Australian Government

MURRAY–DARLING BASIN AUTHORITY

MDBA technical report for Department of Agriculture and Water Resources

Murray and Murrumbidgee Valley National Parks

Engineering Assessment of SDL Adjustment Business Case submitted by NSW

April 2016

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Executive Summary

NSW has submitted a Business Case for the SDL adjustment project*: Murray and Murrumbidgee Valley National Parks.*

The proposal can be divided into two elements which function independently of each other:

- Yanga Forest (Murrumbidgee Valley National Park) component.
- Millewa Forest (Murray Valley National Park) component.

The Yanga Forest component interacts with the Nimmie-Caira Infrastructure Modification SDL adjustment supply measure project, with proposed integrated water delivery from Nimme-Caira to Yanga.

Key issues

Technical Feasibility and Fitness for Purpose

The component projects are presented at feasibility design stage. The level of investigation, costing and stakeholder engagement is consistent for a feasibility level of project development.

As presented there is nothing of a technical nature that would indicate that the project should not proceed to developing a full concept design for both Yanga and Millewa. A number of key issues are raised below which the MDBA recommends are addressed as part of the development of concept designs:

Hydraulic modelling

The development and refinement of hydraulic models at both Yanga and Millewa is required to refine the operating regime and associated flow rates. This will in turn inform the engineering design for gates and structures as well as inform the need for fishways and required design parameters (water levels, head differentials, etc).

Refinement of the hydraulic model for Yanga Forest to incorporate the proposed infrastructure is considered critical to the optimisation of this scheme of works and understanding the operational linkages with Nimmie-Caira.

Hydraulic modelling of the Aratulla Creek and Bullatale Channel area is also considered to be a critical piece of work to understand the interaction between proposed environmental flows along Aratulla Creek and existing supply flows through Bullatale Channel. This will also enable the benefits of the additional option of replacing the Bullatale Channel offtake regulator (or other potential options) to be quantified and assessed during the concept design phase.

Operating regime

The development and simulation of a proposed long term operating regime is also considered a key component of the development of concept designs. The operating regime should be informed by and feed into the hydraulic modelling to enable confirmation of required flow rates and levels for the design of structures.

Structure Type and Functionality

The project involves the modification of a number of existing structures and the construction of new structures where the existing structures do not provide adequate functionality or structural

integrity to deliver the proposed watering regime. The structures proposed are generally of a small or medium scale (sills, culverts, small/medium regulators) and similar in nature to structures constructed under the EWMP.

The current designs are of a feasibility level of development and further detailed site investigations (survey and geotechnical) in addition to hydraulic modelling are required to inform the development of robust concept designs.

Ownership and O&M Arrangements

The majority of structures at Yanga and Millewa are proposed to be owned and operated by NSW NPWS. The estimate of operation and maintenance costs provided in the business case is low and appears to only consider the FTE salary required to operate the works and does not appear to include the cost for maintenance and repairs of the structures (e.g. servicing gates, replacing seals).

There are some additional O&M complexities associated with the proposed works at Bullatale Channel, Gulpa Cutting and Moira Cutting. In all three cases new works are proposed which will be owned, operated and maintained by NPWS on existing channels which are operated and maintained by other parties. This presents a potential O&M risk going forward and ongoing agreements between the key parties will need to be developed in all instances for all associated assets including the appropriate maintenance of existing channels. The MDBA is of the view that these agreements should be in place prior to the project progressing to construction.

Given the current state of disrepair of some existing structures in the project area, more detail would be expected from the proponent to provide adequate assurance that the proposed works will be maintained appropriately to deliver the environmental outcome the investment seeks.

Costs

The costs estimates for the proposed works, based on the feasibility level of design, are of an order that would be expected for these works. The cost estimates should be refined during concept design as design criteria are confirmed and there is greater certainty around foundation conditions from geotechnical investigations.

The 50% contingency adopted for the Business Case is considered appropriate for the current stage of project development.

Risks

The Business Case has conducted a high level risk assessment and proposed mitigation strategies that are appropriate for projects that are in the feasibility design stage. The majority of risks on this type of project can be addressed through contemporary project management with the actions explicitly costed or within the scope of the project contingency to meet the costs.

The MDBA has identified two risks that are outside the scope of the project to adequately address through the application of a traditional percentage based contingency provision due to the potential for very high costs should they be realised. These are Riverine Flooding and Cultural Heritage. Consideration has also been given to Third Party interactions associated with the various components of the project.

Riverine Flooding / Site inundation

No allowance has been made in the Business Case for delays due to flooding during construction.

Constructing works in the river channel and on the floodplain results in flooding posing a very significant financial risk and one for which there are limited mitigation options.

The cost estimates in the Business Case has not made provision for the flood risk cost to be passed to the contractor and as such it remains with the project proponent. Passing the flood risk cost to the contractor is not a reasonable approach in any case.

Given the Business Case is one of several proposed by NSW and these will be delivered over several years it is unlikely that all would be impacted by floods. However, it is not possible to determine in advance which projects will be affected and to allocate appropriate budget to meet associated costs. A suggested approach is to allow a provision for costs associated with flooding across the whole program of works and to draw on this on an as needs basis during construction.

Cultural Heritage

No allowance has been made in the Business Case for delays due to Cultural Heritage during construction.

Despite the best intention and planning the potential for cultural items to be exposed during construction remains. This could result in the need to cease work and potentially demobilise the site while investigations are undertaken and appropriate steps taken to address the issue.

The overall magnitude of the proposed allowance is a matter of judgement and risk appetite. If significant cultural heritage is found in places that were not identified in the CHMP process, as occurred in the EWMP Koondrook project, the costs can be very significant and the allowances will not be adequate.

Third Party

Based on the information provided in the business case, the projects appear to have minimal third party interactions, however there are uncertainties regarding third party impacts, particularly for Millewa project. Any third party impacts that require the development of agreements need to be considered as part of concept design and should be resolved upfront prior to the commencement of construction, particularly where third party negotiations are crucial for the ongoing operation and/or ownership of the works.

Introduction

This report has been prepared for the Department of Agriculture and Water Resources by the MDBA as part of the review of the Business Cases for projects submitted under the Sustainable Diversion Limit Adjustment process.

