm at the lowest point in the river, ensuring suitable conditions for large bodied fish.
- Lowering Fish Point Weir and keeping it open for the majority of the time to allow water to pass from the Murray River to the Little Murray River, maintaining a flow in the river for the majority of time, including from Fish Point Weir to the 6/7 channel
- Diverting flows from the Murray River into the Little Murray River and back to the Murray River.

These refinements have impacted on the water savings that can be achieved but provide a better

environmental outcome.

In addition, changes were made to the north of the project area to ensure the most effective use of the currently underutilised Woorinen pipeline system. This resulted in the No. 9 channel north of Swan Hill being supplied via the Woorinen pipeline rather than from the No. 10 system.

The referred scenario, based upon the lowering of the Little Murray structure on the Little Murray River from a crest height of 69.2m AHD to 67.3m AHD, is the proposal being taken forward for statutory approvals.

Brief description of key alternatives to be further investigated (if known)**:**
Not applicable.

5. Proposed exclusions

Statement of reasons for the proposed exclusion of any ancillary activities or further project stages from the scope of the project for assessment:

Decommissioning of channels

Associated with the works, but covered under the GM-W Connections approval are:

- Decommissioning of the No. 9 Channel and its spurs through Swan Hill from Werril Street to Karinie Street, a length of 9.6 km, (see **Attachment 5**) where it is replaced by the pipeline – relevant to C3;
- Replacement of the spur channels in the No 9 channel area under the Connections program – relevant to C3; and
- The other decommissioning activities include the decommissioning of the No. 9 Channel and spurs from just north of Karinie Street on the No. 9 to where the No. 9 terminates at the southern end of the Woorinen pipeline system (see **Attachment 6**) – relevant to C4

Road Bridges

The Swan Hill City Council will decommission five road bridges across the No. 9 Channel through the township of Swan Hill. This will include the road bridges at Grey Street, Rutherford Street, McCallum Street and Karinie Street. Once the bridges are decommissioned the roads will be reinstated – relevant to C3.

6. Project implementation

Implementing organisation (ultimately responsible for project, ie. not contractor)**:**

Goulburn-Murray Water

Implementation timeframe:
Construction for the SHMP is proposed to begin in mid-2014. The construction will continue through until mid-2016. The modernised Swan Hill Irrigation Area is expected to be operational by August 2016.

Proposed staging (if applicable):
Staging of the project will be required for the Little Murray River component. This is required to manage potential impacts to aquatic fauna and to ensure that works can be implemented in a manageable way. Below is an indicative staged timing of works:

1) Finalisation of the Environmental Management Plan – Year 1
2) Fencing of key sections of the Little Murray Weir pool – Year 1
3) Habitat reinstatement works within the Little Murray River – Year 1
4) Construction of the No. 9 Pump Station – Year 1
5) Fish Point Weir works – Year 1 & 2
6) Little Murray Weir lowering – Year 3
7) Fish passage installation – Year 3

Note: Any presentation of sustained high Murray River and/or Loddon River flows would potentially impact on these timelines

7. Description of proposed site or area of investigation

Has a preferred site for the project been selected?

☐ No ☒ Yes If no, please describe area for investigation.
If yes, please describe the preferred site in the next items (if practicable).

The project area extends from Fish Point Weir (located approximately 35 kilometres south-east of Swan Hill), along the Little Murray River to the Little Murray Weir (approximately 13.5 kilometres south-east of Swan Hill). From the Little Murray Weir, the project follows the No. 9 irrigation Channel north through the Swan Hill township and extends north-west to the south end of the Woorinen pressurised pipeline (approximately 10 kilometres from Swan Hill). The project area also incorporates the No. 2/2/10 channel and the No. 13/9 channel (which are both located approximately 8 kilometres north of Swan Hill).

General description of preferred site, (including aspects such as topography/landform, soil types/degradation, drainage/ waterways, native/exotic vegetation cover, physical features, built structures, road frontages; attach ground-level photographs of site, as well as A4/A3 aerial/satellite image(s) and/or map(s) of site & surrounds, showing project footprint):

There are four key project areas that make up the Swan Hill Modernisation Project, a description of each of the areas is described below. Note that areas 1 and 2, being Fish Point Weir and Little Murray Weir pool, contain the majority of the environmental values and have been described together.

Area 1 & 2 - Fish Point Weir to Little Murray Weir
The Little Murray River is a major anabranch of the Murray River and flows generally parallel to the Murray River for approximately 60km. It also receives major tributary inputs from the Loddon River upstream of Fish Point Weir. It flows entirely across a flat alluvial plain and is generally wide with steep sloping banks. The Little Murray and Murray Rivers enclose Pental Island.

The Little Murray River leaves the western bank of the Loddon River approximately 7km northwest of Benjeroop in low-lying swampland confined by levee banks. The river meanders north-westwards through open irrigated farmland to Fish Point. The river continues to meander west to the Lake Boga outfall, 2km north of Lake Boga (see **Attachment 1**).

The lower reaches are impounded in the Little Murray Weir and veer northwest, 2km to the east of the Murray Valley Highway. It flows under the Pental Island Road on the southern outskirts of Swan Hill. The Little Murray River enters the Murray River near Goat Island within Swan Hill.

The project area includes the Little Murray River and its adjacent aquatic and semi-aquatic habitat between Little Murray Weir and Fish Point Weir. Aquatic and semi-aquatic habitat includes the riparian corridor as far from the channel as may potentially be affected by a reduction in weir level.

The region consists of a flat to gently undulating landscape on recent, unconsolidated sediments. There is evidence of former stream channels, braided old river meanders and palaeochannels and broad floodplain areas associated with major river systems. The vegetation is a mosaic of Plains Grassy Woodland, Pine Box Woodland, Riverina Plains Grassy Woodland and Riverina Grassy Woodland ecosystems.

Over 80% of vegetation cover in the region has been cleared and biodiversity assets and the operation of ecological processes are in poor to very poor condition across the landscape.

The current condition of the Little Murray River is poor (DSE 2004). This is due to several factors including the impact of river regulation for irrigation, over grazing and limited instream habitat.

A limited number of native flora species exist in the riparian zone, dominated by, River Red Gum, Black Box and Tangled Lignum. There is an absence of older River Red Gum trees (approximately 60 years appears to be the oldest). Younger trees are thought to have resulted from a flood approximately 10 years ago and are in relatively good health. Phragmites fringes the

waterway in a number of sections, however there is limited to no fringing emergent or aquatic vegetation at most of the sites visited. There is little structural habitat value as observed during a site inspection when water levels were low.

Riparian vegetation in the upper reaches (Loddon River to the Lake Boga Outfall) is generally up to 40m wide on either bank, however near the Little Murray Weir the vegetation narrows to less than 10m wide on either bank. River Red Gum and Black Box generally form an almost continuous tree canopy along the banks above a dense lignum shrub layer. Exotic Weeping Willow and Boxthorn are also present. Common Reed grows along the water's edge. Stock access along the Little Murray River is also prevalent.

A large proportion of the lower reaches (Lake Boga outfall to the Murray River confluence) is characterised by a complete lack of tree cover, however Common Reed and Cumbungi continue to grow along the margins of the river. Where present, the tree canopy consists of River Red Gum up to 10m wide on either bank above a shrub layer of lignum. Weeping Willows also line the banks through Swan Hill.

The Little Murray River is generally 4.0 – 6.5 metres deep as evidenced by the bathymetric survey (see **Attachment 18**) and is characteristic of an environment with constant water levels evident by the prolific growth of aquatic vegetation and willows. Currently the Little Murray Weir and Fish Point Weir are barriers to migratory fish movement. Naturally occurring populations of Freshwater Catfish, Silver Perch, Unspecked Hardyhead and Crimson-spotted Rainbowfish have been recorded and Murray Cod have been stocked in the river since 2002.

The predominant vegetation is Riverine Chenopod Woodland and Riverine Swamp Forest. Riverine Chenopod Woodlands consist of eucalypt woodland to 15 m tall with a diverse shrubby and grassy understorey occurring on most elevated riverine terraces. Riverine Swamp Forests consist of open eucalypt forest to 25 m tall in flood-prone areas, with a grassy-herbaceous ground layer.

Threats to the native vegetation in the region include salinity, rising water tables, alteration to soil and water nutrient balances, habitat fragmentation, grazing and changed hydrological regimes that affect rivers and wetlands. Important issues facing threatened flora species are stock grazing, loss of habitat, environmental flows, introduced predators and weeds.

Area 3 & 4- No. 9 Channel and spurs through Swan Hill and northern extension towards Woorinen

The No. 9 Channel commences at the Little Murray Weir and terminates at Tyntynder Homestead near the Murray River. It consists of around 23 km of main channel and a similar length of secondary and tertiary spur channel. The channel supplies some 400 irrigation and Domestic and Stock (D&S) customers including the Tyntynder Flats area and the part of the Mallee fringe horticultural area that was not incorporated into the Woorinen pipeline scheme. The Channel passes through the City of Swan Hill as an open waterway.

The No. 9 Channel runs parallel to the Murray Valley Highway from Little Murray Weir to Swan Hill. The channel then passes directly through the urban area of Swan Hill and extends in a north westerly direction along Woorinen Road towards Woorinen where it terminates. The No. 13/9 Channel heads north from the No. 9 Channel and continues to Tyntynder Homestead approximately 15 km from Swan Hill.

There are very few trees along the length of the channel. Where the channel passes through the urban centre of Swan Hill there are a number of large Willows (Salix spp.) scattered along its length. The channel is bordered closely by houses adjacent to both banks from Werril Street to Karinie Street. **Attachment 11** shows a typical section of the No. 9 through Swan Hill, as can be seen there are houses in the background that are close to the channel.

Along most of the channels length there is a G-MW access track on at least one bank. The channel crosses the railway line in one location south of Swan Hill and in two places north of Swan Hill towards Woorinen.

Site area (if known): …… (hectares)

Refer to Section 3

Route length 18 ……. (km) **and width** …….. (m)

Current land use and development:

The land use within the locality of the SHMP is predominantly for agricultural purposes with associated dwellings and infrastructure. Where the No. 9 Channel passes through Swan Hill, residential activity is the primary use of land.

The Little Murray River provides opportunities for fishing, camping, swimming, duck shooting and water skiing.

Irrigated pasture is the main land use adjoining the Little Murray River. Field visits to various sites along the Little Murray River presented evidence of stock access right up to the water's edge (e.g. pugging, excrement).

Description of local setting (eg. adjoining land uses, road access, infrastructure, proximity to residences & urban centres):

C1 – Automated gate and Fish passage installation at Fish Point Weir
The Fish Point Weir site is accessed through private property to the south of the site. The site is quite isolated with the closest residence being approximately one kilometre from the site. The closest township to the site is Lake Boga which is approximately 9km distance. The land use surrounding the site is a mixture of bushland reserve and grazing.

C2 – Lowering of the Little Murray Weir Structure, construction of fish passage and No. 9 Pump Station
The land use surrounding the Little Murray Weir site is a mixture of horticulture and cropping enterprises. There are three residences located within 500 metres of the construction zone. The site is accessible via the Little Murray Weir Road. The nearest township to the site is Lake Boga, a distance of approximately 7km and Swan Hill is approximately 15km from the site. There is power to the site but it is likely to require upgrading in order to service the proposed infrastructure. The length of the Little Murray River is Crown Land and is bordered by farming land.

C3 – Decommissioning of the No. 9 Channel and spur channels through the City of Swan Hill and pump station and alternative pipeline supply
The No. 9 Channel runs through the urban centre of Swan Hill. The channel is bordered by approximately 115 residences along the majority of its length between Werrill Street and Karinie Street. In some cases houses are within 20-30 metres of the channel. The predominant land use is residential. The main channel is accessible along its entire length via G-MW access tracks. The channel is also accessible via major road crossings including Werril Street, Grey Street, Rutherford Street, McCallum Street and Karinie Street.

C4 – Construction of pump station and alternative pipeline supply from the Woorinen scheme north west of Swan Hill
The pipeline supply will be placed within the existing channel. The land use along the length of channel is a mixture of horticultural enterprises. The channel is accessible via a G-MW access track along its length and is also accessible via major road crossings. There are residences in close proximity to the existing channel along its length. The channel is only a short distance north of Swan Hill.

Planning context (eg. strategic planning, zoning & overlays, management plans):

The SHMP is located within Swan Hill Rural City Council; as such land use and development is governed in accordance with the Swan Hill Planning Scheme. The zoning, overlays and management plans relevant to each of the project components is described below:
C1 – The land directly surrounding Fish Point Weir is zoned "Public Conservation and Resource". Outside this zone is "Farming". The entire area is covered by the Land Subject to Inundation Overlay (LSIO). The entire Little Murray River corridor is covered by the Environmental

Significance Overlay (ESO).

C2 – The land directly surrounding Little Murray Weir is zoned "Public Conservation and Resource". The land outside this zone is zoned "Farming". The entire area is covered by the Land Subject to Inundation Overlay (LSIO). The entire Little Murray River corridor is covered by the Environmental Significance Overlay (ESO).

C3 – The land that falls within C3 is a mixture of Low Density Residential, Residential 1 and Public Use – Service and Utility Zones. The land surrounding the construction zone is also a mixture of Residential 1, Low Density Residential Living, Rural Living and Industrial Zone. There are no overlays in this area that will require a Planning Permit.

C4 – The land within the construction area for C4 is all Farming zone. This area is not covered by any overlays that will require a Panning Permit. The location of the pump station is G-MW Freehold.

Local government area(s):
The SHMP is located within Swan Hill Rural City Council.

8. Existing environment

Overview of key environmental assets/sensitivities in project area and vicinity
(cf. general description of project site/study area under section 7)**:**

The key environmental assets and sensitivities within the project area are located within / adjoining the Little Murray River / Weir Pool, these are summarised below:

Fauna

Aquatic Fauna

Ten native fish species have been recorded in the Little Murray River between Fish Point Weir and the Little Murray Weir (Environous and Streamline Research 2012), including six significant species, see Table 2 below. Of the native fish species, one (Murray Cod (*Maccullochella peelii peelii)* is listed under the federal *EPBC Act 1999,* and five are listed as threatened under the Victorian *FFG Act 1988.* Murray River Spiny Cray (*Euastacus armatus*) was last recorded in the river in 1995, which is likely to be due to the lack of instream habitat (Environous and Streamline Research 2012).

