SARFIIP – Katarapko Floodplain hydraulic modelling

Managed inundation options assessment scenarios – 2015–16

DEWNR Technical note 2016/13

Government of South Australia
Department of Environment, Water and Natural Resources

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Department of Environment, Water and Natural Resources

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Summary

Katfish Reach is a floodplain habitat of the River Murray, located on the western side of the River Murray between Berri and Loxton in South Australia, which is comprised of the Katarapko/Eckert Creek anabranch system. The anabranch bypasses Lock 4, with several inlets into Eckert Creek above Lock 4, with a further inlet into Katarapko Creek existing downstream of Lock 4. The natural hydrological regime of the anabranch has been altered by a number of artificial banks and regulators – including a major stone weir in the upper reach of Katarapko Creek – which has contributed to ecological degradation within the floodplain.

A number of hydraulic modelling scenarios were conducted in 2014–15 to provide hydraulic data for further assessment of proposed infrastructure options that allow managed inundation to be conducted within the floodplain (McCullough et al, 2016). Infrastructure options involve the construction of regulators within the floodplain in combination with blocking banks to allow water to be impounded within the floodplain in a controlled manner. Three options were considered as the focus of hydraulic modelling, namely for managed inundation to heights of 13.5, 13.7 and 13.9 m AHD, with each option possessing an identical blocking bank alignment and structure placement.

As a result of hydraulic modelling scenarios conducted in 2014–15, the 13.9 m AHD maximum inundation option was selected in order to progress further design work, requiring a blocking alignment height of 14.1 m AHD to account for freeboard. The MIKE FLOOD model described in McCullough (2016) was subsequently refined as required to match the requirements of the design process.

A series of scenarios were conducted under Scenario 8 to provide hydraulic data for structure designs and operational refinements relating to Katarapko Floodplain outflow structures are separated into two groups. Water exchange scenarios were designed primarily to investigate the requirement for outflows through ancillary regulators for exchange purposes, and then fish attraction scenarios were designed to investigate the ability for flows to be controlled through the main regulators (in particular at Sawmill Creek) to restrict fish attraction downstream of Sawmill Creek regulator.

A number of scenarios were also run under Scenario 9 to supply data for design refinements of proposed infrastructure for Katarapko floodplain. The results indicate that up to 60 000 ML/d the water level remains below the blocking alignment height along its length, while at 70 000 ML/d parts of the blocking bank appear overtopped, in particular alongside Piggy Creek and the bank alignment between Lock 4 and Sawmill Creek.

Note that an external (to DEWNR) peer review of the MIKE FLOOD model and 2014–15 modelling was conducted in parallel to the modelling presented in this Technical Note. The overall outcomes of the review, which are also applicable to the 2015–16 modelling, indicated the model and scenarios were fit for purpose, with no critical errors impacting on results. The context of any issues in the modelling raised through the peer review are presented in Appendix C of this Technical Note for reference.

1 Hydraulic Modelling Summary

1.1 Hydraulic model summary

Katfish Reach is a floodplain habitat of the River Murray, located on the western side of the River Murray between Berri and Loxton in South Australia, which is comprised of the Katarapko/Eckert Creek anabranch system. The anabranch bypasses Lock 4, with several inlets into Eckert Creek above Lock 4, with a further inlet into Katarapko Creek existing downstream of Lock 4. The natural hydrological regime of the anabranch has been altered by a number of artificial banks and regulators – including a major stone weir in the upper reach of Katarapko Creek – which has contributed to ecological degradation within the floodplain.

Hydraulic modelling scenarios contained in this report utilise the MIKE FLOOD 1-D/2-D coupled model as used in modelling exercises explained in McCullough (2016), with modifications and updates made as appropriate to each scenario. Any such changes are listed in the respective scenario chapters.

The model possesses inherent sources of error that may impact on the accuracy of outputs, including:

- 20 m grid cell size in the floodplain topography
- Vertical accuracy of the digital elevation model (DEM) used for the modelled floodplain topography in the order of approximately ±0.10 to 0.15 m, but may vary depending on localised characteristics within the floodplain area (e.g. dense tree coverage may reduce accuracy)
- Minimal in-stream floodplain monitoring data available for calibration/validation of the model under baseflow conditions.