The report provides the Department of Agriculture and Water Resources with an overview of the Business Case for **Murray and Murrumbidgee Valley National Parks**, prepared by NSW Office of Environment and Heritage (OEH).

Due Diligence Review Approach

In conducting this due diligence assessment the MDBA has drawn on long experience in managing and delivering major engineering works associated with the River Murray System. In the last decade the Authority has been responsible for the delivery of the Living Murray (TLM) Environmental Works and Measures Program (EWMP).

The EWMP is a $338 million program that delivered major works to facilitate the provision of environmental water to floodplains and wetlands. The scale of the works varies from major works to small scale strategic infrastructure.

The works proposed in this Business Case is of a scale consistent with the works delivered under the EWMP. Assessment of designs, costs and risks have been made by comparing projects and individual project components to similar works constructed under EWMP.

Summary of Key Issues

This Business Case has been assessed against a series of engineering / technical criteria as set out in the *Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases*. These are:

Section 4.8 - Technical Feasibility and Fitness for Purpose

- the proposal is able to deliver effectively on its stated outcomes and proposed technology will perform as intended; and
- the project delivery and operation is secure over the long term from a construction and maintenance perspective.

Section 4.10.1 Costs, Benefits and Funding Arrangements

- rationale and justification is provided for the estimate of the total cost of the project design, construction and commissioning;
- the level of contingency appears consistent with the level of risk identified;
- the benefits are appropriately described (quantitatively or qualitatively); and
- Ongoing operation and maintenance costs are realistic.

Section 4.11.4 Risk Assessment of Project Implementation

- all significant project development and delivery risks and impacts have been identified, adequately described and analysed and robust treatments and mitigations proposed;
- the risk management strategy complies with the AS/NZS ISO 31000:2009 Risk management—Principles and Guidelines; and
- all other risks are negligible or adequately mitigated.

Scope of assessment for technical feasibility and cost

The Business Case has been assessed to determine whether or not:

- The proposal is able to deliver effectively on its stated outcomes and proposed technology will perform as intended; and
- The project delivery and operation is secure over the long term from a construction and maintenance perspective.

The approach adopted for the assessment focusses on assessing the adequacy of the engineering design and includes the following elements and concepts:

- Review of engineering processes applied to design (e.g. extent and form of hydraulic/hydrologic functional requirements , application of defensive design principles for water control structures)
- Source and quality of base data and associated assumptions
- Consideration of constructability issues and temporary works requirements
- Peer review processes used to develop designs

This assessment does not extend to an assessment of the security of ongoing operation and maintenance funding or appropriateness of asset ownership arrangements.

Section 4.10.1 Costs, Benefits and Funding Arrangements

Each Business Case is assessed to determine whether or not:

- Rationale and justification is provided for the estimate of the total cost of the project design, construction and commissioning;
- The level of contingency appears consistent with the level of risk identified;
- The benefits are appropriately described (quantitatively or qualitatively); and
- Ongoing operation and maintenance costs are realistic.

The approach adopted for the assessment will focus on assessing the adequacy of the cost estimate and includes the following elements and concepts:

- Development of indicative cost ranges for typical infrastructure by size/capacity (e.g. regulators, bridges, culverts, levees). Data sources to include estimates and actual cost data from recent construction activity within the MDBA and associated agency programs
- Development of generic cost estimate line items for typical projects
- Development of typical project on-cost rates
- Consideration of construction scheduling

This assessment does not extend to a review of project scope to ensure optimisation of cost-effective environmental outcomes.

Section 4.11.4 Risk Assessment of Project Implementation

The Business Case should be assessed to determine whether or not:

- all significant project development and delivery risks and impacts have been identified, adequately described and analysed and robust treatments and mitigations proposed;

- the risk management strategy complies with the AS/NZS ISO 31000:2009 Risk management—Principles and Guidelines; and
- all other risks are negligible or adequately mitigated.

The approach adopted for the assessment is to

- Prepare a generic risk register (Appendix A) for environmental watering projects. This has been used as a basis to assess the comprehensiveness of risks identified in Business Cases and by extension contingency provisions based on past experience.
- Review of the risk costs presented in the Business Cases
- Identify any major risks that are not costed appropriately.

Business Case Review

The NSW Office of Environment and Heritage (OEH) has prepared the *Murray and Murrumbidgee Valley National Parks Business Case* for consideration under the SDL Adjustment process. This Business Case has been prepared with consultation of NSW Department of Primary Industries Water (DPI Water) and other agencies.

Technical Feasibility and Fitness for Purpose

The Business Case presents works that are logical and realistic but the level of detail is quite limited. The investigations, designs, and costings are consistent with a feasibility level of project development rather than a concept design. As such the assessments that can be made is limited and the project should go through a further two stages of project review:

1. Concept design
2. Detailed design

The advantage of the two stages is that it manages the risk of funding detailed design for works that are not cost effective or fit for purpose.

The limited level of detail available in the Business Case means that issues such as design considerations (including application of defensive design principles) cannot be realistically assessed at this stage.

The review has been split out by the two packages presented in the Business Case – Yanga National Park and Millewa Forest.

Yanga National Park

Hydrology

The business case discusses the baseline (without Basin Plan) and benchmark (with Basin plan) hydrological conditions for the National Park and details the proposed hydrological regime. The works proposed, in combination with inflows from Nimmie-Caira, aim to reduce the losses associated with the delivery of water to the southern extent of Yanga National Park and improve control and delivery of environmental flow to Yanga National Park.

A proposed hydrological regime has been developed for the purpose of the supply measure business case. The Long term watering plan will be developed as part of the Murrumbidgee Long Term Watering Plan being developed by NSW OEH. The business case specifies that the confirmation of flow and duration figures for the proposed regime will require further analysis and modelling which will be undertaken shortly. The confirmation of required flows and durations will be critical to the development of concept designs for the proposed structures.

Hydraulics

The hydraulic model referred to in the ‘Lowbidgee Yanga Calibration Report 2010’ incorporates works carried out in 2010 in the National Park as part of the ‘Rivers Environmental Restoration Program’ (RERP). The model does not appear to have been extended to include the full suite of structures proposed as part of this business case or calibrated with inundation events post 2005.