Table 2 - Significant fish species/communities recorded in the Little Murray River

Common Name	Scientific Name	EPBC	FFG	VROTS
Crimson-spotted rainbowfish	*Melanotaenia fluviatilis*		L	DD
Freshwater Catfish	*Tandanus tandanus*		L	EN
Golden Perch [M]	*Macquaria ambigua*			VU
Murray River Spiny Cray	Euastacus armatus		L	NT
Murray Cod [M]	*Maccullochella peelii peelii*	VU	L	EN
Silver Perch [M]	*Bidyanus bidyanus*		L	CR
Unspecked Hardyhead	*Craterocephalus stercusmuscarum fulvus*		L	DD
Lowland Riverine Fish Community			L	

Conservation Status:

- *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999* Listed: VU – Vulnerable
- *Flora and Fauna Guarantee (FFG) Act 1988* listing: L – listed as threatened
- Victorian Rare or threatened Species (VROTS): EN – Endangered, CR – Critically Endangered, VU – Vulnerable, DD – Data Deficient (DSE 2007)
- [M] Migratory

Source: Environous and Streamline Research 2012

Birds

Forty bird species have been recorded in the Little Murray River (DSE 2007). From this list, eight are threatened and three of these are protected by various international migratory bird agreements with Japan and China, see Table 3 below.

Table 3: Significant bird species recorded in the Little Murray River

Common Name	Scientific Name	International Agreements	EPBC	FFG	DSE
Australasian Shoveler	*Anas rhynchotis*				VU
Azure Kingfisher	*Alcedo azurea*				NT
Cattle Egret	*Ardea ibis*	J/C			
Eastern Great Egret	*Ardea alba*	J/C		L	VU
Hardhead	*Aythya australis*				VU
Nankeen Night Heron	*Nycticorax caledonicus hillii*				NT
Pied Cormorant	*Phalacrocorax varius*				NT
Red-backed Kingfisher	*Todiramphus pyrrhopygia*				NT
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	C		L	VU

Conservation Status:

- J/C: JAMBA/CAMBA/ international agreements
- FFG listing: L – listed as threatened

- DSE status: VU – Vulnerable, NT – Near Threatened (DSE 2007)

Other fauna

Sampling efforts of the macroinvertebrate community in the Little Murray River concluded that it was similar to other Australian rivers with over 80% of the fauna consisting of insects. Aquatic snails, crustaceans and freshwater shrimps occurred along the length of the river. Other macroinvertebrates sampled included springtails, weevils, water beetles and bugs. Although there were macroinvertebrate Families found in the Little Murray River that are sensitive to increases in salinity, the majority of families present are found over a wide range of salinities or very little is known about their tolerance (Abel, 1998).

Flora

The Little Murray River falls within the Murray Fans Bioregion. The predominant Ecological Vegetation Class' (EVCs) in the Bioregion are Riverine Chenopod Woodland and Riverine Swamp Forest (Ecological Associates 2011).

The actual EVCs along the Little Murray River, which were confirmed through field survey, are listed in Table 4. All of the EVCs listed in Table 4 below are flood dependent.

Table 4 - EVCs at Little Murray River

EVC No.	EVC Name	Bioregional Conservation Status
295	Riverine Grassy Woodland	Vulnerable
946	Grassy Riverine Forest/Riverine Swamp Forest Complex	Depleted
334	Billabong Wetland Aggregate	Depleted
821	Tall Marsh	Depleted
823	Lignum Swampy Woodland	Vulnerable

Definitions:
Vulnerable: 10 to 30% pre-European extent remains
Depleted: Greater than 30% and up to 50% pre-European extent remains

Source: Field survey – ground truthing of DSE predicted EVCs (Ecological Associates 2011)

No flora species or threatened ecological communities listed under the *EPBC Act 1999* have been recorded in the Little Murray River. Only one plant species listed under the *FFG Act 1988* has been recorded, however Pointed Saltbush *(Atriplex acutibractea subsp. Acutibractea)* is not a water-dependent species.

9. Land availability and control

Is the proposal on, or partly on, Crown land? ☐ No ☒ Yes If yes, please provide details. The entire length of the Little Murray Weir pool is Crown Land (see **Attachment 20**)
Current land tenure (provide plan, if practicable): Attachments 19-22 show the land tenure of each construction area.
Intended land tenure (tenure over or access to project land):
Other interests in affected land (eg. easements, native title claims): Presently there is a Native Title Claim application being negotiated with the Wamba Wamba Barapa Barapa and Wadi Wadi peoples. The outcomes of this will influence the consultation process and statutory requirements for any future proposed activities.

10. Required approvals

State and Commonwealth approvals required for project components (if known):

It is expected that a Planning Permit will be required for the project on the basis that C1 and C2 are covered by the Land Subject to Inundation and Environmental Significance Overlays under the Swan Hill Planning Scheme.

In addition to the requirements of the *Planning and Environment Act 1987*, the following State legislation is also applicable to the SHMP:

- Aboriginal Heritage Act 2008 - A Cultural Heritage Management Plan will be prepared covering the relevant works components of the project.
- Flora and Fauna Guarantee Act 1988 – a permit is required to remove or destroy native flora and fauna identified by the Act on public land.
- Water Act 1989 – A Works on Waterways Permit will be required for works at Little Murray Weir, works along the Little Murray River, Fish Point Weir and for the construction of the pump station to pump from the Little Murray River to the No. 9 Channel.
- Fisheries Act 1995 – Permits will be required for future fish surveys conducted in the Little Murray River, these permits will be sought as required.

Environment Protection and Biodiversity Conservation Act 1999 – Referral will be made

Have any applications for approval been lodged?

☒ No ☐ Yes If yes, please provide details.

Approval agency consultation (agencies with whom the proposal has been discussed):
A Project Reference Group (PRG) was established to oversee the project. The PRG consisted of members from the Northern Victoria Irrigation Renewal Project (NVIRP), Goulburn-Murray Water, the Department of Sustainability and Environment, Department of Primary Industries, Swan Hill Rural City Council, North Central Catchment Management Authority and irrigator and community members. The PRG met on approximately 6 occasions, predominantly during the development of the Swan Hill Modernisation Plan.

In addition to the PRG a Technical Reference Group (TRG) was established to provide technical input into the environmental studies being completed on the Little Murray Weir pool. The TRG consisted of representatives from NVIRP, Goulburn-Murray Water, the Department of Sustainability and Environment, the North Central Catchment Management Authority and Parks Victoria.

In addition, Goulburn-Murray Water has met with the Department of Transport, Planning and Local Infrastructure (DTPLI) and the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) on a number of occasions. These discussions have been focussed on discussing the project generally and keeping the Departments updated on the project developments.

Other agencies consulted:
See above.

PART 2 POTENTIAL ENVIRONMENTAL EFFECTS

11. Potentially significant environmental effects

Overview of potentially significant environmental effects (identify key potential effects and comment on their significance and likelihood, as well as key uncertainties):

Effects of construction
The potential environmental effects relevant to the construction aspects of this project include the removal of native vegetation however; this is not likely to be a significant effect on the basis that removal of vegetation is limited and threatened species are avoided. Another potentially significant affect will be the impact on water turbidity, given machinery will need to be operated near the Little Murray River. This will be managed by implementing appropriate environmental management practices as documented in Section 18.

Effects of operation
The potentially significant environmental effects relevant to this project are associated with the project's operation and relate to the lowering of the Little Murray Weir and associated weir pool. There are a number of significant fish species and communities found within the weir pool. The Aquatic Fauna Impacts Report completed by Environous (see **Attachment 17**), concluded that of all the fish populations in the Little Murray Weir pool, the remnant freshwater catfish population is the most significant. While the Little Murray River is thought to be a key Freshwater catfish habitat in Victoria, it is unclear, based on the most recent survey results, if the Little Murray River supports a self-sustaining population or if spawning occurs elsewhere and larvae or juveniles are transported to the Little Murray River where they persist. The shallow habitat in the two offstream wetlands was thought to be potential breeding habitat however there is no indication that this is the case based on the results from the survey conducted in January 2013.

It is also highly possible that the Little Murray Weir pool provides an important refuge for the Lowland Riverine Fish Community (LRFC) of the Southern Murray-Darling Basin. Other individually listed species including silver perch, unspecked hardyhead and crimon-spotted rainbowfish utilise the relatively stable habitat of the Little Murray Weir pool as refuge, however given the low abundance of these species captured in the Little Murray Weir pool, the relative significance of these populations is less clearly defined. Silver perch (as well as other large bodied species) would be susceptible to the current lack of fish passage into and out of the weir pool and the lack of overall instream habitat cover. The smaller species including unspecked hardyhead, crimson-spotted rainbowfish and others within the LRFC would be particularly impacted by the current lack of connectivity with off-stream billabongs, adverse interaction with alien species (particularly redfin and eastern gamusia) and a lack of instream cover including dense beds of aquatic vegetation.

Murray cod have not been recorded in any of the fish surveys conducted on the Little Murray Weir pool. This suggests the Little Murray Weir pool is not ideal environment for these species, despite being stocked in the system for many years. As such the Little Murray Weir pool population is not considered significant given a large natural population occurs within the nearby Murray River. Similarly, the lack of Murray River spiny cray captures within the Little Murray Weir pool and comparatively larger population within the middle to lower Murray River and tributaries indicate that they are not likely to rely on this reach as important habitat.

The significant environmental effects posed to the above listed significant species as result of the operation of the proposed Swan Hill Modernisation Project, and in particular the lowering of the Little Murray Weir and associated weir pool are as follows (Note that these potential impacts assume no mitigation actions are in place):

- **Instream habitat connectivity**
  Poor connectivity between pools leading to restriction for large bodied native fish species; reduced habitat and loss of connectivity with lagoons.

Note – this is a more significant issue in the system currently when the weir pool is drawn down

over the non-irrigation season

- **Water quality deterioration**
  Salinity, turbidity, water temperature and dissolved oxygen concentrations likely to be affected due to reduced volume and depth of water. Within the refuge pools, if water quality declines significantly, this may result in fish kills, particularly among the larger species of Freshwater Catfish, Silver Perch, Murray Cod and Golden Perch.
- **Loss and degradation of habitat**
  Existing habitat is confined to channel margins, therefore reduction in levels will significantly reduce available habitat. Proliferation of unwanted aquatic vegetation may further impact on the reduced habitat available for aquatic fauna.

These potential effects have been addressed through a range of proposed mitigations actions including:

1) Siting and design of works so as to avoid or minimise impacts,
2) Setting of levels at Fish Point Weir and Little Murray Weir to ensure suitable depths are met for fish species.
3) Provision of fish passage at Little Murray Weir and Fish Point Weir,
4) Provision of an environmental passing flow by keeping Fish Point Weir open and allowing water to pass through the Little Murray River.
5) Instream habitat restoration focused on deep pools including the introduction and placement of large woody debris, fencing, targeted aquatic and semi aquatic revegetation
6) Transitional lowering to allow the system to adapt to the proposed change.
7) Ongoing monitoring to ensure the system is responding in the ways expected.

Further detail on the proposed mitigation actions are detailed in Section 18.

12. Native vegetation, flora and fauna

Native vegetation

Is any native vegetation likely to be cleared or otherwise affected by the project?

☐ NYD ☐ No ☒ Yes If yes, answer the following questions and attach details.

What investigation of native vegetation in the project area has been done? (briefly describe)

Terrestrial vegetation

A terrestrial flora assessment was conducted by SKM in September 2011, surveying 11 locations potentially impacted by the SHMP, see **Attachment 23**. The assessment concluded that no plant species or threatened ecological communities listed under the FFG Act will be significantly affected by the SHMP. However, construction activities will require some removal of native vegetation.

Aquatic vegetation

Ecological Associates (2010) was engaged to assess the aquatic and riparian vegetation along the Little Murray River and how the vegetation would be impacted by lowering of the Little Murray Weir pool. The purpose of the survey was to review the nature of impacts associated with the proposed option to lower the weir pool and report the likely significance of impacts on EPBC Act and FFG Act listed species, communities and threatening processes in relation to the EPBC Significant Impact Guidelines and recommend any specific water requirements required to maintain the health of aquatic, semi-aquatic and riparian vegetation in and along the Little Murray Weir pool (see **Attachment 24**).

The key conclusions from the survey were as follows:

- The river system is generally depauperate of aquatic and semi aquatic plants.
- Unrestricted stock access and bank erosion are currently the greatest threats to the condition of native vegetation.
- No plant communities of conservation significance (EPBC Act and FFG Act) were found at the

study site during the survey.

- No aquatic or semi-aquatic plant species of conservation significance (EPBC Act and FFG Act) were found during either of the flora surveys.
- Lowering the water level in the weir pool will not affect any plants or plant communities of conservation significance under the EPBC Act or FFG Act.

The study recommended a number of management actions to ensure that impacts to vegetation are avoided as a result of the weir pool lowering – Refer to Section 18.

What is the maximum area of native vegetation that may need to be cleared?

☐ NYD Estimated area ……2 ha…….(hectares)

This will be confirmed through a Net Gain Assessment prior to construction.

How much of this clearing would be authorised under a Forest Management Plan or Fire Protection Plan?

☒ N/A …… approx. percent (if applicable)

Which Ecological Vegetation Classes may be affected? (if not authorised as above)

☐ NYD ☒ Preliminary/detailed assessment completed. If assessed, please list.

No FFG Act or EPBC Act listed vegetation communities will be impacted by construction or operation of the project.

Have potential vegetation offsets been identified as yet?

☒ NYD ☐ Yes If yes, please briefly describe.

A Net Gain Assessment will be completed which will outline offsetting requirements. G-MW has significant experience in obtaining these offsets.

Other information/comments? (eg. accuracy of information)

NYD = not yet determined

Flora and fauna

What investigations of flora and fauna in the project area have been done?
(provide overview here and attach details of method and results of any surveys for the project & describe their accuracy)

Flora and Fauna Assessment – Entire Project Area.
A terrestrial flora and fauna assessment was conducted by SKM in September 2011. The assessment included a desktop and field component to identify the presence, or likely presence, of any State or Commonwealth listed threatened species, ecological communities, protected taxa or communities of flora and fauna. The assessment was focussed on the key construction components of the project. (see **Attachment 23**).

Aquatic and Semi-aquatic Flora Survey and Assessment – Little Murray River.
An aquatic and semi-aquatic flora survey and assessment was conducted along the length of the Little Murray Weir pool in March 2010 (see **Attachment 24**). The purpose of the assessment was to review existing records of listed species, communities and threatening processes from the site and the vicinity; map aquatic and semi-aquatic plant communities and review the potential impacts to these values. The assessment involved a desktop component and two separate field surveys.

The initial survey was completed in March 2010 when the weir pool was operated at full supply level. In June 2011, a second flora survey was completed when the weir pool had been drawn down for maintenance purposes. The objective of the second assessment was to identify any

additional aquatic and semi-aquatic plant communities that may have been submerged and not identified during the initial survey.