Analysis of model outputs should be considered in the context of these error sources.

1.2 Model refinements

Following modelling conducted in 2014–15 described in McCullough et al (2016), the 13.9 m AHD maximum inundation option was selected during the structure design phase in order to progress further design work, requiring a blocking alignment height of 14.1 m AHD to account for freeboard. The MIKE FLOOD model was subsequently refined as required to match the requirements of the design process, including:

- Updates to blocking alignment, including inclusion of a northern alignment between Sawmill Creek and Lock 4 at a minimum blocking height of 14.1 m AHD, adjustment of structure locations accordingly, and addition of culvert structures through flow paths intersecting the northern alignment (refer to Figure 1.1 for details)
- Refinement of structure sizing and/or locations as required
- Minor modifications to the bathymetry to better represent minor flow paths near proposed structures
- Improvements in detail at the Piggy Creek inlets to differentiate between north and south inlet branches and structures (altering the previous representation of the inlets by a single inlet structure)
- Addressing a potential issue of water being present in both the 1-D and 2-D domains of Katarapko Creek at medium to high River Murray flows (i.e. resulting in potential 'double counting' of water volumes in Katarapko Creek under this general flow range), by ensuring that all flow is conveyed through the 1-D representation of the creek only, and
- Defining additional 1-D/2-D linkages between the River Murray and floodplain where not originally defined in the model at high points in the topography, to ensure that overbank flow is being sufficiently accounted for between relevant River Murray and floodplain areas under high River Murray flows.

Note that an external (to DEWNR) peer review of the MIKE FLOOD model and 2014–15 modelling was conducted in parallel to the modelling presented in this report, as indicated in Yamagata (2016). The overall outcomes of the review indicated the model and scenarios were fit for purpose, even prior to the scenarios presented in this Technical Note, with no critical errors impacting on results. The latter two model refinements listed above, which address potential issues that may impact on results under medium to high River Murray flows, were both identified in the peer review, and so these particular potential issues were already largely addressed for these recent scenarios. The context of other potential issues raised in the peer review are presented in Appendix 3 for reference.

1.3 Hydraulic scenarios

Scenarios were defined with the main focus on infrastructure designs, including refinement of operational methodology for appropriate structure sizing. These included:

- Scenarios investigating exchange requirements through ancillary regulator operation, and an associated refinement to manage flows for fish passage considerations
- Scenarios developed for baseflow, high flow, and managed inundation operations, which involved refined structure sizing and operations derived from the results of the previous scenarios.

Note that the latter scenarios also provide additional data for tailwater level modelling at the two main regulators at Sawmill Creek and The Splash, which feed into a hydrograph analysis for determining fishway design requirements at each regulator. This analysis is conducted externally to this modelling, and hence is not included in the scenario summaries.