Hydraulic modelling has been undertaken to model the extent of inundation of Yanga floodplain under various inflow conditions, with and without Nimmie-Caira inflows. The modelling demonstrates the difficulty in inundating the southern extent of the Yanga National Park without inflows from Nimmie-Caira. Hydraulic modelling does not appear to have been undertaken to incorporate increased flows from 1AS and 1ES regulators as proposed in the business case and interim operating regime. This is a critical limitation with the existing hydraulic model that should be addressed in concept design.

The MDBA is of the view that the further development of the hydraulic model is a critical step for the proposed works to optimise the design of the structures to meet the required flow regime in Yanga National Park. The development of a hydraulic model should also include scope for an expert independent review of the model, to review the base data underpinning the model, assumptions and limitations within the model and sensitivity of key parameters.

Operating Regime

An interim proposed watering regime has been developed for the purpose of this supply measure proposal. It is noted that the enduring watering regime will be developed as part of the 'Lower Murrumbidgee Long Term Watering Plan'. The development of agreements for the delivery and coordination of flows from the Nimmie-Caira area will be critical for the achievement of the proposed hydrological regime. The business case identifies the development of these agreements as a key risk for the project. Agreements between the management of Nimmie-Caira and Yanga National Park should be formalised as part of concept design.

The development of concept designs will be dependent on a solid understanding and simulation of the proposed operating regime. The operating regime should include mechanisms to understand how operations may change over time so that necessary allowance can be made in the engineering designs.

Structure type and Functionality

The project involves the modification of a number of existing structures and the construction of new structures where the existing structures do not provide adequate functionality or structural integrity to deliver the proposed watering regime. The business case relies on anecdotal information to justify the decision to retrofit or replace a structure. This should be addressed with on-site investigations, surveying and modelling as part of concept design.

1ES Offtake Regulator

The proposal is to upgrade the structure to a two bay structure with automated lay flat gates and vertical slot fishway, powered by a solar array. The proposed structure aims to improve flow capacity, flow control and reduce the negative ecological effects of overwatering of the northern Yanga floodplain. The proposal appears sound however there are a number of details that should be confirmed as part of concept design.

The business case states the structure is estimated to constrain flows within the park. The proposal aims to increase flow capacity from 200ML/Day to 300ML/Day. The basis for this choice of design flow capacity is not clear. The final size and design flow capacity of the structure should be based on hydraulic modelling with consideration to how the weir pool and structure will be operated over time and into the future.

There is limited detail to clarify the requirement for automation of the gates at this structure, the cost of automation should be justified in concept design based on the frequency of operation, remoteness of the site and potential labour savings. The structure is proposed to be replaced in order to lower the existing sill level by 0.3m, allowing lower commence to flow level and greater flow capacity at normal Redbank weir pool levels. The benefit of this sill lowering has not been quantified, the current and proposed commence to flow level should be confirmed at concept design. The extent of sill lowering and design flow rate should be informed by hydraulic modelling with consideration to any future weir pool raising or lowering.

The Business Case states that the existing concrete is observed to be in good condition. The MDBA is of the view that the option of retrofitting new gates to the existing structure should also be considered during concept design to understand the ecological and cost implications of retaining or replacing the structure.

The proposal includes the provision of a carp cage at the fishway exit. The MDBA experience with carp trapping is that it is labour intensive and costly. The installation of such a facility and associated labour requirements appears to contradict the automation of the structure gates to reduce labour requirements at the structure. The costs and labour requirements and potential benefits of such a system should be considered as part of concept design. Experience with The Living Murray works indicate fishways require commissioning and monitoring post-construction to ensure they are passing fish as designed. Funding arrangements for any fishway monitoring are yet to be confirmed, this should be addressed as part of concept design.

1AS Regulator

The proposed structure will be a six bay regulator with lay flat gates and increased flow capacity from 600ML/Day to 1000ML/Day. The proposal to replace the existing structure with an entirely new regulator appears sound given the uncertainties surrounding the condition of the existing asset. However, the integrity of the existing structure should be confirmed through formal survey and investigation as part of concept design in order to justify the replacement of the structure.

The basis for the final design flow rate is not clear. The final size and design flow capacity of the structure should be optimised based on hydraulic modelling with consideration to how the weir pool and structure will be operated over time and into the future. The need for all gates to be layflat gates should also be reviewed during concept design.

A carp capture facility is proposed for the fishway. Refer to comments on carp capture in 1ES regulator section above.

Bruton's Regulator

The business case states the capacity of the existing regulator is not sufficient, new gates will be retrofitted to the structure on a new frame. The benefit gained from installing gates that can be lifted to the full height of the existing culverts is not quantified. The Authority would expect to see detail quantifying the current capacity of the gates and the clear ecological imperative for increasing the flow capacity at this structure. Choice of gate should be confirmed as part of concept design.

Twin Bridges North and South Regulators

The regulating structures are relatively new (2010) however the business case indicates the capacity of the structures is limited by the gates and leakage through the regulator gates is an issue. The business case does not indicate the extent to which the capacity is currently restricted or quantify the ecological impacts of the leakage. The MDBA suggests that further analysis be undertaken during concept design to quantify the impact of leakage through the structure. Hydraulic modelling of the structure should also be undertaken to confirm that hydraulic impact of the existing gate arrangement and hydraulic benefits of replacing the gates.

The proposal is for penstock gates to be installed on the existing culverts to increase capacity of the structures. This choice of gate appears logical if the regulators are to be operated fully open or closed for the majority of the time. The ability for these gates to achieve the required floodplain recession target of 0.25 m/day should be confirmed as part of concept design.

Wagourah Creek Block Bank Regulator

The proposal is to construct a sheet pile regulator at the location of an existing block bank to control flows into North Stallion swamp when closed or to Top Creek swamp when open. The capacity of this regulator is to be equal to the capacity of the Wagourah Creek inlet from the Murrumbidgee (part of Nimmie-Caira project). The design and flow capacity of the Nimmie-Caira inlet regulator to Wagourah creek does not appear to have been finalised.

The business case states fish passage provisions are not required at this site without any further explanation for this. The Authority is of the view that consideration should be given to fish passage in the design of all floodplain flow control structures.

Existing Regulators

It is not clear how the existing Woolshed creek regulator will perform with increased flows delivered from Tala Creek (via Nimmie-Caira) and increased inflows from 1AS. The proposal does not include the upgrade of this structure. The capacity of this structure to convey increased flows should be confirmed during concept design.