Aquatic Fauna Assessment – Little Murray River.
An aquatic fauna assessment was conducted on the Little Murray River by Environous and Streamline Research over 2011/12 (**Attachment 17**). The purpose of the assessment was to assess the potential impacts to State and Commonwealth listed fish fauna as a result of the proposed lowering of the Little Murray Weir pool. The assessment also identified potential mitigation options. The assessment involved a field investigation which was conducted in May 2011, but was compromised by high flows in the Murray River, which resulted in a rise in the water levels in the Little Murray Weir pool during the survey period. Information from concurrent investigations, comments from the Technical Reference Group and results from the field investigations were used to assess the potential impact of lowering the water level of the weir pool on aquatic fauna. In addition, Pam Clunie (Arthur Rylah Institute for Environmental Research) contributed much information and commented on draft versions of the report.

Aquatic Fauna Survey – Little Murray River.
In 2013 Austral Research and Consulting were engaged to undertake a survey of the Little Murray River and the associated wetlands. The survey aimed to identify and assess the current status of the freshwater fish community within the Little Murray River upstream of the weir with a special emphasis on the Freshwater catfish community. Data was also gathered on the presence of frog species using acoustic monitoring stations. Only two Freshwater catfish were recorded in the Little Murray River. The assessment concluded that the status of the Freshwater catfish population is unclear. Extensive anecdotal evidence from the local community suggests that the Little Murray River supports a substantial population of Freshwater catfish. Although it is possible that there is a self-sustaining population within the Little Murray River, results of previous surveys do not support this.

Past surveys have utilised a range of techniques targeting Freshwater catfish in the Little Murray River however, only a very low number of individuals have ever been recorded. An extensive effort has gone into establishing species composition of the Little Murray Weir pool, in particular the Freshwater catfish population however, for Freshwater catfish these assessments have proven to be inconclusive. While the Little Murray River is thought to be a key Freshwater catfish habitat it is unclear if the Little Murray River supports a self-sustaining population or if spawning occurs elsewhere and larvae or juveniles are transported to the Little Murray River where they persist.

While only very low numbers of Freshwater catfish have been recorded, a conservative approach has been taken in terms of potential impacts to the species and mitigation actions.

Have any threatened or migratory species or listed communities been recorded from the local area?

☐ NYD ☐ No ☒ Yes If yes, please:

- List species/communities recorded in recent surveys and/or past observations.
- Indicate which of these have been recorded from the project site or nearby.

This section summarises threatened or migratory species or listed communities as follows:

- Terrestrial flora
- Riparian flora
- Aquatic flora
- Terrestrial fauna (including riparian)
- Aquatic fauna

Terrestrial Flora

A flora and fauna assessment was conducted by SKM in September 2011 concluded that no plant species or threatened ecological communities listed under the FFG Act will be significantly affected by the SHMP. A brief summary of each location surveyed, relevant to the construction areas is provided below.

C1 - Fish Point Weir
Site G is located at Fish Point Weir on the Little Murray River, in Fish Point, approximately 25 km south-east of Swan Hill. The site is within the Murray Fans Bioregion. No FFG Act listed threatened flora species were observed during the field assessment. Cotton Fireweed was recorded at site G, and is a member of the FFG Act protected flora taxa Asteraceae. The species is not likely to be affected.

C2 - Little Murray Weir
Two sites were assessed relevant to C2, Site A is located at the Little Murray Weir, on the Little Murray River, approximately 6 km north-west of Lake Boga, and 10 km south-east of Swan Hill.

Site B1 is located 150 m upstream of the Little Murray Weir, on the Little Murray River and No. 9 Channel, approximately 6 km north-west of Lake Boga, and 10 km south-east of Swan Hill.

No FFG Act listed threatened species were observed at either site during the field assessment. No protected flora taxa, listed under the FFG Act are considered likely to be present at either site.

C3 - No. 9 Channel, Swan Hill
Site C follows the No. 9 channel through the western half of Swan Hill, within a generally residential area, largely following Wilkins Grove to the North, until it turns west bordering the northern side of McCallum Street. The northern extent of site C (north and west of Murlong Street) overlaps with site D1, while the southern extent (South of Poole Boulevard) overlaps with site D2. Site C is within the Murray Fans Bioregion, and consists largely of public parkland, of planted locally-indigenous, or Australian-native plants, or stands of exotic trees. No communities of flora and fauna that are threatened are present at site C. No FFG Act listed threatened species were recorded during the field assessment. New Holland Daisy was recorded in EVC 103 – Riverine Chenopod Woodland, in areas overlapping with site D2. New Holland Daisy is a member of the family Asteraceae, which is a protected flora taxa under the FFG Act. This species will be avoided during construction to avoid impact.

C3 - South-west Swan Hill, No. 8A/9, 9/9 & 1/9/9 Channels
Site D1 is located throughout the south-western part of Swan Hill, on the 8A/9, 9/9 and 1/9/9 channels. The site overlaps with site C along the No. 9 channel, between Poole Boulevard and Werril Street. The entire site is within the Murray Fans Bioregion. No FFG Act listed communities of flora and fauna were recorded at site D1. No FFG Act listed communities of flora and fauna were recorded at site D1. New Holland Daisy is a member of the FFG Act listed protected flora taxa Family Asteraceae, and was recorded in the small patch of EVC829 – Chenopod Grassland along Yana Street. This patch will be avoided during construction to avoid impact.

C3 - No. 9 Channel, McCallum Street, Swan Hill
Site D2 runs along the No. 9 channel, north from McCallum Street in Swan Hill to the Swan Hill – Piangil railway line. A further section overlaps with site E along Karinie Street, in western Swan Hill. All of site D2 is within the Murray Fans Bioregion. No FFG Act listed communities of flora and fauna were recorded at site D2. No FFG Act listed threatened species were observed during the field assessment. No species which are members of FFG Act listed protected flora taxa were recorded at site D2 during the field assessment. No species of significance were noted in C4

Terrestrial Fauna

A flora and fauna assessment was conducted by SKM in September 2011, surveying 11 terrestrial locations to be impacted by the SHMP. The assessment concluded that no fauna species listed under the FFG Act will be significantly affected by the SHMP. A brief summary of each location surveyed is provided below.

C1 - Fish Point Weir
The FFG Act listed community of flora and fauna 'Victorian Temperate-woodland Bird Community' may occur at site G. This is not likely to be impacted as a result of the project. In addition, no significant fauna species were recorded in C2 to C4.

Intersection of Little Murray River / Lake Boga Outfall

The FFG Act listed community of flora and fauna 'Victorian Temperate-woodland Bird Community' may occur at site I. One species the White-bellied Sea-eagle was observed flying over the site. However, no suitable nesting habitat was identified at the site, so it is considered unlikely that this species makes significant use of the site.

Riparian Flora

The Aquatic Flora report (Ecological Associates 2011) summaries the current condition of riparian flora along the banks of the Little Murray River:

- Five Ecological Vegetation Classes are present along the Little Murray River including Riverine Grassy Woodland, Grassy Riverine Forest/Riverine Swamp Forest Complex, Billabong Wetland Aggregate, Tall March and Lignum Swampy Woodland.
- Riparian vegetation is generally in moderate condition, although unrestricted stock access and bank erosion are major threats. Weeds are also common along the entire river.
- Undercutting/steep banks due to constant water level combined with unrestricted stock access and Carp has impacted on quality of riparian vegetation and do not encourage aquatic vegetation to establish.
- No plant communities of conservation significance were found, although one terrestrial species Pointed Saltbush (FFG Act 1988 Listed) was found. This species is not located in an area prone to waterlogging or flooding and is not dependent on waterlogging or flooding. It will not be affected by the project.

Aquatic Flora

The Aquatic Flora report (Ecological Associates 2011) (**Attachment 24**) has summarised the current condition of the Little Murray River:

- The Little Murray River is generally lacking aquatic and semi aquatic species due to the constant water height under existing conditions. Growth of aquatic plants is limited by water depth and turbidity, hence plants are unlikely to have established at a depth of more than 1.3m below Full Supply Level.
- Aquatic species found in low abundance and highly disturbed by trampling of cattle.
- No plant establishment observed beneath stands of willows.
- No aquatic or semi aquatic species found are of conservation significance.

Two off stream wetlands, located along the Little Murray Weir pool were surveyed as part of the aquatic flora assessment. The wetlands are approximately 600m in length and are located approximately 12km upstream of the Little Murray Weir, they are described below:

Wetland 1 – is a small off-stream wetland on the southern side of the river. The wetland is shallow (<1m) with a riparian cover of River redgum. The wetland is seasonal and only fills from the Little Murray River during high flows in the irrigation season and from catchment runoff, therefore connection with the main channel of the Little Murray River is intermittent. Habitat within the wetland is dominated by open water with macrophyte cover limited to large beds of water primrose. Stock access is unrestricted to the site. Ecological Associates mapped the Ecological Vegetation Class (EVC) as being Billabong Wetland Aggregate (EVC 821), which has a bioregional conservation status of depleted.

Wetland 2 – is situation on the northern side of the Little Murray River within the floodway reserve. The wetland is intermittently connected to the main channel of the Little Murray River during the irrigation season and high flow periods. Catchment runoff to the lagoon is likely to be limited. Riparian vegetation is dominated by River redgum with an understorey of Juncus and Lignum. Macrophyte cover within the wetland includes beds of Thypa and Water primrose. Woody habitat is extensive within the lagoon. Ecological Associates mapped the vegetation surrounding the wetland as Riverine Grassy Woodland (EVC 295) (Bioregional status – vulnerable). The vegetation within the wetland was mapped as Grassy Riverine Forest/Riverine Swamp Forest Complex (EVC 812) (Bioregional status – vulnerable).

Aquatic Fauna

An assessment of potential aquatic fauna impacts was conducted by Environous in June 2012.

The assessment included a summary of large aquatic species identified in the locality of the SHMP between 1995 and 2011. The native species identified included Murray cod, Golden perch, Silver perch, Freshwater catfish, Unspecked hardyhead, Bony bream, Australian smelt, Carp gudgeon and Crimson-spotted Rainbowfish. The exotic species recorded included Carp, Goldfish, Eastern gambusia and Redfin. Other taxa recorded included Murray crayfish and Eastern long neck turtle.

Nine of the 15 species included in the Lowland Riverine Fish Community (LRFC) of the Southern Murray-Darling Basin have been recorded within the Little Murray River, which is considered a significant habitat for this community. Six of these species considered threatened on an individual basis at a state level, see Table 5. Silver perch is considered to be critically endangered, Murray cod and freshwater catfish are considered to be endangered, Murray River spiny cray is considered to be near threatened, whilst unspecked hardyhead and crimson-spotted rainbowfish are listed as data deficient, requiring further research.

Table 5 – The fish species of the Lowland Riverine Fish Community of the Southern Murray-Darling Basin

Common name	Scientific Name	Recorded in the Little Murray Weir pool	State VROT listing #	National EPBC listing
Agassiz's Chanda perch	*Ambassis agassizii)*		Regionally Extinct	
Southern Purple-spotted gudgeon	*Mogurnda adspersa*		Regionally Extinct	
Silver perch	*Bidyanus bidyanus*	✓	Critically Endangered	
Murray hardyhead	*Craterocephalus fluviatilis*		Critically Endangered	Vulnerable
Trout cod	*Maccullochella macquariensis*		Critically endangered	Endangered
Murray cod	*Maccullochella peelii peelii*	✓	Endangered	Vulnerable
Macquarie perch	*Macquaria australasica*		Endangered	Endangered
Freshwater catfish	*Tandanus tandanus*	✓	Endangered	
Flat-headed galaxias	*Galaxias rostratus*		Vulnerable	
Unspecked hardyhead	*Craterocephalus stercusmuscarum fulvus*	✓	Data deficient	
Crimson-spotted rainbowfish	*Melanotaenia fluviatilis*	✓	Data deficient	
Golden perch	*Macquaria ambigua*	✓	Not Listed	
Carp gudgeon	*Hypseleotris* spp.	✓	Not listed	
Bony bream	*Nemotalosa erebi*	✓	Not listed	
Flat-headed gudgeon	*Philypnodon grandiceps*	✓	Not listed	

- Victorian Advisory List of Threatened Vertebrates (DSE (2007)

Freshwater catfish

Freshwater Catfish is listed as endangered under the *FFG Act 1988.*

Freshwater catfish nests are often located in shallow margins, where bottom water temperatures are higher than in deep water habitats. It is important that stable water levels are maintained wherever possible during the breeding period, which can extend from October to March, with a peak in Summer (Environous and Streamline Research 2012, p 16). Preferring low flowing streams and lakes, spawning coincides with warmer water temperatures ranging from 20-24°C during spring and summer.

Freshwater catfish abundance has been limited within the Little Murray River across all the surveys completed dating back to 1995. The low abundance of Freshwater catfish surveyed is in contrast to anecdotal evidence from local recreational fisherman that indicate they are caught regularly. However, since the floods in 2012 anecdotal information suggests that lower numbers have been caught. This is supported by the low numbers (2 individuals) recorded in the most recent survey completed in January 2013.

While the Little Murray River is thought to be a key Freshwater catfish habitat it is unclear if the Little Murray River supports a self-sustaining population or if spawning occurs elsewhere and larvae or juveniles are transported to the Little Murray River where they persist.

On that basis, a precautionary approach has been used and it has been assumed that the Little Murray River does represent a significant Freshwater catfish population.

Table 6 below indicates known sites of freshwater catfish in Victoria.

Table 6 – Victorian sites where populations of Freshwater catfish are known

Basin	Site	Comment
Wimmera	Wimmera River	• Introduced population • Well established self-sustaining population. Most abundant in the lower reaches of the river. • Genetic diversity high
Goulburn	Tahbilk Lagoon	• Remnant native population, self-sustaining. • Genetic diversity low
		Occasional records within the Goulburn River including: • Upstream of Goulburn Weir in Major and Hughes Creeks and Lake Nagambie • Immediately downstream of Goulburn Weir • Genetic composition unknown
Loddon	Gunbower	• Natural population • Gunbower Creek and associated lagoons and wetlands. • Genetic composition unknown
	Little Murray River	• Natural population • Consistently caught during fish surveys, although in relatively low numbers. • Anglers, however, consistently catch large numbers, particularly between Fish Point Weir and the Little Murray Weir. • Genetic composition unknown
	Several impoundments in central Victoria	• Introduced population • Genetic diversity low.
Mallee	Mallee wetlands	• Natural populations • Koorlong Lake near Mildura. • Kings Billabong and Psyche Creek has a small population which may have originally seeded the irrigation system and Cardross, the Hawthorn drain and Koorlong. • Butlers Creek on the Kings reserve. Sandilong Creek (golf course near Mildura) has good population which is largely isolated from the river. • Genetic composition unknown
	Cardross Lakes	• Previously good natural population now extinct • Genetic diversity high.

Because most of the instream habitat in the weir pool appears to be confined to the channel margins it is possible that the lowering will reduce habitat availability and access to features such as complex woody structure, root masses, and emergent vegetation. However, under lower water level conditions and assuming suitable connectivity, it is expected that submerged and emergent aquatic macrophytes would increase in distribution and abundance and therefore provide additional habitat for Freshwater catfish and other aquatic fauna.