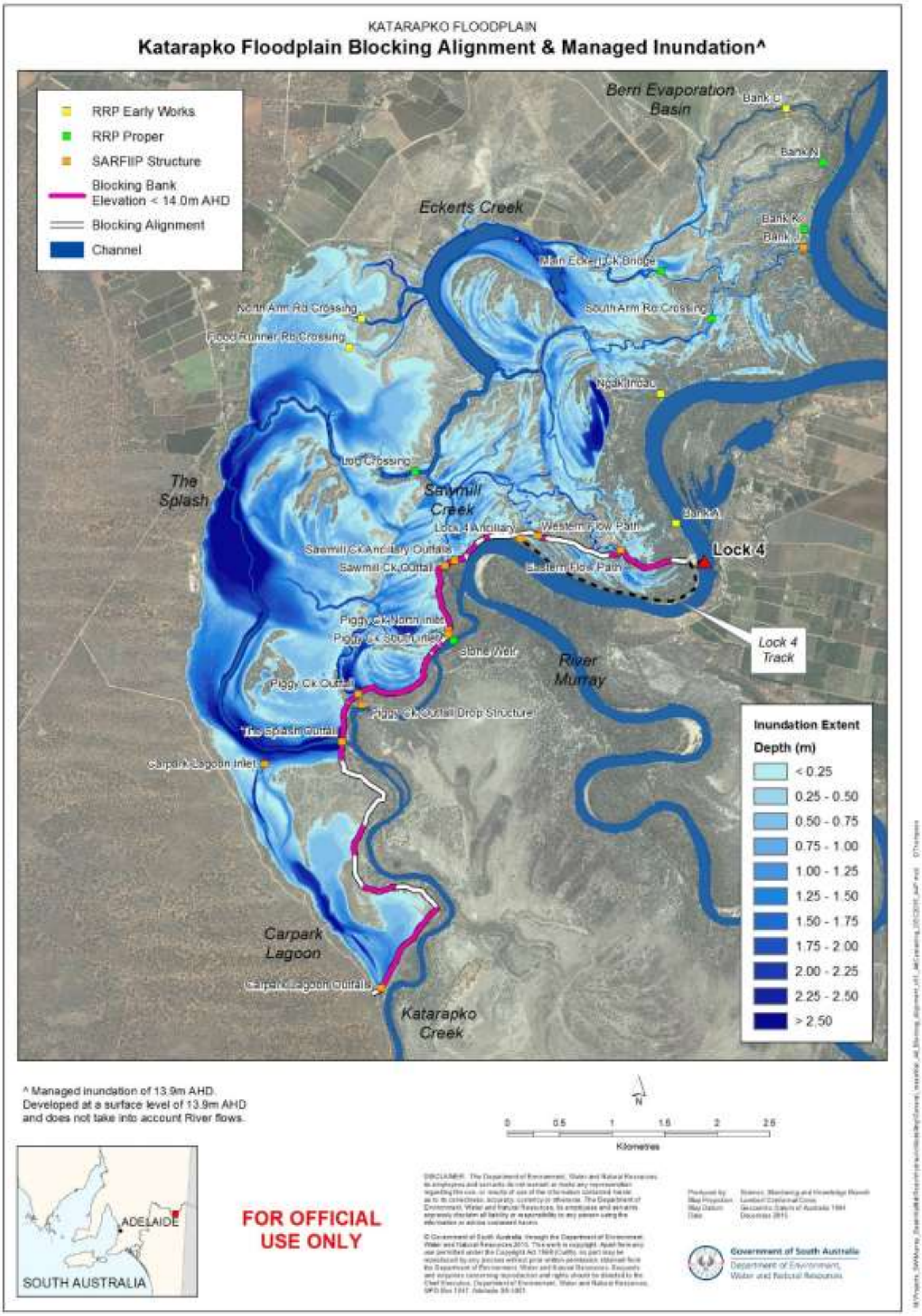

Figure 1.1 Latest blocking alignment at 14.1 m AHD bank height

2 Scenario 8 – Fishway attraction and water exchange refinement scenarios

2.1 Summary

Scenarios to provide hydraulic data for structure designs and operational refinements relating to Katarapko Floodplain outflow structures are separated into two groups, namely:

- Water exchange scenarios (8a to c), designed primarily to investigate the requirement for outflows through ancillary regulators for exchange purposes
- Fish attraction scenarios (8d to g), designed to investigate the ability for flows to be controlled through the main regulators (in particular at Sawmill Creek) to restrict fish attraction downstream of Sawmill Creek regulator.

For the water exchange scenarios, flows for each ancillary structure are considered at 0 ML/d to represent a fully closed state, 10 ML/d to represent minor flows through the use of a hose for exchange, and 20 ML/d to indicate flows over each regulator through a rock lined channel.

Scenario details are shown in Table 2.1 for the water exchange scenarios tested, and Table 2.2 for the fish attraction scenario details. The following summarises the general scenario configurations based on those used in prior scenarios modelled under SARFIIP:

- River flow upstream of Lock 5 set to 10 000 ML/d (with the exception of Scenario 8e, at 20 000 ML/d)
- Lock 4 upstream set to 14.2 m AHD (i.e. 1 m raising above normal pool) and Lock 3 set to 9.8 m AHD
- Bank J and Log Crossing regulators fully open
- Stone weir in Katarapko Creek set to upgraded crest level of 10.24 m AHD
- Blocking alignment set to a level of 14.1 m AHD, using the latest blocking bank alignment considered at the time of modelling (see Figure 1.1).