Culverts

The proposal includes the replacement of a number of existing pipe culverts with box culverts where increased flow capacity is required and/or where the existing structures is in disrepair. Although the justification for these structures appears sound the functional requirements should be confirmed and refined following development of the hydraulic model as part of concept design.

The proposal to consider fish friendly design of culverts through the control of hydraulic conditions in the culvert and the use of baffles and roughened surfaces is supported.

Tarwille Cattleyards Culvert and Regulator

The proposal is to replace the existing road pipe culvert with twin box culvert and regulator. The proposal to replace the existing culvert to increase the capacity to pass flows at this point appears logical. The design flow capacity for the regulator is not clear. There appears to be a contradiction between ‘Appendix B Technical Feasibility Report’ and ‘Appendix C- Operating rules and design criteria’. Appendix C states the flow capacity will match 1AS capacity

(1000ML/Day) whereas Appendix B states the flow capacity will be 2 to 3 times the current flow capacity, which is unknown. This should be confirmed with hydraulic modelling in concept design.

Wagourah Lake-North stallion swamp

The proposal is to replace the existing pipe culvert between the two water bodies with box culverts to more than double the existing capacity of this flow path. The required flow capacity at this structure should be confirmed with hydraulic modelling through concept design.

Shaw's Swamp/Wagourah Lake

Culverts between the two water bodies have limited capacity and do not provide the ability to hold water within the lakes. The proposal is to install twin box culverts with vertical regulator gates to match the capacity of Shaw's inlet regulator (in excess of 1ES). The required flow rate and structure sizing should be optimised in concept design. This regulator is to be designed to manage flow in both directions, concept design should have consideration to the risks involved in operating the regulator in this manner (e.g. reverse loading).

Block Banks

The proposal includes the modification of various banks in order to improve the retention of environmental water within waterbodies on the floodplain (e.g. Tarwille Swamp). Conceptually the proposal appears practical, the placement, alignment and height of block banks should be confirmed through hydraulic modelling and detailed site investigations as part of concept design.

Woolshed Creek floodway sills

A series of fixed crest sills are proposed to manage inflows to Tala swamp and prevent excessive watering of Tala Lake, allowing safe access for operation of woolshed regulator during high flows. These fixed crest sills are proposed to be placed on flood runner escapes east of woolshed regulator. The downstream side will be rock ramp design to facilitate fish passage during high flow events. The practicality and ecological imperative for this function should be confirmed in concept design. The required locations and dimensions of the proposed sills should be confirmed in concept design. Field survey and modelling works are recommended to inform this analysis. The estimated cost for detailed design should include a specific cost for further refinement of the hydraulic model, if necessary.

Natural Flood Flows

The impact on natural flooding is likely to be a critical consideration for sizing of regulators. Concept designs should specifically review the impact of the works on flood flows and what impact any increase in afflux will have on third parties.

Fish passage

Vertical slot fishways are proposed for 1AS and 1ES regulators with a design head differences of 1.5 meters and 1 metre respectively. The MDBA would expect to see detailed hydraulic modelling of the proposed operating scenarios, including inflows from Nimmie-Caira, to look at the velocities across the floodplain to confirm if there will be fish attraction to these regulators during managed events. If fishways are required at these sites the analysis will also help to inform the operating requirements of the fishways (timing, frequency, flow rates, etc).

The MDBA would also expect to see an analysis of the head difference across each weir as a percentage of time as robust justification for this choice of design head loss, informed by the

modelling above. The final design head difference should consider the variation in Redbank weir pool level over time and how this may change in the future, particularly during the main fish passage season (September –April).

Resolving the head difference and hydraulic conditions that the fishways will need to operate under represents a critical aspect of this project.

Fishways have been broadly costed at $1M/metre lift. This is considered an appropriate allowance for the current level of project development. This estimate should be refined as part of concept design.

The proposal to enhance fish passage within culverts by managing hydraulic conditions within the culvert, using baffles and roughened surfaces is supported, particularly where the risk of floodplain stranding for small bodied fish may be mitigated.

The designs for the proposed structures are at feasibility level of development therefore we are not able to comment on the appropriateness of fish passage provisions for each structure. The MDBA is of the view that fish passage should be a key consideration in the development of concept designs for floodplain control structures. Provision of downstream fish passage should be facilitated through the management of downstream water levels and plunge pools. Upstream fish passage should be facilitated through the management of velocity and head loss through the structure as well as the use of side plates and roughened surfaces through culverts.

Constructability

None of the proposed works appear to be outside the scale or complexity of works that have been constructed under 'The Living Murray' program. As such the works should be able to be constructed.

There is uncertainty surrounding the condition of existing structures where works are to be retrofitted to existing structures or new structures are to be built. The condition of existing structures should be confirmed as part of concept design.

It is not clear whether passing flows are required (e.g. to maintain critical habitat or refuge areas) during construction or whether arrangements will be in place to ensure passing flows are maintained during construction should they be required.

Construction methods and access to sites is unclear at this point and therefore the MDBA is unable to provide specific comments on these issues. Consideration to constructability issues represents a critical component of the concept design stage. These considerations will need to be informed by detailed survey and geotechnical investigations.

Third Party Considerations

The risk of third party impacts arising from the proposed works at Yanga appears minimal given the area is not subject to ongoing agricultural use or irrigation. The business case identifies loss of access for private land holders as a risk consideration. The number potentially affected land holders is stated as very low though not quantified. Access requirements for third parties should be identified to inform the development of concept designs. Cost estimates should take into account any required road augmentation.

Quality Assurance Method & Review

No external review has been undertaken for the proposed works. This is consistent with a feasibility level of project development. It would be logical for the concept designs to be subject to independent review before proceeding to detailed design.

Given the scale of the proposed works, it would be expected that the concept and detailed designs be subject to a rigorous review by independent experts. Appropriate allowance should be made in project planning for both the cost and time of this review.

Ownership and O&M Arrangements

1AS and 1ES are critical for maintaining the level of the Redbank weir pool and will be owned and operated by WaterNSW. Operation and maintenance of fishways will be funded by the structure owner. Funding arrangements for fishway monitoring are yet to be confirmed. Funding arrangements for monitoring of fishways for at least the commissioning of the structures should be confirmed during concept design.