A Recovery Plan for Freshwater Catfish exists, outlining recovery objectives and required management actions for this listed species. The plan identifies a range of threats that have played a significant role in the species decline, including flow regulation, the availability of suitable slower flowing habitats and reduced water temperatures (Clunie and Koehn 2001).

Silver Perch

Silver perch have been consistently recorded in the Little Murray Weir pool during fish surveys since 1995. The highest capture was made in 1998, with a 58% decrease in capture during a survey in 2009 and further reductions in the 2013 survey. This decrease may indicate a decline in population size, however it is assumed that a self-sustaining population persists within the Little Murray Weir pool.

Silver perch have a wide range of habitat preferences including large impoundments and irrigation channels, but are usually found within the main stream channel and often within flowing water reaches. Spawning occurs in spring and summer when as water temperature exceeds 20°C.

Silver perch have consistently been captured during fish surveys in the Little Murray Weir pool since 1995. Each survey conducted has seen a decrease in abundance; this may indicate a decrease in population size. It is assumed that the silver perch population persists in relatively low abundance within the Little Murray Weir pool, as a self-sustaining population.

Ecologically, the open water environment of the Little Murray Weir pool may represent an

important refuge for the silver perch population.

Murray Cod
Conventional fish surveys have captured the species in the Murray River adjacent to the Little Murray, but have not captured Murray cod within the Little Murray Weir pool. Recreational anglers have recently reported capturing Murray cod within the Weir pool during high flows in 2010 and 2011.

Murray cod have a strong association with solid shelter, such as fallen trees and undercut banks. Spawning occurs in spring and summer as water temperature exceeds 16°C and flow pulses can trigger large scale spawning migrations. They are known to make significant upstream and downstream migrations in spring and early summer.

Prior to the installation of in stream barriers, habitat degradation and flow regulation (its natural state), the Little Murray River and Weir pool is expected to have represented a significant refuge for the Murray cod. However, under current operation (with restricted fish passage, limited instream habitat and lack of natural flow events to stimulate and facilitate migration and breeding) the ecological significance for the Little Murray Weir pool is likely to be low. However, Environous and Streamline Research (2012) noted that it would be possible to improve the ecological suitability for Murray cod under the proposed lowering of the Little Murray Weir pool with the provision of fish passage, habitat restoration and re-instating a more nature flow regime (as per the mitigation actions – see section 18).

It is considered likely that the persistence of Murray cod within the Little Murray Weir pool is related to the stocking program. Since 2002 approximately 10,000 fish per year have stocked within the Little Murray River and Weir Pool. Thousands of additional fish have also been stocked in regional stream and wetlands.

Given the consistent stocking program in the region, the Murray cod population in the Little Murray Weir pool is not likely to represent a genetically significant population.

Unspecked Hardyhead
Unspecked hardyhead are generally collected in the margins of lowland rivers, lakes, backwaters and billabongs. It prefers slow flowing or still habitats with aquatic vegetation and sand, gravel or mud substrates. They spawn in from October to February, with a peak in spring when water temperatures are above 24°C, and are capable of multiple spawnings.

Few unspecked hardyhead have been captured within the Little Murray Weir pool. Given the previously low capture rate and current habitat availability within the Weir pool, the population is not likely to be important for the long-term survival of the species.

Crimson-spotted rainbowfish
Crimson-spotted rainbowfish are generally found in the lowland parts of the Murray Darling Basin, and prefers slow-flowing rivers, wetlands and billabongs. Breeding is seasonal, generally spring to summer when water temperature exceeds 20°C, and is generally conducted under the cover of aquatic vegetation.

Like the unspecked hardyhead, the previously low capture rate of crimson-spotted rainbowfish and current habitat availability indicates that the Little Murray Weir pool population is not likely to be important for the long-term survival of the species.

Murray River Spiny Cray
Only two Murray River spiny cray have been captured downstream of the Little Murray Weir (recorded in 1995). No other records, including recreational captures have been recorded in the Little Murray system. The lack of this species within the Little Murray system is likely to be associated with the lack of suitable in stream habitat such as rock and large woody structures.

If known, what threatening processes affecting these species or communities may be exacerbated by the project? (eg. loss or fragmentation of habitats) Please describe briefly.

Without mitigation, the lowering of the Little Murray Weir pool will represent a loss of a large refuge habitat for native fish and would potentially exacerbate threatening processes including:

- In stream and off-stream habitat connectivity
- Water quality deterioration
- Loss and degradation of habitat.

Under current operating conditions these threatening processes already exist in the weir pool. Currently the weir pool is lowered each year during the non-irrigation season between May and August. During this time Fish Point Weir is kept closed and Little Murray Weir is opened to allow the weir pool to be dewatered, generally to sill level however, at times, when G-MW need to do maintenance on the weir, the weir pool can be totally dewatered via an outlet valve that runs between upstream and downstream sides of the weir.

Instream and off-stream habitat connectivity
With poor connectivity between remnant pools expected at the proposed lower water level, habitat fragmentation is a likely threat. It is anticipated shallow sections may represent a restriction to large bodied species including Murray cod, golden perch, silver perch and freshwater catfish that require a minimum of 0.3 to 0.5m depth. The loss of connectivity with off-stream billabongs is also thought to be a particular threat to smaller bodied fish of the Lowland Riverine Fish Community.

It is also likely that emerged aquatic assemblages (for example, Phragmites, Cumbungi and Lignum) would spread in response to lowering the weir pool level. However, this would only be in areas where the current distribution is controlled by water depth. Where the normal depth reduces, and where the substrate is still soft enough (i.e. moist), rhizomes may well grow into new areas. Where this could occur is difficult to predict, as the reactions will be very site-specific. These species can become dominant if conditions allow which can restrict streamflows and can also restrict the growth of other native species.

Water quality deterioration
Reduced water volume is anticipated to result in greater variability in water connectivity, water temperature and dissolved oxygen concentrations in the lowered weir pool. Warm temperatures and nutrient runoff may result in excessive algal growth, in turn causing significant variation in dissolved oxygen. In addition, salinity (groundwater intrusion) and / or temperature gradients may result in deoxygenation of the water. As a result, the likelihood of deteriorating water quality and subsequent risk of fish kills is greatly increased, without mitigation.

Water quality issues have historically been experienced in the Little Murray River in the reach between Fish Point Weir and where the No. 6/7 Channel inflows to the Little Murray River. Water quality issues, in particular elevated salinity levels, have been recorded downstream of the Little Murray Weir. The water quality issues are caused by a lack of flow in the river due to historical operational arrangements i.e. keeping both Fish Point Weir and Little Murray Weir closed at most times during the year. These in river conditions will be exacerbated without mitigation.

Loss and degradation of habitat
The loss of large aquatic habitat within the Little Murray Weir pool has a number of potential implications as under current operating arrangements, the system effectively acts as an artificial wetland refuge. Because most of the instream habitat appears to be confined to the channel, limited habitat is anticipated to remain post lowering based on reduced water volume. Species reliant on this habitat including freshwater catfish and Murray cod may be restricted. Species including silver perch and bony bream would also be at higher risk due to the significant reduction in available deep refuge pools. Smaller bodied fish in the LRFC utilise the marginal habitat such as complex woody structure, root masses and emergent vegetation. Under lower water level conditions and assuming suitable connectivity, it is expected that submerged and emergent aquatic macrophytes would increase in distribution and abundance and therefore provide additional habitat for these species.

Riparian vegetation along the Little Murray River is generally in moderate condition however weeds, particularly understorey species, are common along the river. Very little of the Little Murray River is fenced therefore, riparian vegetation has been significantly impacted by unrestricted stock access. The impact of stock access will potentially be exacerbated as stock

will have access to a larger portion of the river given the lowered water level.

It should be noted that a number of the technical reports that have been completed were done so on the basis that the weir was being lowered to 67m AHD rather than the final proposal of 67.3m AHD. This difference has a significant impact on the volume of water in the weir pool and habitat connectivity.

Are any threatened or migratory species, other species of conservation significance or listed communities potentially affected by the project?

☐ NYD ☐ No ☒ Yes If yes, please:

- List these species/communities:
- Indicate which species or communities could be subject to a major or extensive impact (including the loss of a genetically important population of a species listed or nominated for listing) Comment on likelihood of effects and associated uncertainties, if practicable.

The potential effects of construction and operation on threatened or migratory species and other species of conservation significance or listed communities are summarised below:

Terrestrial flora

No threatened terrestrial flora or listed vegetation communities are likely to be affected as a result of construction or operation associated with the project.

Riparian flora

No riparian plant communities of conservation significance have been found in any of the assessments conducted along the Little Murray River however, one terrestrial species, Pointed Saltbush (FFG Act 1988 Listed), was found. This species is not expected to be affected by the construction or operation associated with the project.

Aquatic flora

No threatened aquatic or semi aquatic plant communities or threatened species have been found in any of the assessments conducted along the Little Murray River and therefore, no species will be impacted by construction or operation associated with the project.

Aquatic fauna

The Aquatic Fauna report (Environous and Streamline Research 2012) (see **Attachment 17**) indicated the proposed lowering of the Lowering the Little Murray Weir will significantly reduce refuge habitat for native fish species and, without mitigation, is likely to exacerbate threatening processes and therefore impact on aquatic fauna. The threatening processes include:

- Instream habitat connectivity
  Poor connectivity between pools leading to restriction for large bodied native fish species; reduced habitat and loss of connectivity with lagoons.
- Water quality deterioration
  Salinity, turbidity, water temperature and dissolved oxygen concentrations likely to be affected due to reduced volume and depth of water. Within the refuge pools, if water quality declines significantly, this would result in fish kills, particularly among the larger species of Freshwater Catfish, Silver Perch, Murray Cod and Golden Perch.
- Loss and degradation of Instream habitat
  Existing habitat is confined to channel margins at current full supply level of 69.2m AHD therefore, reduction in levels will significantly reduce available habitat. There is a lack of large woody debris and very little aquatic vegetation within the channel profile. Proliferation of unwanted aquatic vegetation may further impact on the reduced habitat available for aquatic fauna.
- Flow regulation and changes to natural flow regime
  The Little Murray River has been highly regulated for over 100 years, unseasonal flow regimes (low winter/spring flows and high summer flows) and water levels kept relatively

stable due to weir operation in the irrigation season. Species have adapted to this regime.

- Instream and off stream habitat connectivity (Winter)
  Although during irrigation season connectivity is good (due to weir operating level), the weir pool is drained annually in the non-irrigation season causing a temporary disconnection of habitat. The Fish Point Weir is normally closed during the irrigation and non-irrigation season

Terrestrial fauna

No threatened terrestrial fauna or listed communities are likely to be affected as a result of construction or operation associated with the project.

Is mitigation of potential effects on indigenous flora and fauna proposed?

☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

A number of key mitigation actions are proposed to mitigate the potential effects on indigenous fauna, these are briefly described below and detailed further in Section 18:

Construction – works will be sited, where possible to avoid effects to flora and fauna. A Site Environmental Management Plan will be developed to ensure that works are carried out in accordance with relevant legislation and that detail regarding siting and location of works, water management, dust and noise are managed.

Flow Requirements – The proposed lowered crest levels at Fish Point Weir and Little Murray Weir are based on meeting the interim flow requirements established by Environous and Streamline Research (2012) as part of the Aquatic Fauna Assessment for the Little Murray River. They were based on meeting a minimum depth of 500mm, so as to provide habitat connectivity for large bodied fish species such as Freshwater catfish and Murray cod.

Regulation of Fish Point Weir – Fish Point Weir will be regulated which will allow a variable flow regime to be implemented. In addition, Fish Point Weir will be kept open for the majority of time and water will be able to pass from the Murray River and the Loddon River through the Little Murray River.

Fish Passage at Fish Point Weir and Little Murray Weir – Currently there is no fish passage at Fish Point Weir or Little Murray Weir unless both structures are open. Fish passage is proposed at both structures which will allow unimpeded fish movement through the Little Murray River

Instream habitat restoration – This will include placement of large woody debris at key locations including deep pools and key areas. This will be carried out at approximately 30 sites that have been identified based on the bathymetric survey completed for the Little Murray River.

Fencing – Approximately 30kms of fencing will be carried out along the riparian zone, this will be targeted towards the deep pool areas where habitat restoration is occurring. Fencing will reduce the risk of stock access and will encourage faster establishment of native vegetation along the riparian zone.

Targeted riparian revegetation – Revegetation will be targeted towards aquatic and semi aquatic vegetation and again will be linked to deep pools and large woody debris placement. This will encourage broader regeneration and provide important habitat for fish species, particularly Freshwater catfish and small bodied species.

Transitional lowering – The lowering will need to be done over one to two year period and will allow aquatic and semi aquatic vegetation to establish and species to adapt.

Water quality monitoring – Additional water quality probes will be established to monitor key water quality parameters in the Little Murray River. Appropriate monitoring will enable an adaptive management approach to linked to the Operational Plan for the system.

Other information/comments? (eg. accuracy of information)

13. Water environments

Will the project require significant volumes of fresh water (eg. > 1 Gl/yr)?
☐ NYD ☒ No ☐ Yes If yes, indicate approximate volume and likely source.

Will the project discharge waste water or runoff to water environments?
☐ NYD ☒ No ☐ Yes If yes, specify types of discharges and which environments.

Are any waterways, wetlands, estuaries or marine environments likely to be affected?
☐ NYD ☐ No ☒ Yes If yes, specify which water environments, answer the following questions and attach any relevant details.

A number of construction activities are proposed in the Little Murray River (C1 and C2). These construction activities will involve works to be carried out in and along the Little Murray River using an excavator. The major impact associated with the works will be potential increases in turbidity in the vicinity of the works sites. This will be controlled through mitigation actions as discussed in Section 18. In addition some native vegetation may need to be removed.

The crest height of the Little Murray Weir is proposed to be lowered from 69.2m AHD to 67.3m AHD. This will decrease the volume of water in the Little Murray Weir pool to approximately 35% of existing levels. Apart from being lowered the operation of the weir pool will change significantly, as described below.

The Little Murray River can be described as a number of key sections as follows:

Fish Point Weir to the 6/7 Channel
Under current operation this section of the Little Murray River receives minimal inflow as Fish Point Weir remains closed at all times unless flows upstream in the Murray River at Torrumbarry exceed 12,000ML/d, at which time Fish Point Weir is opened. As a result of current operation, this section of river has limited flow and is essentially a backwater. Historically, this has resulted in significant water quality issues.

Under proposed operation Fish Point Weir will be kept open for the majority of time and water will pass through the Little Murray River from the Murray River and the Loddon River. Based on the hydraulic analysis completed by Fluvial Systems (2013) (see **Attachment 18**) flows through Fish Point will exceed 300ML/d 95% of the time. Given Little Murray Weir will be lowered to a crest height of 67.3m AHD the river will operate at a much lower level however, water quality will significantly improve.