Due to uncertainty of the blocking alignment requirements at the time of modelling, the model configuration includes two sections of bank between Sawmill Creek and Lock 4, including:

- The Lock 4 track (Figure 1.1), which contains the Lock 4 ancillary spillway and formed the previous blocking alignment between Lock 4 and Sawmill Creek
- The updated alignment (Figure 1.1), which includes two culvert structures at eastern and western flow paths.

Each of these bank sections were configured at a minimum elevation of 14.1 m AHD for the purposes of the modelling listed here, whereas the latest design at the time of writing includes the Lock 4 track at a minimum elevation of 13.7 m AHD (and Lock 4 ancillary spillway at 13.5 m AHD elevation), which creates a cascading-type inundation arrangement of 13.9 m AHD maximum inundation level upstream of the blocking alignment, and a lower inundation level of approximately 13.5 m AHD between Lock 4 and Sawmill Creek, bounded by the blocking alignment and Lock 4 track. This lower level inundation area is therefore overestimated in terms of level and inundated area for this modelled scenario compared to the current blocking alignment, however given the main focus of the modelling was to investigate the impact of various control scenarios from main and ancillary regulators, this difference in the blocking alignment representation does not adversely affect the results.

Outputs include velocity maps for each scenario and associated hydraulic data at each structure (e.g. upstream and downstream water levels, head difference, structure velocity, etc.). Note that positive flow is considered to be from floodplain side to river side of the blocking alignment.

Table 2.1 Water exchange scenarios tested

Scenario	River flows ML/d	Inundation level m AHD	Ancillary regulator* flows ML/d	Splash regulator operation	Sawmill regulator ML/d
8a	10 000	13.9	0 (shut)	Control to inundation level	100
8b	10 000	13.9	10	Control to inundation level	100
8c	10 000	13.9	20	Control to inundation level	100

* Ancillary regulators include Sawmill Creek ancillary regulators x 2, Piggy Creek northern and southern inlets, Piggy Creek outfall and Car Park lagoons outlet, and flow indicated is applicable to each structure individually.

Table 2.2 Fish attraction scenarios tested

Scenario	River flows ML/d	Inundation levels m AHD	Ancillary regulator* flows ML/d	Splash regulator operation	Sawmill regulator ML/d
8d	10 000	13.9	10	Control to inundation level	10
8e	20 000	13.9	10	Control to inundation level	10
8f	10 000	13.9	0	Control to inundation level	0
8g	10 000	13.9	0	Control to inundation level	10

* Ancillary regulators include Sawmill Creek ancillary regulators x 2, Piggy Creek northern and southern inlets, Piggy Creek outfall and Car Park lagoons outlet, and flow indicated is applicable to each structure individually.

2.2 Results

Modelled velocity maps of water exchange Scenarios 8a–c are shown in Figure 2.1 to Figure 2.3. Also included are velocity difference maps, comparing the difference in velocities between Scenarios 8b and 8a (Figure 2.4), Scenarios 8c and 8a (Figure 2.5) and Scenarios 8c and 8b (Figure 2.6). Excluding velocity differences under 0.01 m/s, the results indicate that the main differences between the scenarios exist on the river side of the main structures in each case, with the largest velocity differences existing between Scenario 8c and 8a (i.e. ancillary flows of 20 ML/d against no ancillary flows), exceeding a 0.20 m/s difference on the downstream side of Sawmill Creek ancillary structures and at the Piggy Creek south inlet. Only minor differences are modelled upstream of the blocking alignment between any of the water exchange scenarios (8a–c), suggesting that little impact may be expected on exchange in the floodplain during the managed inundation events modelled at the ancillary flows considered.

Velocity maps for the fish attraction Scenarios 8d–g are shown in Figure 2.7 to Figure 2.10. Velocity downstream of Sawmill Creek regulator are observed to be lowest for fish passage considerations when no flow is passing through Sawmill Creek (Scenario 8f), while operating at raised river flow (i.e. 20 000 ML/d in Scenario 8e) also results in a reduction of velocities in Sawmill Creek due to a raising of tailwater level at the regulator. Note that the velocities may be further reduced from those shown if Stone Weir is taken at current crest levels (i.e. approximately 10.58 m AHD), due again to a raising of tailwater level from that modelled.