All other Yanga floodplain structures are currently owned and operated by NSW NPWS. The estimate of operation and maintenance costs provided in the business case appears to only consider the FTE salary required to operate the works. This is estimated at approximately $100,000 or 0.5 of an FTE to be accommodated through existing budgets. This figure does not appear to include the cost for maintenance and repairs of the structures (e.g. servicing gates, replacing seals). Given the current state of disrepair of some structures in the National Park, 1AS and 1ES, more detail would be expected from the proponent to provide adequate assurance that the proposed works will be maintained appropriately and are able to deliver the environmental outcomes the proposal seeks. Sufficient funds should be provided for these purposes.

Cost Considerations

Detailed design and approvals

The allowance for detailed design and approvals has been estimated based on a percentage of total capital cost. 12% of the project capital cost has been allowed for survey, investigation, design, documentation, and modelling. This allowance is considered to be of the right magnitude for the current level of project development.

4% of total construction costs has been allowed for environmental and cultural heritage assessments. This cost estimate appears to be on the low side for a project of this scale. It is acknowledged that the management of cultural heritage is a regular activity in the Park which may reduce the need for extra resources. However, despite all of the best intention, experience and planning the potential for cultural items to be exposed during construction remains. This could result in the need to cease work and potentially demobilise the site while investigations are undertaken and appropriate steps taken to address the issue. The costs associated with managing cultural heritage finds could be significant and beyond the normal contingency provision.

The Business Case has not made budget allowance for costs incurred due to approval delays. This would appear to be a significant oversight.

The Authority would suggest that as part of the development of concept designs a strategy for approvals and cultural heritage management be developed and costed. This should also inform the timeframe for obtaining the relevant approvals.

Construction

The costs estimates for the proposed works, based on the feasibility level of design, are of an order that would be expected for these works.

The costs include minimal allowance for foundation works and management of seepage issues. If geotechnical investigations determine that sheetpile cut-offs are required or significant foundation treatment work is required to manage poor foundation conditions this could potentially add significantly to structure costs and as such represents a high cost uncertainty at this point in time.

There also appears to be some inconsistencies in the estimated costs of some items between structures. For instance, penstock gates (1.8 m x 1.5 m) are costed at $8,000 each for the Moira Regulator, where similar sized gates are costed at $15,000 each at Pigsty and $20,000 each for Wagourah Creek regulator at Yanga. Generally, it is expected that itemised costs should be consistent between sites and these costs should be reviewed to ensure consistency in concept design.

The business case does not appear have made cost allowances for the augmentation of roads to mitigate the risk of loss of access due to inundation.

The cost estimates for each structure have been presented at a high level. As such the MDBA is not able to comment on the appropriateness of cost estimates for individual structures. In the absence of site specific geotechnical survey the cost estimates have assumed foundation conditions will not require the use of sheet pile cut offs or piled foundations. Geotechnical survey is required to confirm these assumptions and to refine the cost estimates provided in the business case.

Construction contingency

A 50% contingency has been applied to total capital costs (including fishways). This is considered an appropriate level of contingency for the current stage of project development given the uncertainty surrounding final structure designs and geotechnical conditions.

Millewa Forest

Hydrology

The general hydrology of the Millewa National Park is discussed in the Business Case including comparisons between the baseline (without Basin Plan) and benchmark (with Basin plan) hydrological conditions.

General detail is provided on the intended hydrological changes with the proposed works and indicative operational rules have been developed to inform IQQM modelling of potential evaporative savings from the measures. However, it is not clear if there will need to be additional environmental flows delivered to these sites to meet ecological requirements and what the nature of these deliveries would need to be (timing, frequency, duration, magnitude).

The package of works generally enable small-scale management of individual areas of the forest. They are intended to enable more appropriate watering regimes to be provided to areas of the forest as opposed to enabling watering of additional areas of the forest.

It appears as though the proposed works within the Aratula Creek and Bullatale Channel area will result in more flows to Bullatale Creek to enable proposed flows in the forest to pass to the west of Bullatale Channel. The interaction of these flows with existing irrigation releases within the channel is not clear in terms of timing, flow rate and volume as well as operational and/or ecological implications within Bullatale Creek. These operational interactions should be quantified during concept design to inform the design of the proposed structures.

Hydraulics

The Business Case includes reference to a two dimensional hydraulic model (Water Technology 2009) and includes modelled inundation maps of benchmark model runs for a range of site-specific flow indicators. However, it doesn't appear as though the model has been reviewed as part of the development of the Business Case to confirm how existing structures are represented in the model.

The Business Case also includes modelled inundation mapping for Millewa Forest with the proposed infrastructure in place for a range of flows (12,500 ML/d, 14,000 ML/d and 18,000 ML/d) and a comparison of areas of inundation (by vegetation type) for both existing and proposed scenarios. The modelling shows little difference in area of inundation between the existing and proposed scenarios. For 12,500 ML/d and 14,000 ML/d flows the proposed inundation area appears to be slightly less than existing, while for 18,000 ML/d the proposed inundation area is slightly more. The Business Case discusses that this is likely due to the fact that the majority of the proposed works are to address overwatering of areas of the forest and therefore the total watering extent is largely unchanged.

It doesn't appear as though the existing hydraulic model has been used to inform the development of the proposed works to date. This is acceptable for feasibility level designs, however, the MDBA would expect that hydraulic modelling would be used to underpin the development of concept designs. At the least the concept designs should confirm how key design parameters (flow rates, sill and crest levels, dimensions, etc) have been determined. The existing hydraulic model may be able to be used to support the development of concept designs, however this would need to be reviewed and confirmed by the proponent as part of the next stage of the project.

Specifically, the MDBA is of the view that hydraulic modelling of the Aratulla Creek and Bullatale Channel works area should be undertaken during the next phase of the project and that this hydraulic modelling should extend to the Bullatale Creek to understand the interactions of the proposed works with existing operations and delivery through Bullatale Channel. The modelling will help to inform the existing capacity of the Bullatale Channel, required flow rates and levels to enable flows to break out to the west of the channel, sizing and dimensions of the proposed works and quantification of the benefits of the additional option of replacing the Bullatale regulator.