6/7 Channel to the Little Murray Weir
The section of the Little Murray River from the 6/7 Channel to the Little Murray Weir is highly regulated and is considered part of G-MW's irrigation backbone network. The 6/7 Channel is the main water supply to the Little Murray River, supplying all irrigation demands including those on the Little Murray River and the No. 9 Channel. The 6/7 Channel is supplied via the No. 7 Channel which passes through the Kerang Lakes system. The demands on both the Little Murray River and the No. 9 Channel have varied significantly over the last 10 years ranging from 8,600 ML to 26,000ML. Based on these demands inflows from the 6/7 Channel have ranged between 300 to 600 ML per day over the irrigation season (August to May). Given the crest of the weir is held at 69.2m AHD, the inflows result in the entire weir pool operating at close to bank full over the irrigation season. Under current operation, during the non-irrigation season inflows from the 6/7 Channel cease and the weir pool is dewatered to sill level.

Under the proposed operation the No. 9 demand will continue to be supplied by the 6/7 Channel however, the weir will be lowered to a crest height of 67.3m AHD. This will result in a much lower level and volume in this section of the river. In addition the weir pool will not be dewatered during the non-irrigation season. In addition, irrigators on the Little Murray River will be supplied from Murray River via Fish Point Weir rather than the 6/7 Channel. This will not impact on the operation of the Kerang Lakes.

Downstream of Little Murray Weir
Currently the section of the Little Murray River downstream of Little Murray Weir receives little to no flow during the irrigation season (August to May). The only water that passes downstream is whatever leaks through the weir structure and a small volume to supply downstream demand. Therefore, unless there is a flood and Little Murray Weir needs to be opened there is very little flow downstream of the weir. This has resulted in very low flow conditions downstream of the weir which has impacted significantly on water quality. It has also resulted in terrestrial vegetation encroachment in parts of the river and has restricted the access to water for irrigation.

Under the proposed operation, the section of the Little Murray River downstream of the weir will receive a significant increase in flow on a consistent basis. This will be important for enhancing habitat for aquatic fauna and improving overall water quality.

Offstream wetlands
As detailed in Section 12 there are two off-stream wetlands along the Little Murray River, one of them is seasonal and only fills from the Little Murray during high flows and catchment runoff, its connection with the main channel is intermittent. Given the shallow nature of the wetland (<1m) the wetland will not hold water for long periods. Once the weir pool is lowered the wetland will still be inundated during high flows however, this will occur less frequently than under current conditions and therefore, it is expected that over time the vegetation in the wetland will become more terrestrial.

The second wetland is deeper and although only filled during the irrigation season the wetland will maintain connectivity at lower flows however, these flows will only partially fill the wetland. The wetland will fill during high flows and floods however, the lowering of the weir pool will reduce the habitat available within the wetland. The habitat lost in both wetlands will be compensated for through the mitigation works being carried out along the main channel such as introduction of large woody debris, revegetation and fencing.

Are any of these water environments likely to support threatened or migratory species?
☐ NYD ☐ No ☒ Yes If yes, specify which water environments.

The Little Murray River supports threatened species (refer Sections 11 and 12).

Are any potentially affected wetlands listed under the Ramsar Convention or in 'A Directory of Important Wetlands in Australia'?
☐ NYD ☒ No ☐ Yes If yes, please specify.

The Kerang Wetlands are located approximately 50 kilometres south-west of Swan Hill, upstream of the Little Murray system. The wetlands are a system of lakes and swamps that differ widely in permanence, depth, salinity and aquatic vegetation. They also support large populations of native species, including various listed migratory species. No changes to the operation of the Kerang Lakes will occur as a result of implementing Swan Hill Modernisation Project.

Could the project affect streamflows?
☐ NYD ☐ No ☒ Yes If yes, briefly describe implications for streamflows.

Under current operating conditions the Little Murray Weir pool is held at full-supply level of 69.2m AHD during the irrigation season (August to May). During this time generally the only water that enters the weir pool is via the No. 6/7 Channel which enters the weir pool approximately 7km's downstream of Fish Point Weir. During the irrigation season, depending on demand, 300 to 600 ML/d enters the Little Murray River via the No. 6/7 Channel. Unless Murray River flows are above 12,000ML/d at Torrumbarry Weir Fish Point Weir is kept closed. Therefore the section of River from Fish Point Weir to the No. 6/7 Channel intake receives no flow. In addition, little to no flow passes downstream from the Little Murray Weir, due to the structure being held at full supply level. During the non-irrigation season (May to August), the weir pool is dewatered.

When the river is held at full-supply level during the irrigation season, the average depth through the weir pool is approximately 4-5 metres, with deeper pools ranging from 5-8 metres. There is

limited water quality data available for the Little Murray Weir pool however, water quality is generally maintained at suitable levels during the irrigation season due to the volume of water in the weir pool. Historically blue green algal blooms have been recorded between Fish Point Weir and the No. 6/7 Channel.

The SHMP will return the Little Murray River System to a flow regime more aligned with natural conditions in terms of variability and level. The flows will be regulated to provide appropriate flows in order to manage the values in the weir pool, in particular aquatic fauna.

As stated above, the volume held in the river will be much less than current however, Fish Point Weir will be kept open and flows from the Murray River and the Loddon Rivers will be passed through the entire Little Murray River. Flows will be in excess of 300ML/day 95% of the time during all seasons. An automated gate structure at Fish Point Weir will allow the regulation and manipulation of flows suit environmental requirements. There will also be fish passage provided at both Fish Point Weir and Little Murray Weir. If elevated salinity levels experienced in the Loddon, Fish Point Weir will be closed so the water cannot enter the Little Murray Weir pool.

The off-stream wetlands on the Little Murray River will receive less high flow events that fill them or keep them connected with the main channel. As a result the wetlands will hold less water and reduce habitat availability for aquatic fauna. As a result, it is likely that the vegetation composition in the wetlands will become more terrestrial.

The operation of the weir pool during flood events won't change. Fish Point Weir will be opened and flows will pass over the lowered Little Murray Weir structure downstream. The Pental Island floodway will also remain in operation.

Could regional groundwater resources be affected by the project?

☐ NYD ☒ No ☐ Yes If yes, describe in what way.

Regional groundwater resources are unlikely to be affected by the project. A hydrogeological assessment was completed by RPS Aquaterra (2011) (see **attachment** 25). The assessment concluded there are two groundwater/surface water interactions occurring upstream and downstream of the intersection with the 6/7 Channel. From Fish Point Weir to upstream of Channel 6/7 the river system was gaining through groundwater intrusions, whilst below Channel 6/7 to the Little Murray Weir the river is losing to the local groundwater network. The impact of lowering the weir pool is a reduction in leakage (from the weir pool to groundwater) in the order of 20 ML/year. The assessment concluded that leakage from the weir pool post lowering would be in the order of 2ML/year (under wet conditions) and up to 20 ML/year (under dry conditions). The likely changes to groundwater volumes under wet and dry conditions are insignificant and will not impact on groundwater dependent ecosystems or riparian/floodplain vegetation.

Could environmental values (beneficial uses) of water environments be affected?

☐ NYD ☐ No ☒ Yes If yes, identify waterways/water bodies and beneficial uses (as recognised by State Environment Protection Policies)

The environmental values (beneficial uses) of the Little Murray Weir pool will potentially be affected by the project, the relevant beneficial uses are detailed below:

Aquatic plants and animals – Aquatic plants are not expected to be affected by the project however, aquatic animals, in particular native fish may be impacted by the project as a result of reduced Instream habitat connectivity, water quality deterioration and loss and degradation of habitat, refer to Section 12.

Water based recreation – The Little Murray River is used for recreational activities such as fishing, camping and water skiing. Water skiing is likely to be restricted as a result of the lowering of the Little Murray Weir pool.

Water suitable for human consumption – The Little Murray River joins the Murray River in Swan Hill. Water for human consumption is pumped from the Murray River just downstream of where the Little Murray enters the Murray River. The project is not expected to affect the

suitability of water for human consumption.

Cultural and spiritual values – A Cultural Heritage Management Plan will be prepared for the entire project area to ensure that cultural and spiritual values are protected.

Water suitable for agriculture – The project is not expected to affect the suitability of water for agriculture.

Could aquatic, estuarine or marine ecosystems be affected by the project?

☐ NYD ☐ No ☒ Yes If yes, describe in what way.

Aquatic ecosystems are potentially affected by the operation associated with the project, refer to Sections 11 and 12.

Is there a potential for extensive or major effects on the health or biodiversity of aquatic, estuarine or marine ecosystems over the long-term?

☐ No ☒ Yes If yes, please describe. Comment on likelihood of effects and associated uncertainties, if practicable.

There is potential for extensive effects on the health and biodiversity of aquatic fauna, in particular Freshwater catfish in the Little Murray Weir pool however, this is very unlikely. Numerous surveys have been conducted over the last few years to understand the status of the aquatic fauna population, in particular Freshwater catfish. Despite the extensive effort, only low numbers of Freshwater catfish have been surveyed and therefore the status of the population is largely unknown. However a conservative approach has been taken and it has been assumed there is a self-sustaining population of Freshwater catfish in the weir pool. As a result the key potential impacts to aquatic fauna have been identified and mitigation actions have been proposed.

Is mitigation of potential effects on water environments proposed?

☐ NYD ☐ No ☒ Yes If yes, please briefly describe.

Key mitigation actions are proposed to mitigate potential construction and operation effects associated with the project, refer Section 18.

Other information/comments? (eg. accuracy of information)

A number of detailed assessments have been completed on the Little Murray River to understand the potential effects and mitigation actions associated with the Swan Hill Modernisation Project. This has provided a sound technical basis for preparing the referral documentation however in order to maximise the benefits of lowering the Little Murray Weir to the Freshwater catfish population ongoing investigation is proposed.

Despite a range of fish surveys being completed in the Weir pool since 1995, Freshwater catfish have been recorded in very low numbers. However, anecdotal evidence from local recreational fisherman indicates that they are regularly caught in the weir pool. Given very low numbers have been recorded in survey's to date, there is very little known about their habitat and breeding sites, or their abundance and genetic diversity within the weir pool. Impacts have been assessed and mitigation actions proposed on the basis that there is healthy self-sustaining population of Freshwater catfish in the weir pool. In order to ensure that the mitigation actions proposed are effective ongoing aquatic fauna surveys of the Little Murray River are proposed.

14. Landscape and soils

Landscape

Has a preliminary landscape assessment been prepared?

☐ No ☐ Yes If yes, please attach.

Is the project to be located either within or near an area that is:

- **Subject to a Landscape Significance Overlay or Environmental Significance Overlay?**
  ☐ NYD ☒ No ☐ Yes If yes, provide plan showing footprint relative to overlay.

- **Identified as of regional or State significance in a reputable study of landscape values?**
  ☐ NYD ☒ No ☐ Yes If yes, please specify.

- **Within or adjoining land reserved under the *National Parks Act 1975* ?**
  ☐ NYD ☒ No ☐ Yes If yes, please specify.

- **Within or adjoining other public land used for conservation or recreational purposes?**
  ☐ NYD ☐ No ☒ Yes If yes, please specify.

The Little Murray River provides opportunities for fishing, camping, swimming, duck shooting and water skiing. All of these recreational activities, apart from water skiing will still be possible at the proposed lowered level.

Two trials, operating the river at approximately the proposed lowered level, have been run in the Little Murray River. These trials have been communicated with the community so they can understand what the river looks like at the proposed lowered level. Feedback has been received from the some of the community that although aesthetically the river will be different and will take some time to adjust to, it will actually provide a more natural river environment.

Is any clearing vegetation or alteration of landforms likely to affect landscape values?

☐ NYD ☒ No ☐ Yes If yes, please briefly describe.

Is there a potential for effects on landscape values of regional or State importance?

☐ NYD ☒ No ☐ Yes Please briefly explain response.

Attachment 10 shows a photograph of the Little Weir pool slightly below the proposed lowered level.

Is mitigation of potential landscape effects proposed?

☐ NYD ☒ No ☐ Yes If yes, please briefly describe.

Other information/comments? (eg. accuracy of information)

Note: A preliminary landscape assessment is a specific requirement for a referral of a wind energy facility. This should provide a description of:

- The landscape character of the site and surrounding areas including landform, vegetation types and coverage, water features, any other notable features and current land use;
- The location of nearby dwellings, townships, recreation areas, major roads, above-ground utilities, tourist routes and walking tracks;
- Views to the site and to the proposed location of wind turbines from key vantage points (including views showing existing nearby dwellings and views from major roads, walking tracks and tourist routes) sufficient to give a sense of the overall site in its setting.

Soils

Is there a potential for effects on land stability, acid sulphate soils or highly erodible soils?

☐ NYD ☒ No ☐ Yes If yes, please briefly describe.
Are there geotechnical hazards that may either affect the project or be affected by it? ☒ NYD ☐ No ☐ Yes If yes, please briefly describe. Geotechnical hazards are not anticipated to affect the project or be affected by it however, this will be confirmed when geotechnical testing is completed as part of the detailed design for the key project components. Appropriate construction design will ensure that geotechnical standards are met during all stages of the project.
Other information/comments? (eg. accuracy of information)

15. Social environments

Is the project likely to generate significant volumes of road traffic, during construction or operation?

☐ NYD ☒ No ☐ Yes If yes, provide estimate of traffic volume(s) if practicable.

During construction there may be a requirement for a slight increase in traffic when the section of channel through Swan Hill is being backfilled. This will require two to three trucks unloading fill into the channel at any one time.

Is there a potential for significant effects on the amenity of residents, due to emissions of dust or odours or changes in visual, noise or traffic conditions?

☐ NYD ☒ No ☐ Yes If yes, briefly describe the nature of the changes in amenity conditions and the possible areas affected.

Traffic management and potentially traffic detours will be required during the decommissioning of the channel sections and during the installation of the pipelines and reinstatement of road crossings. These impacts will not be significant as changes in traffic conditions will be short-term.

Is there a potential for exposure of a human community to health or safety hazards, due to emissions to air or water or noise or chemical hazards or associated transport?

☐ NYD ☒ No ☐ Yes If yes, briefly describe the hazards and possible implications.

Is there a potential for displacement of residences or severance of residential access to community resources due to the proposed development?

☐ NYD ☒ No ☐ Yes If yes, briefly describe potential effects.

Are non-residential land use activities likely to be displaced as a result of the project?

☐ NYD ☐ No ☒ Yes If yes, briefly describe the likely effects.

Water skiing at on the Little Murray River will no longer be possible post lowering. There are alternate water skiing locations in nearby Lake Boga and in the Murray River.

Do any expected changes in non-residential land use activities have a potential to cause adverse effects on local residents/communities, social groups or industries?

☐ NYD ☒ No ☐ Yes If yes, briefly describe the potential effects.