In terms of velocities in the impounded area for the fishway attraction scenarios, the main areas of zero velocities are modelled in Piggy Creek and Car Park lagoon, with zero velocities in the latter area increasing when the Car Park outfall structure is closed, compared to passing some flow. This indicates that some flow through the Car Park outfall structure may be desired during a managed inundation event for exchange considerations.

Design data generated from these scenarios are contained in Appendix 1.

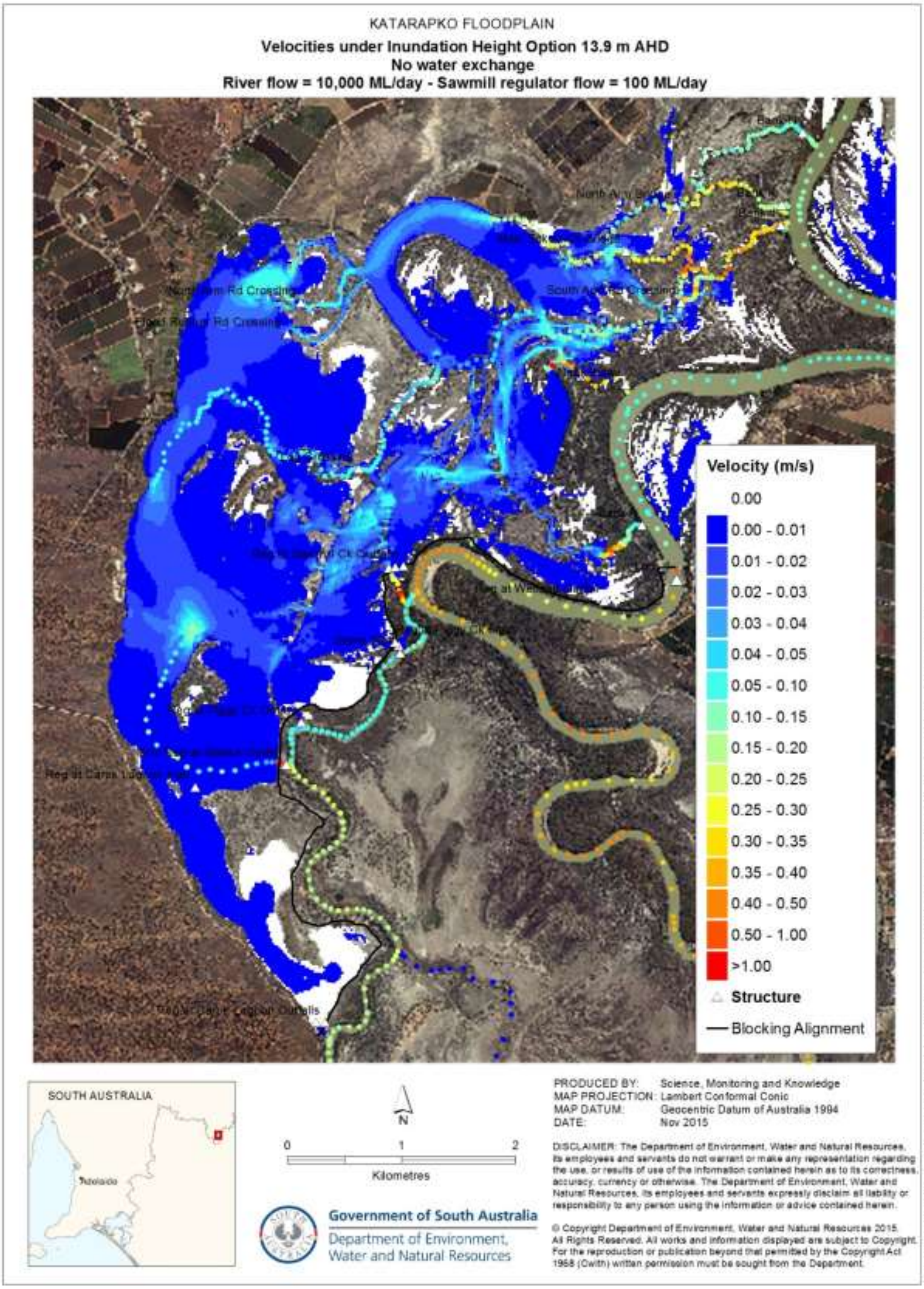

Figure 2.1 Velocity map for Scenario 8a – no water exchange through ancillary structures