There appears to have been no specific allowance, either funding or schedule, for hydraulic modelling to support the further development of designs in the Business Case. The MDBA is of the view that any hydraulic modelling used to inform the development of designs should be subject to an expert independent review to look at the base data underpinning the model, assumptions and limitations within the model and sensitivity of key parameters.

The MDBA is aware of significant recent improvements in hydraulic modelling software and is of the opinion that hydraulic models to support detailed design should be of the new triangular mesh hydraulic modelling format to allow for greater resolution at key sites. The better representation of the landscape should improve the calibration and provide greater confidence in the application of the models to the detailed design process.

Operating regime

The Business Case presents some generic operating rules which appear to be primarily around fish passage and are more of an operating guide than an overall strategy for how the proposed works will be operated.

An overall operating strategy informed by detailed hydraulic modelling outputs and hydrological requirements is considered to be a critical requirement and will need to be developed during concept design to inform required flow rates, timing and duration of flows, operating ranges, etc.

The interaction of the proposed works around the Aratulla Creek and Bullatale Channel area with the existing Bullatale Channel infrastructure is not clear. It appears that there are a number operational complexities with these works that require further analysis to inform the development of concept designs and operating plans for the delivery of environmental flows to the west of Bullatale Channel.

The Warwick Creek regulator is proposed to exclude flow from entering or leaving Warwick Creek as well as to supply water into Warwick Creek. The proposed frequency, duration, timing and magnitude of flow deliveries as well as any potential constraints associated with the proposed operations are not clear in the Business Case and should be developed to inform concept designs and confirm that the ecological outcomes sought, can be delivered.

Structure Type and Functionality

The Business Case generally proposes small-scale infrastructure works (sills, culverts, small regulators) to upgrade and increase functionality of existing infrastructure. These works are proposed to address over-watering of areas of the forest as well as to enable a more natural flow regime to be re-established to targeted areas. The exception to this is the proposed replacement of the Moira Lake regulator and the optional extra of replacing the Bullatale channel offtake regulator which are both considered to be significant regulators in terms of size and cost.

Low Sandy Creek

The Business Case proposes to lower the sill level at the upper end of Low Sandy Creek by 0.6m to reduce the commence to flow from the River Murray from 12,500 ML/d to 10,500 ML/d. A three bay regulator with vertical penstock gates (2.7 m W x 2.3 m H) is also proposed. The default position for the gates would be open and the gates would only be closed when flows in the River Murray are sufficiently high and it is desired to exclude inflows to Low Sandy Creek. It would appear that the regulator is proposed to prevent unseasonal watering of the creek, however it is not clear how often this would need to be used and if a simpler option of a concrete sill has been considered for the site.

Sill lowering works also proposed along 70m of channel which will need to be confirmed with field survey and modelling during concept design and appropriate consideration given to potential Cultural Heritage and vegetation impacts.

Aratulla and Toupna Creek works (Intersection with the Bullatale Supply Channel)

The proposal is to install a number of fixed crest sills on the east and west banks of the Bullatale Channel to allow flows along Aratula Creek to pass east to west across the Bullatale Channel and prevent leakage of water supply flows resulting in unseasonal overwatering of the forest to the west of the channel. It is also proposed to replace the existing bridge crossing of the channel at Seven Mile Creek with a new box culvert bridge structure with adequate capacity to prevent water backing up at this point.

It appears as though the Bullatale Channel will need to be operating at full capacity to enable flows down Aratula Creek to pass over the concrete sills to the west of the channel. It is unclear how these operations would be managed (frequency, timing and magnitude) to minimise flows from Aratula Creek being diverted down Bullatale Channel to Bullatale Creek and what the volumes involved and impacts are likely to be.

The MDBA is of the view that the Aratula Creek and Bullatale Channel area needs to be modelled in detail to understand these operational complexities as well as to confirm the existing capacity of the Bullatale Channel and associated infrastructure to inform the concept design of the proposed works (sills and bridge culvert).

The Business Case also includes an additional option of replacing the Bullatale regulator at the offtake from the River Murray. It is unclear what the ecological value of the proposed replacement would be and the hydraulic modelling should be used to confirm the existing capacity of the channel and quantify the environmental benefits of replacing the regulator.

This option also includes an estimated 80,000 m3 of earthworks to lower the sill of the existing channel downstream of the regulator. Detailed field survey and modelling will need to be undertaken during the development of concept designs to confirm the required flow rate and sill lowering works. The potential impacts on Cultural Heritage and vegetation may be significant given the large indicative footprint and these risks should be further investigated during the concept design phase to ensure that impacts are minimised and mitigation strategies are developed to manage approvals and construction risks.

It does not appear as though a new regulator on Bullatale channel near the northern perimeter of the forest has been considered as part of the options assessment. There are three potential

options that could be considered for such a structure and the MDBA is of the view that the feasibility of these options should be considered as part of the concept design phase of the project:

- New structure at the northern perimeter to replace the existing offtake regulator near the River Murray (i.e. remove the existing regulator). The new regulator would need to be designed with sufficient freeboard to enable environmental flows to be delivered to the west of the channel over the proposed concrete sills.
- Maintain the existing offtake regulator and construct an additional regulator at the northern perimeter of the forest. The new regulator would be sized to only pass the required flow rates for Bullatale Trust diversions and would enable targeted environmental watering to the west of the channel without losses to the Bullatale system. With sufficient freeboard on the regulator it may be possible to provide all environmental flow requirements to the west of the channel via the Low Sandy Creek regulator and proposed concrete sills across the Bullatale channel.
- Replace the existing offtake regulator and construct an additional regulator at the northern perimeter of the forest. The northern regulator would be sized to only pass the required flow rates for Bullatale Trust diversions and would enable targeted environmental watering to the west of the channel without losses to the Bullatale system. This would likely represent the highest cost option.

Douglas Swamp

While the intent of the proposed works is understood, the number, location and size of the proposed fixed crest causeways are still to be determined. Two options have been put forward in the Business Case for the fixed crest sills. These are;

- Replace the existing culvert with a fixed crest sill along the roadway.
- Maintain the existing culvert and install a new fixed crest sill upstream of the roadway.

While both options are likely to be feasible the pros and cons of each option will need to be further assessed and quantified during the concept design phase. The costing in the Business Case is based on installing a new fixed crest sill upstream of the road way which is likely to represent the more costly option although the overall cost of these proposed works are a minor component of the overall Business Case cost.