Is mitigation of potential social effects proposed?

☐ NYD ☒ No ☐ Yes If yes, please briefly describe.

Other information/comments? (eg. accuracy of information)

Cultural heritage

Have relevant Indigenous organisations been consulted on the occurrence of Aboriginal cultural heritage within the project area?

☒ No If no, list any organisations that it is proposed to consult.
☐ Yes If yes, list the organisations so far consulted.

The Torrumbarry Irrigation Area is recognised as an important cultural heritage and archaeological region in Victoria. A number of registered Aboriginal sites have been located at the junction of Barr Creek and the Loddon River and near the Little Murray River.

At present there is a Native Title Claim application being negotiated with the Wamba Wamba Barapa Barapa and Wadi Wadi peoples. The outcomes of this will influence the consultation process and statutory requirements for any future proposed activities.

In 2009 Sinclair Knight Merz were engaged by Goulburn-Murray Water to prepare a standard

Cultural Heritage Management Plan for the lowering of the Little Murray Weir. During this time, Aboriginal Affairs Victoria was contacted and the relevant Indigenous Stakeholders identified. Consequently, Wamba Wamba, Barapa Barapa and Wadi Wadi Peoples Native Title Claimants representatives were consulted during the cultural heritage assessment and in preparation of the management recommendations.

What investigations of cultural heritage in the project area have been done?
(attach details of method and results of any surveys for the project & describe their accuracy)

In 2009 Sinclair Knight Merz were engaged by Goulburn-Murray Water to complete a Standard Cultural Heritage Management Plan for the lowering of the Little Murray Weir only. The activity area included the Little Murray Weir and its immediate surrounds. The activity comprised three major components; weir lowering (described in the plan as "decommissioning"), construction of a pump station and upgrade of an access track.

In preparing the Cultural Heritage Management Plan a desktop and field assessments were completed for the site. The desktop assessment was based on a review of the relevant historical, ethnohistorical and archaeological literature for the activity area. A search of the Victorian Aboriginal Heritage Register (VAHR) at Aboriginal Affairs Victoria. The VAHR was searched for in order to:

1) Investigate the nature and extent of previous archaeological studies within the activity area and the greater region;
2) Locate previous reports relevant to the activity area; and
3) Identify previously registered Aboriginal Places within the activity area.

A standard field assessment was completed for the Cultural Heritage Management Plan. The aims of the survey were to:

1) Identify/re-inspect any new Aboriginal Places within the activity area;
2) Undertake consultation with a representative of Gourramjanyuk Aboriginal Association;
3) Identify any areas with potential to contain sub-surface archaeological deposit (that may require sub-surface testing); and
4) Document the extent of significant ground disturbance in the activity area (combination of the data from the initial reconnaissance and field survey).

Is any Aboriginal cultural heritage known from the project area?

☐ NYD ☐ No ☒ Yes If yes, briefly describe:

- Any sites listed on the AAV Site Register
- Sites or areas of sensitivity recorded in recent surveys from the project site or nearby
- Sites or areas of sensitivity identified by representatives of Indigenous organisations

The study area forms part of the Wembawemba language tribal area (Clark 1990: 20). Wembawemba territory traditionally extended from the Wakool and Edwards Rivers in NSW, west to Swan Hill and east to Cohuna in Victoria, and south to the Avoca River. It is possible that the relevant clan for the study area may be the Gorumjanyuk (meaning 'along edge of trees' (Stone 1911)) or Lake Boga clan (Clark 1990: 407). It is believed that Wembawemba were divided into moieties of Gamadj and Grugidj and followed matrilineal descent (Clark 1990: 406).

Stone (1911: 432) commented that in the Lake Boga and Little Murray region there was significant evidence of 'one-time' large population. Burial sites, ovens and middens were common on the banks of the Little Murray River and Lake Boga (Stone 1911: 432). Burial sites tended to be shallow (1.5 m) and in sandy locations.

The Aboriginal people of the region were semi-nomadic, moving inland in winter to avoid floods. Extensive travel was also involved in order to trade for stone axes and for ceremonies and marriage opportunities (Mackay et al, no date). According to Stone (1911: 460) the Wembawemba traded plentiful water reeds to be used for spears for raw materials such as stone.

Are there any cultural heritage places listed on the Heritage Register or the Archaeological Inventory under the *Heritage Act 1995* within the project area?

☐ NYD ☐ No ☒ Yes If yes, please list.

Registered Aboriginal Places
The desktop assessment identified that over 25 archaeological places have been recorded within the Little Murray River floodplain study area. Most of the places are located on the Lake Baker lunette, approximately 1 km south of the study area between the Lake Baker shoreline and the No. 1/9 Channel.

Of the registered Aboriginal Places within 2 km of the activity area (n=12), the main types are shell deposits, earthen mounds, artefacts scatters or burials. As stated above, the majority of places (n=10) were found within the lunette on the eastern edges of Lake Baker (a dry lake). Two earthen mound sites were founds on the banks of the Little Murray River. All sites show some degree of damage or disturbance as a result of land use, either from farming practices or road construction. It was concluded that none of the Aboriginal Places are located within the activity area or likely to be impacted.

Registered Historic Aboriginal Places
The assessment found that only one historic Aboriginal Place has been recorded within 2 km of the activity area. This site is a historic fishing location for a prominent local Aboriginal family in the early 1900's.

Areas of Cultural Heritage Sensitivity
Within the study region, areas of cultural heritage sensitivity (CHS), as identified by the Aboriginal Heritage Regulations 2007 (Division 3, Part 2) relate to "waterway or land within 200 m of a waterway". In this case the waterway is the Little Murray River.

Field Assessment
One Aboriginal Place (VAHR 7627-0307) was located during the field survey. It is located on Crown Allotment 2008 in the Parish of Kunat Kunat. This Place was a shell midden located on the western side of the man-made levee bank. This midden contained clay balls and freshwater mussel shell. The shell had been uncovered through animal burrowing activities. It is most likely being unearthed from underneath the man-made levee bank.

A preliminary assessment of surface remains indicates this shell midden is cultural (Aboriginal) in origin, however, this could not be confirmed without sub-surface testing.

Is mitigation of potential cultural heritage effects proposed?
☒ NYD ☒ No ☒ Yes If yes, please briefly describe.

A Cultural Heritage Management Plan will be prepared and will address all works components apart from those already covered through the broader project approvals. Construction activities already included are decommissioning of existing channels and construction of new channels.

The proposed construction activities will occur within close proximity to VAHR 7627-0307 (relevant to C2) which has been assessed as being of low-moderate scientific significance. However, all activities avoid the Aboriginal Place – only the existing access track to the Little Murray Weir is within 50m of the place and there will be no excavation occurring in that area. It is recommended that G-MW avoid impact to these Aboriginal Places by applying the following:

1) All registered Aboriginal Places must be marked on the construction plans for avoidance purposes.
2) Prior to the commencement of all construction works, G-MW must fence off all Aboriginal Places to ensure their protection.
3) All vehicles and construction equipment must remain outside of the fenced areas.
4) The relevant Indigenous stakeholder and/or cultural heritage advisor will need to be present during the fencing to ensure that the full extent of the area is protected, adequate notice should be given to the Indigenous stakeholder and/or cultural heritage advisor to ensure their availability to be present during fencing.

In addition to the specific recommendations above the following general recommendations will also be followed for the construction phase of the project:

1) A copy of the Cultural Heritage Management Plan must be kept on site for reference at all times.
2) All persons involved in the construction works for the project must be made aware of the location of all Aboriginal Places located near the works.
3) All persons must be made aware of the procedures involved if any further cultural heritage material is uncovered.
4) All employees, contractors and subcontractors must undertake a Cultural Heritage Induction prior to the commencement of works. The cultural heritage advisor should be contacted, with sufficient notice to organise this.

Other information/comments? (eg. accuracy of information)

It should be noted that Pursuant to s.54 of the *Aboriginal Heritage Act 2006 (the Act)* a Notice of Intent to Prepare a Cultural Heritage Management Plan (NOI) was lodged with Aboriginal Affairs Victoria (AAV) on 6 April 2009. At the time the NOI was submitted G-MW were the project sponsor.

An automated response was received from AAV on 17 April 2009 confirming that the Secretary, Department of Planning and Community Development (the Secretary) had received the NOI and that the notification had been allocated CHMP number 10780. This NOI relates to the CHMP discussed above. The CHMP was never approved by Aboriginal Affairs Victoria.

The Northern Victoria Irrigation Renewal Project (NVIRP) was formed in 2008 and the Swan Hill Modernisation became the responsibility of NVIRP to plan and implement. On that basis, a revised NOI was submitted to the Secretary on December 2010. The activity area included in the NOI was much broader and encompassed all components, unless already approved through other mechanisms, of the Swan Hill Modernisation Project. A CHMP was drafted but never submitted.

In 2012, NVIRP was absorbed back into G-MW. A Cultural Heritage Management Plan including all components of the Swan Hill Modernisation Project will be prepared prior to construction beginning.

16. Energy, wastes & greenhouse gas emissions

What are the main sources of energy that the project facility would consume/generate?

- [x] Electricity network. If possible, estimate power requirement/output …Unknown.
- [ ] Natural gas network. If possible, estimate gas requirement/output ……...
- [ ] Generated on-site. If possible, estimate power capacity/output …….
- [ ] Other. Please describe.

Please add any relevant additional information.

What are the main forms of waste that would be generated by the project facility?

- [ ] Wastewater. Describe briefly.
- [ ] Solid chemical wastes. Describe briefly.
- [x] Excavated material. Describe briefly.
- [ ] Other. Describe briefly.

Please provide relevant further information, including proposed management of wastes.

Excavating / fill material ancillary to the construction of the SHMP, in particular material will need to be excavated at each of the pump station sites, the fish passage sites and the along the new section of channel between the No. 9 and No. 10 systems however, a large portion of this will be used to form the banks of the channel.

What level of greenhouse gas emissions is expected to result directly from operation of the project facility?

- [x] Less than 50,000 tonnes of CO_2 equivalent per annum
- [ ] Between 50,000 and 100,000 tonnes of CO_2 equivalent per annum
- [ ] Between 100,000 and 200,000 tonnes of CO_2 equivalent per annum
- [ ] More than 200,000 tonnes of CO_2 equivalent per annum

Please add any relevant additional information, including any identified mitigation options.

17. Other environmental issues

Are there any other environmental issues arising from the proposed project?

☒ No ☐ Yes If yes, briefly describe.

18. Environmental management

What measures are currently proposed to avoid, minimise or manage the main potential adverse environmental effects? (if not already described above)

- ☒ Siting: Please describe briefly
- ☒ Design: Please describe briefly
- ☒ Environmental management: Please describe briefly.
- ☒ Other: Please describe briefly

Add any relevant additional information.

The nature of the works will cause direct construction impacts and also impacts associated with the changed operation of the Little Murray River. As identified in Section 11 the main potential adverse environmental effects associated with the Swan Hill Modernisation Project relate to the lowering of the Little Murray Weir. The potential adverse environmental effects of this are predominantly associated with aquatic fauna, in particular water quality deterioration, loss and degradation of habitat and a reduction of connectivity between in-stream habitats.

A number of measures are proposed to ensure that potential adverse environmental impacts resulting from the construction and operation of the Swan Hill Modernisation Project are avoided, minimised and managed, each of these is described below.

Construction
A number of key construction activities are proposed in the Little Murray River, as described in Section 3. The main construction impacts include operation of machinery in construction areas resulting in impacts/removal of native vegetation. Impacts to water turbidity caused by bed and bank disturbance by machinery. These potential impacts will be managed by ensuring that sensitive areas are identified and where possible fenced off during construction to ensure they are avoided. In addition, bunding, silt traps and geo-fabric will be used to avoid construction impacts.

Site layout is a key component of managing environmental effects associated with construction. Works will be laid out, where possible, to avoid native vegetation and to avoid, minimise and manage potential impacts on cultural heritage values. Laydown and stockpile areas, vehicle access will be deigned in a way that minimises impacts.

Site Environmental Management Plan
A Site Environmental Management Plan will be developed to ensure that all construction activities associated with the Swan Hill Modernisation Project, including those outside the Little Murray Weir pool, are implemented in accordance with all relevant Acts and legislation. The Plan will include detail regarding the siting and location of works including lay down areas, stockpile locations, construction facilities, car park areas and management of water, dust and noise. The plan will be prepared in accordance with G-MW's Environmental Management System (EMS) which is currently accredited under ISO14001.

Cultural Heritage Management Plan
A Cultural Heritage Management Plan will be prepared for the entire Swan Hill Modernisation Project to ensure compliance with the Aboriginal Heritage Act.

In addition to the specific recommendations that will be identified in the Cultural Heritage Management Plan the following general recommendations will also be followed for the construction phase of the project:

- A copy of the Cultural Heritage Management Plan must be kept on site for reference at all times.
- All persons involved in the construction works for the project must be made aware of the location of all Aboriginal Places located near the works.

- All persons must be made aware of the procedures involved if any further cultural heritage material is uncovered.
- All employees, contractors and subcontractors must undertake a Cultural Heritage Induction prior to the commencement of works. The cultural heritage advisor should be contacted, with sufficient notice to organise this.

During the construction phase site environmental management will be carried out by a contractor, the Contractor who will be engaged to oversee the implementation of the Swan Hill Modernisation Project. The contractor will maintain regular contact with the G-MW Project Manager.

Operation

A number of key aspects have been considered through the investigation phase that have or will carry through into operation. The future operation of the system has the greatest potential for impact to listed species and values. The potential impacts will largely be avoided, managed or minimised through the operation of the system, these are detailed below:

Level of the lowered Little Murray Weir and Fish Point Weir – Instream Habitat Connectivity

Flow objectives

Preliminary environmental flow suggestions and objectives were developed for the Little Murray River as part of the Aquatic Fauna Assessment completed by Environous and Streamline Research (2012), the key flow objectives are as follows:

- Maintenance of a minimum depth throughout the Little Murray Weir pool of 0.3 to 0.5 m;
- Sufficient flows to dilute and freshen water quality;
- Avoiding large pulses in flow during egg spawning and incubation period of Freshwater catfish (October to February); and
- Salinity thresholds not to exceed 2,000 EC, so as to avoid impacts to aquatic fauna.

Setting of weir levels to achieve minimum depth criteria

Fluvial Systems were engaged to complete a detailed assessment of the hydraulics in the Little Murray Weir pool. The recommendations and objectives developed by Environous and Streamline Research (2012) were used to model a range of scenarios. The outputs were used to set the proposed sill heights at both Little Murray Weir and Fish Point Weir i.e. 67.3m AHD and 67.8m AHD respectively. At these design levels the modelling (for over a 100 year period) indicated that the recommended minimum depths at the shallowest point of the river are achieved in all seasons for the majority of time. Therefore, the majority of the river will have much greater depths, than the 0.5 m, throughout its length.