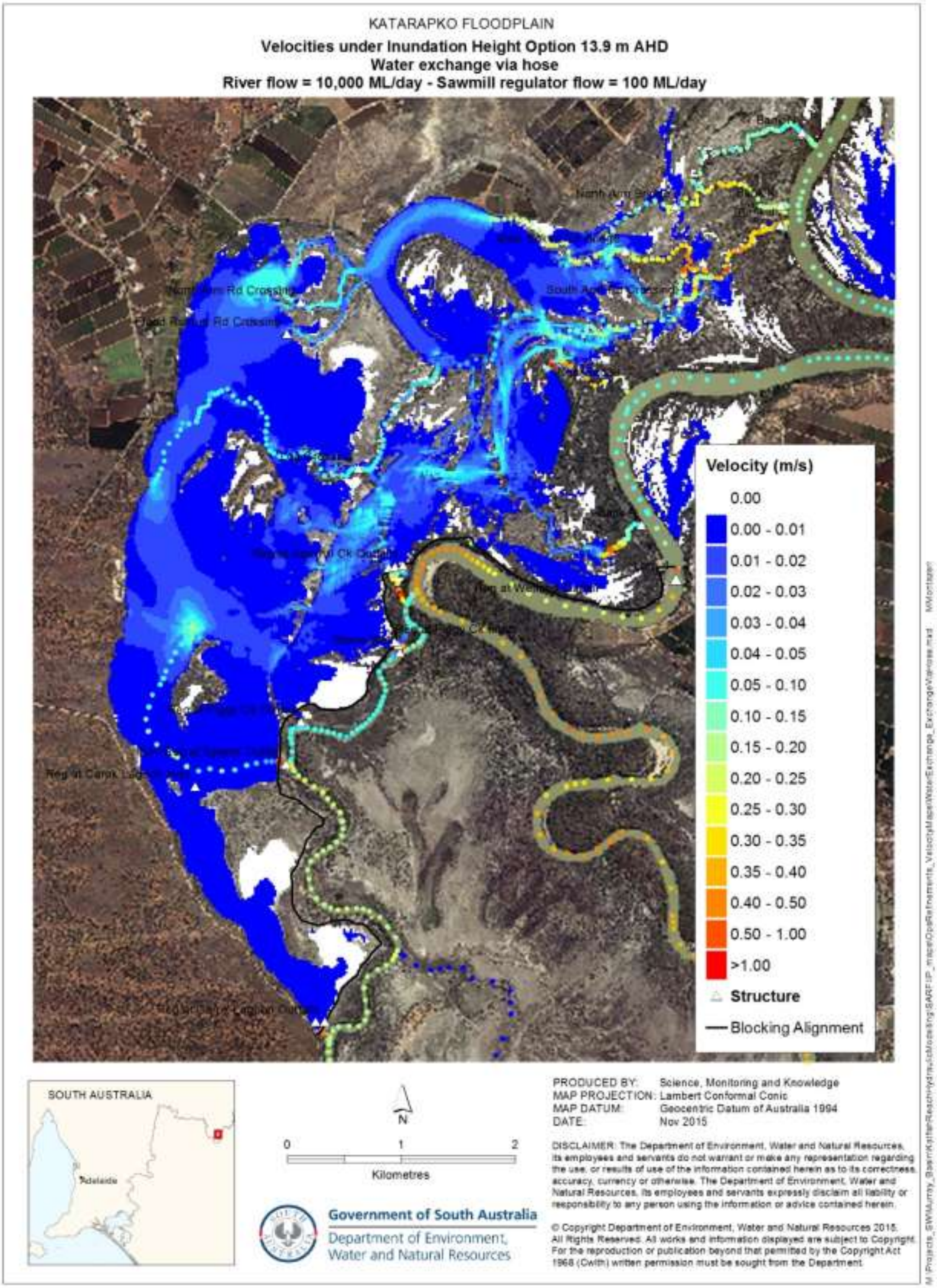

Figure 2.2 Velocity map for Scenario 8b – water exchange through ancillary structures of 10 ML/d