The proposed works at Douglas Swamp also includes the construction of a new regulator on the main outlet runner from Douglas Swamp. The proposed regulator is a 3 bay box culvert structure with penstock gates (2.7 m W x 2.3 m H). As this structure does not need to be trafficable a sheetpile structure similar to that proposed for Little Edwards may be appropriate for this site and the MDBA is of the view that this should be considered in concept design.

Little Edward River

The proposal is to install two fixed crest sills with a commence to flow of 1,700 ML/d along Little Edward River to prevent overwatering at normal flows. Fixed crest sills are proposed to be constructed using a line of sheetpile. It is unclear whether a concrete sill arrangement has been considered for this site similar to other fixed crest sills proposed in the Business Case. Detailed field surveys and modelling are recommended in concept design to confirm the level and dimensions of the proposed sills and refine the proposed design.

A new sheetpile regulator is also proposed at the 're-entry' point from the floodplain back to Edward River. Detailed survey and modelling is also recommended for this site to optimise the sizing of the structure and confirm the design criteria. Geotechnical investigations are also required to confirm the required depth of the sheetpile. Depending on the foundation conditions at this site there may be the need for longer lengths of sheeptile than is currently proposed in the Business Case (6m). The proposal for the structure to be operated either fully open for fully closed is supported for this site.

Pigsty

At pigsty it is proposed to replace an existing 0.9m diameter pipe culvert which connect Edwards River to a local tributary. The existing structure is said to be in a state of disrepair and the proposal is to replace it with a two bay box culvert structure with penstock gates (1.5 m W x 1.5 m H) and vehicular access. The proposed structure appears to be reasonable but structure dimensions and flow rates will need to be confirmed and optimised as part of concept design.

Reed Beds, Gulpa Creek and Channel

The proposed works at this site aim to address overwatering resulting from informal bank breaches caused by bank failure. It is unclear why the channel has not been maintained to prevent bank failure to occur in the past and how the channel will be maintained into the future to ensure that further failures do not occur.

A new sheetpile regulator is proposed at the 're-entry' point from the floodplain back to Gulpa Creek. Detailed survey and modelling is required to optimise the sizing of the structure and confirm the design criteria. Geotechnical investigations are also required to confirm the required depth of the sheetpile. Depending on the foundation conditions at this site there may be the need for longer lengths of sheetpile than is currently proposed in the Business Case (6m).

Four fixed crest sills are proposed to maintain flows within Gulpa Cutting during normal flows and allow water into Reed Beds when flows in the channel exceed a nominated value. The channel flow rate and level at which these sills are to be set is yet to be determined as well as the required locations and dimensions of the proposed sills. These activities will need to be undertaken during concept design to ensure optimal design of the proposed works. Field survey and modelling works are recommended to inform this analysis.

Moira Lake regulator

The Business Case proposes to replace the existing Moira Lake regulator with a new regulator as the stop logs are currently resulting in excessive leakage and the operations do not conform with contemporary OHS practices.

It is proposed to set the sill level for the structure at 92.5m AHD which is 0.3m below the assumed lake sill level of 92.8 m AHD. It is recommended that the lake sill level should be confirmed during concept design and the invert of the structure set to match the sill of the channel into Moira Lake.

The proposed structure includes ten penstock gates (1.8 m W x 1.5 m H). These gates would either be operated fully open or fully closed. Two layflat gates are also proposed for this structure to enable overshot discharge of water from the lake to the River Murray to manage lake levels which can be operated by SCADA. Consideration should be given to the potential for the layflat

gates to be damaged by debris during flood events if the River Murray level is higher than the lake and the layflat gates are shut. The requirement for SCADA operation of the layflat gates should be reviewed in concept design considering the frequency of operation, remoteness of the site and potential labour savings

South Moira Lake

Two small stop board regulators and repairs to a number of sections of the southern bank of Moira Cutting are proposed to manage overwatering of the southern portion of the lake resulting from a number of existing breaches in the southern bank.

The Business Case includes proposed sill levels and dimensions for the two regulators and these should be confirmed and optimised during concept design with field survey and modelling. Consideration will need to be given to the management of erosion on the downstream side of the structures during managed releases and flooding scenarios.

The MDBA also understands that there are a number of breaches along the northern bank of Moira Cutting resulting in unseasonal filling of Moira Lake and associated losses. The MDBA is of the view that this package of works should incorporate the repair to existing breaches on both the northern and southern banks of Moira Cutting and that enduring management arrangements are established between appropriate parties to ensure the ongoing maintenance of the channel and banks into the future.

Natural flood flows

Refer to comments under the Yanga section of the report, which are consistent for the Millewa component of the project.

Fish passage

A vertical slot fishway is proposed for the additional option of replacing the Bullatale regulator with a maximum head difference of 2.0 m. There is no supporting analysis provided for this maximum head difference and as such the MDBA would expect to see an analysis of the head difference at the weir as a percentage of time to optimise the design head difference if this structure is progressed to concept design. It is likely that the analysis will need to be informed by hydraulic modelling and should consider an appropriate level of functionality to optimise fish passage during the fish passage season (September to April).

The fishway has been costed at $2.5 M ($1.25 M/m lift). This is considered an appropriate allowance for the current level of project development. This estimate should be refined if the structure is progressed to concept design.

Refer to the Yanga section of the report for general comment on fish friendly design of regulator and culvert structures to support safe upstream and downstream passage of fish.

Constructability

Refer to comments under the Yanga section of the report, which are consistent for the Millewa component of the project.

Third Party Considerations

The Business Case proposes a number of works on existing channels used to supply irrigation and stock and domestic water through the park. However the risk around supply appears to be low as the intent of the proposed works is to ensure that the existing level of supply is maintained. While this general principle is supported, the required flow rates and levels to maintain existing supply will need to be quantified and confirmed during concept design to ensure the design of the proposed works are optimised for ecological outcomes as well as maintaining existing supply levels for irrigation and stock and domestic.

The MDBA understands that there may be some third party implications associated with unintentional inundation of some low-lying land in the vicinity of Warwick Creek. It is unclear whether the proposed works along Gulpa Cutting and the new regulator at Warwick Creek have any potential implications in regards to this issue that may affect future operations of these proposed works. The MDBA is of the view that any potential third party impacts associated with the works in the vicinity of Warwick Creek need to be considered as part of the development of concept designs.