Provision of fish passage

In conjunction with setting weir levels to meet the minimum depth objective, fish passage is proposed at both Fish Point Weir and Little Murray Weir. Currently there is no fish passage at either weir, except when the system is in flood and both weirs are opened. The introduction of fish passage will improve habitat connectivity and allow fish to move through the system unimpeded.

Operation of Fish Point Weir – Water Quality Deterioration

Salinity, turbidity, water temperature and dissolved oxygen concentrations are likely to be affected due to reduced volume and depth of water within the Little Murray River weir pool, unless mitigation action are proposed. A significant water quality decline may result in a fish kill, particularly among the larger species of Freshwater Catfish, Silver Perch, Murray Cod and Golden Perch. A number of mitigation actions are proposed to manage this, as described below.

Changed operation of Fish Point Weir resulting in a passing flow

The hydraulic modelling completed by Fluvial Systems (2013) was used to indicate what flow conditions in the weir pool would be like if it was lowered to the proposed level and Fish Point Weir was kept closed. The results indicated that like current conditions there would be cease to flow conditions between Fish Point Weir and the 6/7 Channel outfall, therefore potentially impacting on water quality. In order to mitigate this, changes to the operation of Fish Point Weir

are proposed. Rather than being kept closed throughout the year (the current default operational mode), Fish Point Weir will be kept open and water will pass from the Murray River and Loddon Rivers into the Little Murray River. The hydraulic modelling indicates that operating Fish Point Weir in this way will provide a minimum of 300ML/day 95% of the time. Regulation of water, by upgraded regulating structure at Fish Point Weir will allow the flow conditions in the river to be managed to meet the depth, velocity and water quality requirements of environmental values such as aquatic fauna.

This will provide a number of benefits: it will provide an environmental flow throughout the Little Murray River, including below Little Murray Weir which currently receives no flow; it will manage water quality and in-stream habitat connectivity. Operating the system in this way provides a greater flexibility in delivery of water and allows the flow guidelines and objectives, developed as part of the Aquatic Fauna Assessment, to be met. The key flow objectives outlined in Environous and Streamline Research (2012) can be met in the absence of an Environmental Flow Study, using the Operational Plan for the Little Murray River (see below), however a flow study is proposed to maximise the benefits of these flows to the entire native fish community and to the riverine ecological processes, which have been incidentally managed since the river was regulated.

Ongoing monitoring and adaptive management
Monitoring of water quality will be an important mechanism to understand and manage any potential water quality issues in the weir pool. An additional water quality probe is proposed to be installed between Fish Point Weir and the No. 6/7 Channel. This will be in addition to current site at the Little Murray Weir and upstream monitoring at Kerang Weir. Parameters to be monitored include Dissolved Oxygen, Temperature, Turbidity and Salinity. Should salinity levels in the Loddon exceed acceptable levels Fish Point Weir will be closed.

System operation will be monitored on a regular basis to ensure that the system is operating in the way proposed. For example, fish passage is proposed at both Fish Point Weir and at the Little Murray Weir and, therefore, ongoing monitoring will be required to ensure that fish passage is operating as it should be. In addition, areas where remedial works are proposed i.e. revegetation of deep pools, monitoring will be carried out to ensure vegetation is establishing and that weeds aren't becoming an issue.

Ongoing monitoring of the aquatic fauna, in particular Freshwater catfish will be carried out in the weir pool. The ongoing monitoring will confirm the status of the population and will help adaptively manage the system. Monitoring will occur twice in the first five years following implementation.

Operational Plan for the Little Murray River
A Draft Little Murray River Operational Plan has been prepared. The purpose of the Operational Plan is to detail how the system will be operated in order to meet the flow objectives of the system both from an environmental perspective and from an irrigator demand perspective. This includes triggers and thresholds for managing salinity into the weir pool, through flow requirements, flood operation and water accounting. This has been prepared in consultation with the Department of Environment and Primary Industries, Goulburn-Murray Water and the North Central Catchment Management Authority.

In-stream habitat restoration – Loss and degradation of habitat
One of the significant environmental effects that could occur without appropriate mitigation is the loss and fragmentation of in-stream habitat. Given the system has been regulated for over 100 years and held at bankfull for the majority of time, a large percentage of habitat is found at the full supply level. Therefore, lowering the weir pool to the proposed level will significantly reduce the availability of in-stream habitat for aquatic fauna. A number of mitigation actions are proposed to avoid, minimise and manage these potential effects, these are described below.

A bathymetric survey was completed for the entire length of the Little Murray Weir pool. The results of the bathymetric survey provided a detailed understanding of where in the weir pool the deep refuge pools are and where the shallow areas are. This data was used in the hydraulic modelling and was also used to identify target mitigation actions. A number of key restoration activities are proposed including:

- Introduction and placement of large woody debris
- Fencing
- Targeted aquatic/semi aquatic revegetation linked to deep pools and large woody debris replacement
- Transitional lowering

Introduction and placement of large woody debris – to be completed in year one
Large woody debris will be introduced to approximately 30 of the deep pools along the weir pool. There are approximately 45 deep pools along the weir pool, not all of these are accessible nor will they be suitable for the introduction of woody debris. Introducing woody debris to 30 pools will provide a substantial increase to habitat and the diversity of habitat, throughout the weir pool therefore, providing habitat for aquatic fauna, particularly large bodied fish species.

In conjunction with this, a number of other complementary actions are proposed including:

Fencing – proposed to be completed in year one
A large proportion of the river is currently unfenced and livestock can access the river. During the non-irrigation season when the weir pool is drawn down, stock can cross the river in some locations. Should the proposed lowering of the weir pool proceed, it will be important to minimise stock access to the river to ensure that aquatic and semi-aquatic vegetation gets an opportunity to establish.

Fencing will be important for reducing stock access to the river; this will encourage the faster establishment of native vegetation along the riparian zone. It is estimated that up to 30 km's of fencing will be required; this is based on protecting the deep pool areas where the introduction of large woody debris is proposed. Fencing will ensure that no further habitat degradation occurs and will also ensure that habitat is improved. Fencing will also assist in managing water quality impacts.

Targeted Aquatic/semi aquatic revegetation linked to deep pools and large woody debris placement – to be completed in year one
Targeted revegetation is proposed in areas surrounding deep pools. The revegetation will be carried out using locally indigenous plant species to encourage broader establishment of native species and will also be targeted towards the deep pool areas. Aquatic and semi-aquatic vegetation provides important habitat for fish species particularly Freshwater catfish and small bodied fish. The amount of revegetation required will vary from site to site and will be confirmed once the deep pool sites have been identified.

Weed control will be carried out at these sites to ensure revegetation has the best chance of establishment. It is also expected that the growth of colonising native species such as cumbungi and phragmites will largely be managed by the passing flow through Fish Point Weir. While these species are still likely to establish in the shallow, low velocity areas, it is expected that due to flow conditions generated by the passing flow that conditions will be unfavourable for the majority of time.

Transitional Lowering
A transitional approach will be developed to allow time for the key environmental features to adapt to the new regime. The lowering of the Little Murray Weir will be phased over a one to two year period prior to a complete and permanent lowering.

Draft Environmental Management Plan
The mitigation actions described above have been captured in a draft Environmental Management Plan for the Little Murray River. The Plan will be used to guide mitigation activities required as part of the Swan Hill Modernisation Project as well as set objectives and management targets for the longer term management of the river. The plan will also include communication and engagement with the community and other key stakeholders.

Based on the mitigation actions proposed it is expected that the potential adverse effects of the Swan Hill Modernisation Project can be avoided, minimised and managed, particularly in relation to potential effects to aquatic fauna. It is expected that the implementation of the above mitigation

actions will provide a significant improvement to the current condition of the Little Murray River.

19. Other activities

Are there any other activities in the vicinity of the proposed project that have a potential for cumulative effects?

☐ NYD ☒ No ☐ Yes If yes, briefly describe.

20. Investigation program

Study program

Have any environmental studies not referred to above been conducted for the project?

☒ No ☐ Yes If yes, please list here and attach if relevant.

Has a program for future environmental studies been developed?

☐ No ☒ Yes If yes, briefly describe.

A program for future environmental studies has been developed, this involves the following:

Further investigation of Freshwater catfish – Freshwater catfish have been surveyed in very low numbers in all fish surveys completed in the weir pool over the last 15 years. Therefore, there is very little known about their habitat and breeding sites, or their abundance and genetic diversity within the weir pool. It is proposed that further surveys be conducted to ensure benefits to the species are maximised, this will be done post construction.

Completion of the Environmental Management Plan - The Environmental Management Plan for the Little Murray River will be completed including additional community consultation.

Consultation program

Has a consultation program conducted to date for the project?

☐ No ☒ Yes If yes, outline the consultation activities and the stakeholder groups or organisations consulted.

A number of public consultation processes have been carried out throughout the project and a number of consultation processes are continuing as the project develops. The key consultation processes are detailed below:

Communication Strategy

A detailed Communication Strategy was prepared for the SHMP. Significant consultation occurred throughout the development of the Swan Hill Modernisation Plan.

Landholder discussions

Tyntynder

Following the public meetings in December 2011, an Expression of Interest process was ran in Tyntynder. The process determined the level of interest from irrigation and stock and domestic customers in relinquishing Delivery Shares, exiting irrigation altogether and maintaining a stock and domestic supply, or transferring to the Woorinen pipeline system. The EOI process received a positive response which enabled Farm Irrigation Assessors (FIA) to target individual landholders regarding their on-farm reconfiguration options.

Little Murray Weir

FIA's have also been out talking to customers on the Little Murray River regarding what they would need to do to maintain their supply should the Little Murray Weir lowering proceed. Currently there are a number of customers who gravity irrigate from the weir pool, should the lowering proceed, these customers would need to move to a pumped supply. The customers, who already have a pumped supply, may need to extend suction lines or change/upgrade pump configurations to allow for the additional head that will need to be pumped.

The FIA assessed the customers current supply arrangements and what would be required to ensure their supply at the proposed lowered level. The options were costed and landholders were supplied with a concept of their supply should the project proceed.

Swan Hill

Landholders on the section of the No. 9 Channel proposed to be decommissioned were interviewed regarding their supply. The purpose of the interviews was to inform people about the SHMP, to understand their current irrigation demand and how it related to their entitlement and to

gauge their level of interest in relinquishing Delivery Share. The interviews targeted landholders who had entitlements of 5 ML or above.

Stakeholder / Community discussions

Little Murray Weir Pool Customer Committee
Following the public meetings in December 2011, the customers on the Little Murray Weir pool established a customer committee to ensure the interests and views of the irrigation community on the weir pool were represented. G-MW has met with the committee on six occasions to provide information and seek the committee's input on aspects of the project. The committee most recently met on 11th December 2012.

Little Murray River Environmental Management Plan – Steering Committee
A Steering Committee, involving the Department of Environment and Primary Industries, VR Fish, the North Central Catchment Management Authority, Goulburn-Murray Water and local landholders have been involved in developing an Environmental Management Plan for the Little Murray River which includes actions to mitigate the potential effects of the Swan Hill Modernisation Project.

Swan Hill Rural City Council
Regular presentations and updates have been provided to the Swan Hill Rural City Council since the projects inception in 2009. Presentations have also been given at a number of Council Assembly meetings. In August 2012, the Council passed a motion of support for the ongoing development of the project.

Torrumbarry Reconfiguration and Asset Modernisation Strategy (TRAMS) Committee
Regular updates have been provided by G-MW staff to the TRAMS Committee. The TRAMS Committee were involved in the initial formulation of the Swan Hill Modernisation Plan through the Torrumbarry Reconfiguration and Asset Modernisation Strategy and maintained a keen interest in the project throughout its development. The TRAMS Committee has since been incorporated into the Torrumbarry Water Services Committee, who have also been provided with regular project updates.

State / Federal Government Departments
Ongoing discussions have been held with several Government Departments including:
Department of Planning, Communities and Development;
Department of Sustainability and Environment;
Department of Primary Industries (Fisheries); and
Department of Sustainability, Environment, Water, Planning and Communities.
These discussions have focussed largely on future referrals under relevant State and Federal environmental legislation.

Newsletters
Four Swan Hill Modernisation Project Newsletters have been prepared and circulated to all customers on the No. 9 and No. 10 channel systems and the Little Murray Weir pool (approximately 700). The purpose of the Newsletters was to keep customers updated on project progress.

Public Meetings
A series of public meetings were held in December 2011. The purpose of the meetings was to provide an update to the community on the SHMP and to seek their input on the works proposed. The meetings were attended by approximately 180 people from the project area. While the meetings were being held, NVIRP staff made themselves available to answer questions on a one to one basis.

Has a program for future consultation been developed?
☐ NYD ☐ No ☒ Yes If yes, briefly describe.

An ongoing consultation program is being developed for the next phase of the project. This will

involve targeted consultation with individual landholders involved in the project. It will also involve ongoing consultation with agencies at a local, State and Federal level.

Authorised person for proponent:

I, ……(full name),

……(position), confirm that the information contained in this form is, to my knowledge, true and not misleading.

Signature _____

Date

Person who prepared this referral:

I, …Scott Morath……(full name),

Water and Environment Operations Centre Manager (SA)……(position), confirm that the information contained in this form is, to my knowledge, true and not misleading.

Signature _____

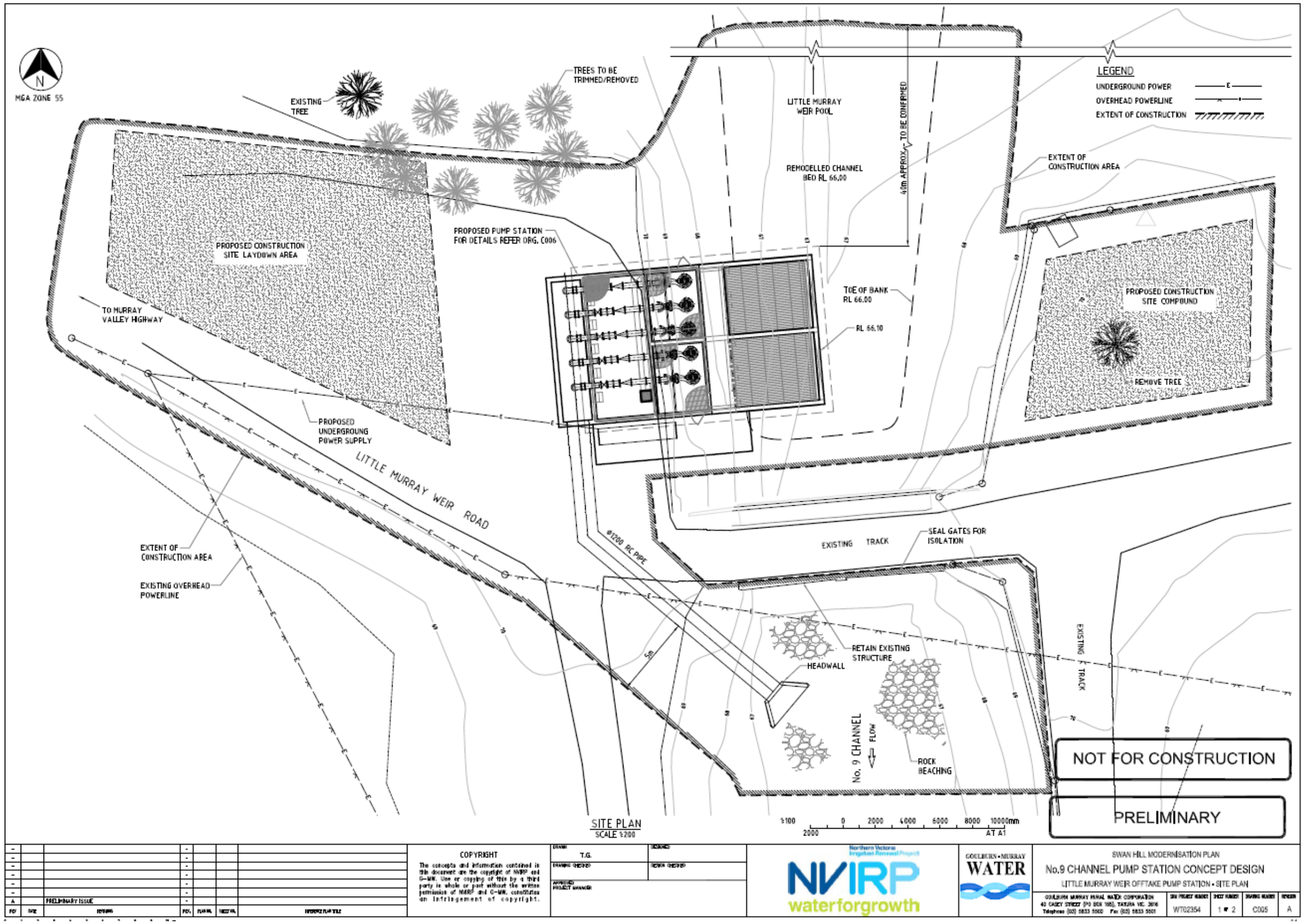
Date 02/10/13

Attachment 1 – Map showing location of the Swan Hill Modernisation Project

Attachment 2 – Location of Fish Point Weir

Attachment 3 – Location of Little Murray Weir

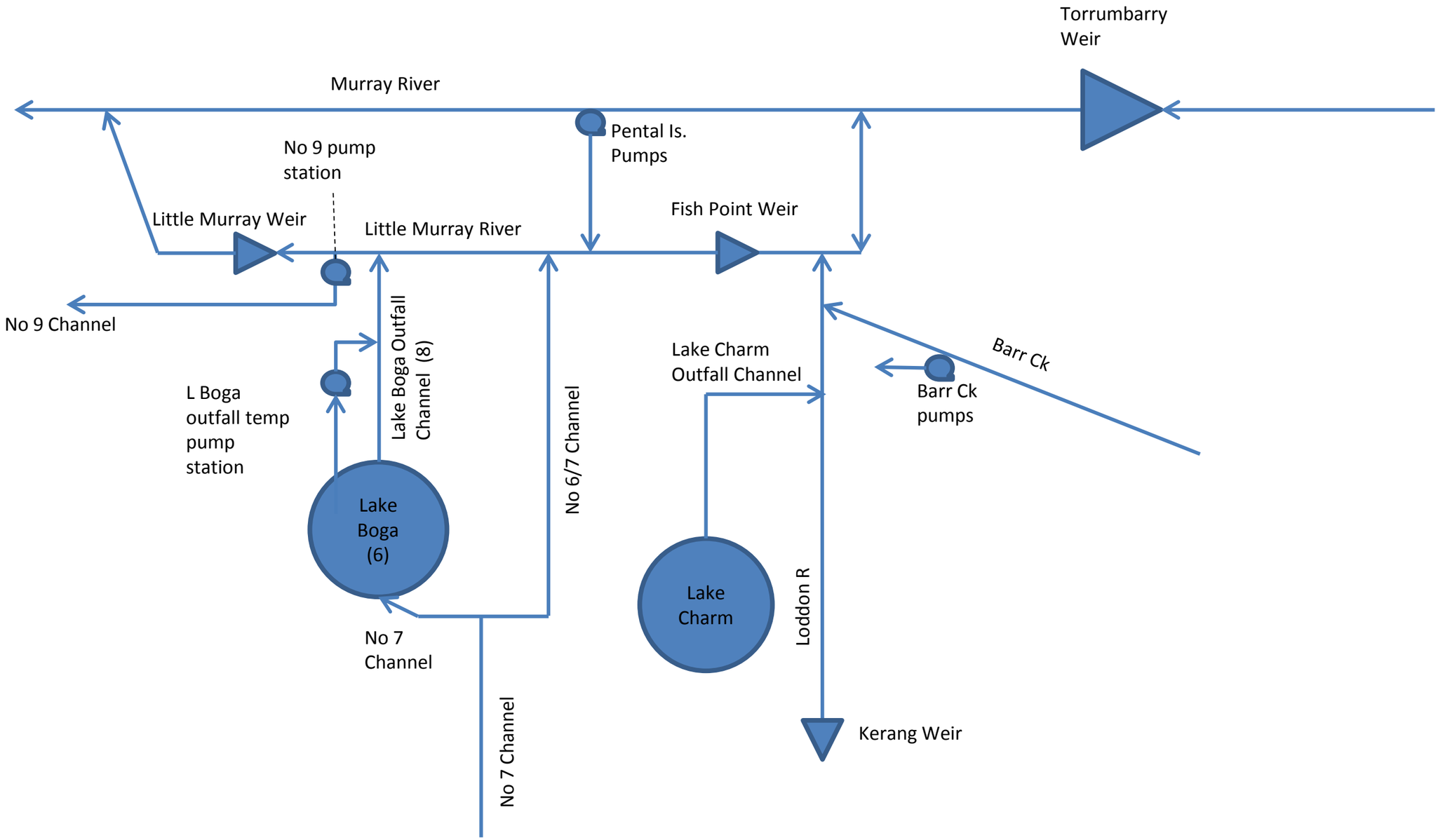
Attachment 4 – No. 9 Pump Station Layout (Preliminary)



Attachment 5 – No. 9 Channel Decommissioning

Attachment 6 – Woorinen Extension – Proposed section of channel to be decommissioned and piped

Attachment 7 – Torrumbarry Irrigation Area Schematic Diagram



Attachment 8 – Photograph of Fish Point Weir

Drop door structure

Drop bar structure

Attachment 9 – Photograph of Little Murray Weir

Little Murray Weir Structure

Attachment 10 – Photograph of Little Murray Weir pool

Little Murray River – slightly lower than proposed lowered level – no flow was being passed down the river when the photograph was taken

Attachment 11 – Photograph of the No. 9 Channel through Swan Hill

Section of the No. 9 Channel through Swan Hill

Attachment 12 – Construction Zone 1

Attachment 13 – Construction Zone 2

Attachment 14 – Construction Zone 3

Attachment 15 – Construction Zone 4

Attachment 16 – Final Report – Swan Hill Modernisation Project – Reconfiguration of the Swan Hill Region

In 2010, a comprehensive Modernisation Plan was prepared for the Swan Hill Irrigation Region. Completed by independent consultants, URS, the objective of the Plan was to extend the previous work of TRAMS to determine the actions required to reconfigure the irrigation infrastructure of the Swan Hill Irrigation Region, including Little Murray Weir, to best meet the future demands of the irrigation network.

The key drivers for developing the Swan Hill Modernisation Plan were to:

- Address the structural and operation concerns associated with the Little Murray Weir;
- Align channel delivery capacity in the No. 9 Channel with the future delivery shares that would result from the Connections Program;
- Address the concerns associated with the passage of the No. 9 Channel through the City of Swan Hill as an open waterway;
- Enhance environmental values in the Little Murray River;
- Align with the Victorian Mid-Murray Storage Project; and
- Secure water savings.

The Swan Hill Modernisation Plan assessed opportunities to gain water savings by lowering the Little Murray Weir pool and reconfiguring the Torrumbarry No. 9 and No. 10 channel systems near Swan Hill. The aspects assessed in the report included:

- The future of the Little Murray Weir (LMW), given that the weir is reaching the end of its physical life and the existence of significant OH&S risk associated with its current operations;
- If the LMW were to be lowered, to identify an alternative water supply source to meet current customer demand (including for those supplied directly from the LMW pool), as well as the infrastructure required to meet the environmental objectives of the Mid-Murray Storages project;
- The operation of the open, irrigation supply channel (the No. 9 Channel) through the Rural City of Swan Hill and whether the presence of such a channel would be acceptable from a public health and safety perspective;
- If the No. 9 Channel were removed, to identify an alternative water supply option in order to meet future demand on the No. 9 Channel north of Swan Hill;
- The impact on the No. 9 Channel capacity requirements, based on changes in the volume of irrigation water that now needs to be delivered to meet current delivery share (DS) demand, or adjusted DS demand arising from the Connections Program, and whether that capacity should be adjusted; and
- Overall, the potential water savings associated with reconfiguring the existing irrigation infrastructure.

Attachment 17 – Lowering of the Little Murray Weir: Potential aquatic fauna impacts

Environous and Streamline Research were engaged to assess the impacts to state and national listed fish fauna as a result of the proposed lowering of the Little Murray Weir. The specific scope of the study was to:

- Compile a list of fish fauna previously recorded in the Little Murray Weir pool;
- Present the information obtained during a short site assessment and fish survey;
- Determine the fish species and fish communities of the Little Murray Weir pool that have protection under FFG Act and the EPBC Act;
- Assess the key requirements of protected species and communities to inform the preparation of an Environment Effects Act 1978 (EES) Referral and a Referral consistent with EPBC Matters of National Environmental Significance (MNES); and
- Develop mitigation options to limit the impact to key protection fish and communities of the proposed water level lowering.

Attachment 18 – Assessment of the hydraulics of the Little Murray River Weir Pool under alternative operating scenarios

Fluvial Systems were engaged to consider the hydraulics of the Little Murray River under current conditions and proposed conditions, the specific objectives of the investigation were as follows:

- Determine the volume of the water held in the Little Murray River weir pool under the current operating conditions.
- Determine the volume and timing of water that will pass through Fish Point Weir from the River Murray and into Little Murray River, if Fish Point Weir is kept open whenever possible.
- Determine the volume and depth of water that will be held in the Little Murray River at a range of levels at Little Murray Weir and Fish Point Weir.
- Assess the likelihood of not being able to meet peak irrigation demands.
- Assess the hydraulic habitat conditions in the Little Murray River under potential alternative operating scenarios.
- Model the salinity time series of Little Murray River under the potential operating scenarios with respect to ecological and irrigation requirements.
- Refine the estimates of the long-term water savings achieved under selected alternative operating scenarios.

Attachment 19 – Land Tenure C1

Attachment 20 – Land Tenure C2

Attachment 21 – Land Tenure C3

Attachment 22 – Land Tenure C4

Attachment 23 – Flora and fauna assessment for EPBC and other applications

Sinclair Knight Merz were engaged to carry out a terrestrial flora and fauna assessment of Swan Hill Modernisation Project sites in relation to any potential impacts to matters listed under the EPBC Act or the FFG Act. The purpose of the assessment was to identify any known or likely occurrences of matters listed under the EPBC Act and the FFG Act, including threatened or protected species, and ecological communities that may be impacted by, as well as any threatening processes which may occur as a result of the Swan Hill Modernisation Project. The specific objectives of the assessment were to:

- Undertake a desktop assessment of the Swan Hill Modernisation Project using the Victorian Sustainability Victorian Biodiversity Atlas and the Commonwealth Department of Sustainability, Environment, Water, Population and Community Protected Matters Search Tool.
- Undertake a field assessment of the Swan Hill Modernisation Project to identify any EPBC and FFG Act listed or protected species, communities, and identify the potential for any listed threatening processes to occur.
- If any FFG or EPBC Act listed species are known, or are considered likely to occur, assess species-habitat relationships.
- Recommend appropriate management measures to minimise and, where possible, avoid any impact to species and communities of significance;
- Where species and communities of significance are likely to be impacted, determine the significance of the impact, and the requirement for approvals under State and Commonwealth legislation.

Attachment 24 – Little Murray Weir Pool – Aquatic and Semi-aquatic Flora Survey and Assessment Following Weir Pool Lowering: 2011 Revision

Ecological Associates were engaged to assess the aquatic and riparian vegetation along the Little Murray River and how the vegetation would be impacted by lowering of the Little Murray Weir pool. The purpose of the survey was to review the nature of impacts associated with the proposed option to lower the weir pool and report the likely significance of impacts on *EPBC Act* and *FFG Act* listed species, communities and threatening processes in relation to the *EPBC* Significant Impact Guidelines and recommend any specific water requirements required to maintain the health of aquatic, semi-aquatic and riparian vegetation in and along the Little Murray Weir pool. The specific scope of the assessment was to:

- Review existing records of *EPBC Act* and *FFG Act* listed species, communities and threatening processes from the site and its vicinity;
- Map aquatic and semi-aquatic plant communities associated with the Little Murray Weir Pool;
- Report the plant communities present and their composition;
- Revisit the site when it was being operated nearer to the proposed operating level to identify any additional aquatic and semi-aquatic plant communities associated with the weir pool;
- Report the conservation status of plant species under the *EPBC Act* and *FFG Act* and report the locations of species of conservation significance;
- Review the nature of impacts associated with the proposed option and report the likely significance of impacts on *EPBC Act* and *FFG Act* listed species, communities and threatening processes in relation to the *EPBC* Significant Impact Guidelines; and
- Report the findings and provide maps of plant communities and any issues of conservation significance.

Attachment 25 – Hydrogeological Desktop Analysis – Lowering of the Little Murray Weir Pool

RPS Aquaterra was engaged to prepare a hydrogeological desktop analysis to examine the potential salinity impacts arising from the proposed operational changes to the Little Murray Weir and to quantify the volume of water leaking from the weir pool to groundwater. The specific scope of the study was to:

- Evaluate and interpret existing data and reports to develop a conceptual model of the surface water/groundwater interactions for the Little Murray River.
- Use the existing data to develop a HOTSPOTS model to predict salt load discharge to the Little Murray River as a result of lowering of the Little Murray Weir and potential increases in groundwater fluxes to the river.
- Use the predicted salt loads and existing data to make preliminary assessments of flow and salinity inputs and outputs to Little Murray Weir Pool to derive estimates of salt concentration within the weir pool. This information was used to inform the assessment of impacts to aquatic values.