Ownership and O&M Arrangements

As with the Yanga floodplain structures the majority of the proposed works at Millewa are proposed to be owned and operated by NPWS. Similarly, the estimate of operation and maintenance costs provided in the business case appears to only consider the FTE salary required to operate the works and the Business Case states that these costs can be accommodated within existing operational budgets. This figure does not appear to include the cost for maintenance and repairs of the structures (e.g. servicing gates, replacing seals, channel maintenance). Given that a number of the proposed works are to address issues associated with the deterioration of existing assets, more detail would be expected from the proponent to provide adequate assurance that the proposed works will be maintained appropriately and sufficient cost estimates provided for these purposes.

There are some additional O&M complexities associated with the proposed works at Bullatale Channel, Gulpa Cutting and Moira Cutting. In all three cases new works are proposed which will be owned, operated and maintained by NPWS on existing channels which are operated and maintained by other parties. This presents challenges in ensuring that O&M responsibilities are clearly defined between parties going forward. In all three instances it will be critical that ongoing agreements are put in place between NPWS and the respective parties that stipulate the O&M responsibilities of each party. This is particularly important given that a number of the works are proposed to fix existing breaches in these channels which appear to be largely a result of poor historical maintenance regimes. It will be important that these agreements cover not only the maintenance of new assets but also the appropriate maintenance of the existing channels to ensure that further breaches do not occur in the future. It is the MDBA's view that these agreements should be confirmed during the design phase of the project prior to construction.

For the additional option of replacing the Bullatale channel regulator it is proposed that the Bullatale Trust would own, operate and maintain the regulator and NPWS would own, operate and maintain the fishway. This arrangement adds some operational complexity, particularly in ensuring that the regulator is operated to maximise conditions for the fishway. An agreement will need to be established between the two parties assigning the required O&M responsibilities for

the structure. It is the MDBA's view that this agreement should be confirmed prior to the project progressing to construction.

As discussed in the Business Case the Moira regulator is a Joint Venture asset and therefore replacement of the regulator and implications on ongoing O&M will need to be considered by the Joint Venture in accordance with the MDB Agreement.

Cost Considerations

Detailed Design and Approvals

Refer to comments under the Yanga section of the report, which are consistent for the Millewa component of the project.

The design life of the proposed works is not included or discussed in the Business Case and should be considered during concept design in terms of construction and O&M implications.

Construction

Refer to comments under the Yanga section of the report, which are consistent for the Millewa component of the project. Specific comments relating to the Millewa Forest works are provided below.

Douglas Swamp

It is noted that the Business Case includes an additional option of a second regulator at Douglas Swamp, however the cost for this additional structure is not part of the overall Business Case cost estimate.

Additional Option – Bullatale Channel regulator

The cost for the additional option of replacing the Bullatale Channel offtake regulator is considered to be very high in comparison to similar sized structures built under TLM and other structures included in the Business Case. It is noted that the Bullatale Channel regulator represents approximately half of the total cost for the Millewa component of the Business Case ($10,450,263 of $20,983,056). The MDBA recommends that the ecological justification for this structure be further reviewed and quantified during concept design and the proposed design and cost refined to enable further assessment on the value of this option to be considered.

In particular it appears that elements of the cost estimate have been significantly over-estimated. The quantity of foundation works and sheetpile cut-offs appears very high for this type of structure. The layflat gates (2W x 2.5H) are costed at $110,000 each which is significantly more than the cost for similar sized layflat gates at 1AS which are costed at $45,000. If this structure is funded further it is recommended that all costs associated with the structure are reviewed and further refined during concept design.

Moira Cutting

The benefits of the proposed replacement of the Moira regulator will not be realised if existing breaches in the northern bank of Moira Cutting are not repaired. These works could be completed as part of the proposed repairs to the southern bank of the cutting. These works are

not currently costed as part of the Business Case and the MDBA is of the view that they should be considered as part of concept design including the development of appropriate cost estimates.

Construction Contingency

A 50% contingency has been applied to total capital costs (including fishways). This is considered an appropriate level of contingency for the current stage of project development given the uncertainty surrounding final structure designs and geotechnical conditions.

Risk Assessment of Project Implementation

A risk assessment and proposed mitigation strategy is included in the Business Case. The risk assessment is very high level - consistent with a project in the feasibility stage.

A more robust risk assessment should be undertaken as part of concept design once further information (e.g. Geotechnical investigations, preliminary cultural heritage field surveys) have been undertaken.

As set out in the Risk Report (Appendix A) the majority of the risks that a project will be exposed to can be contained and managed within the project. The MDBA has identified two key financial risks that need to be further considered for this project.

Flooding

No allowance is made in the Business Case for flood risk.

Flood risk was underestimated in the early stages of The Living Murray and was not costed appropriately and was considered the greatest financial risk to the projects, with very little mitigation options available.

During the EWMP program the definition of a flood, when a flood delay would occur, and associated costs payable was altered in the construction contracts to reflect the learnings from flooding in early projects which incurred major costs.

The key learnings from EWMP that are relevant to the SDL Business Cases are:

- it is not financially realistic to pass the risk of flooding to the contractor;
- there is a practical limit to the amount of flood mitigation that can be achieved by use of temporary works, beyond this level it is cheaper to accept the cost of demobilising / remobilising site;
- projects need to plan the timing of the works to minimise the flood risk (this is something that should be addressed in the detailed design / approvals phase of the projects);
- sufficient funds need to be allocated to cover the risk that a flood(s) will require a work site to be demobilised and remobilised at a later date. This incurs large costs to both the construction team and for the project management team.

Cultural Heritage

No allowance has been made in the Business Case for delays during construction.

Funding for cultural heritage was underestimated in the early stages of The Living Murray and was not costed appropriately.

Despite the best intention and planning the potential for cultural items to be exposed during construction remains. This could result in the need to cease work and potentially demobilise the site while investigations are undertaken and appropriate steps taken to address the issue.

The overall magnitude of the proposed allowance is a matter of judgement and risk appetite. If significant cultural heritage is found in places that were not identified in the CHMP process, as occurred in the EWMP Koondrook project, the costs can be vary significantly and the allowances will not be adequate.