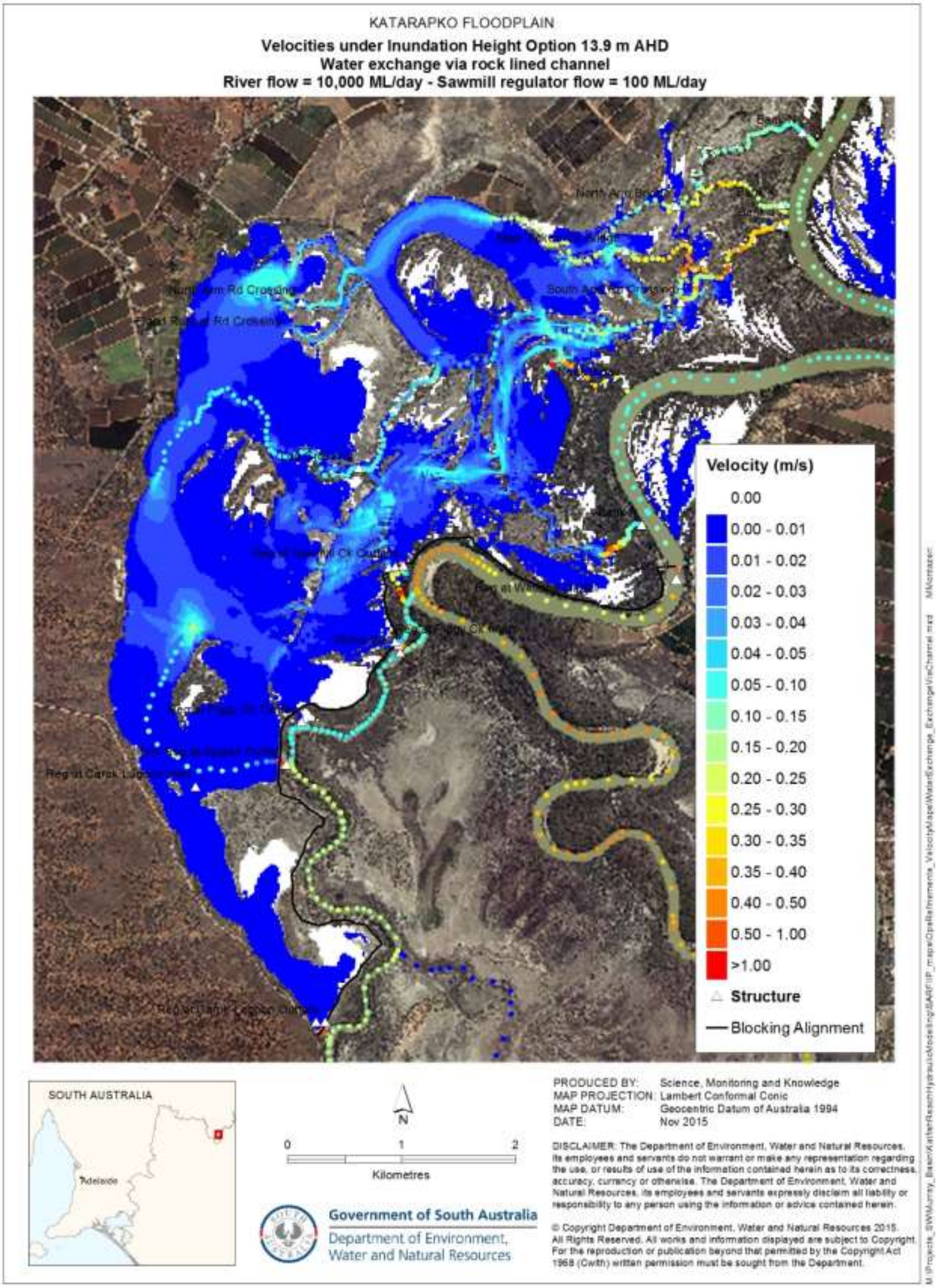

Figure 2.3 Velocity map for Scenario 8c – water exchange through ancillary structures of 20 ML/d

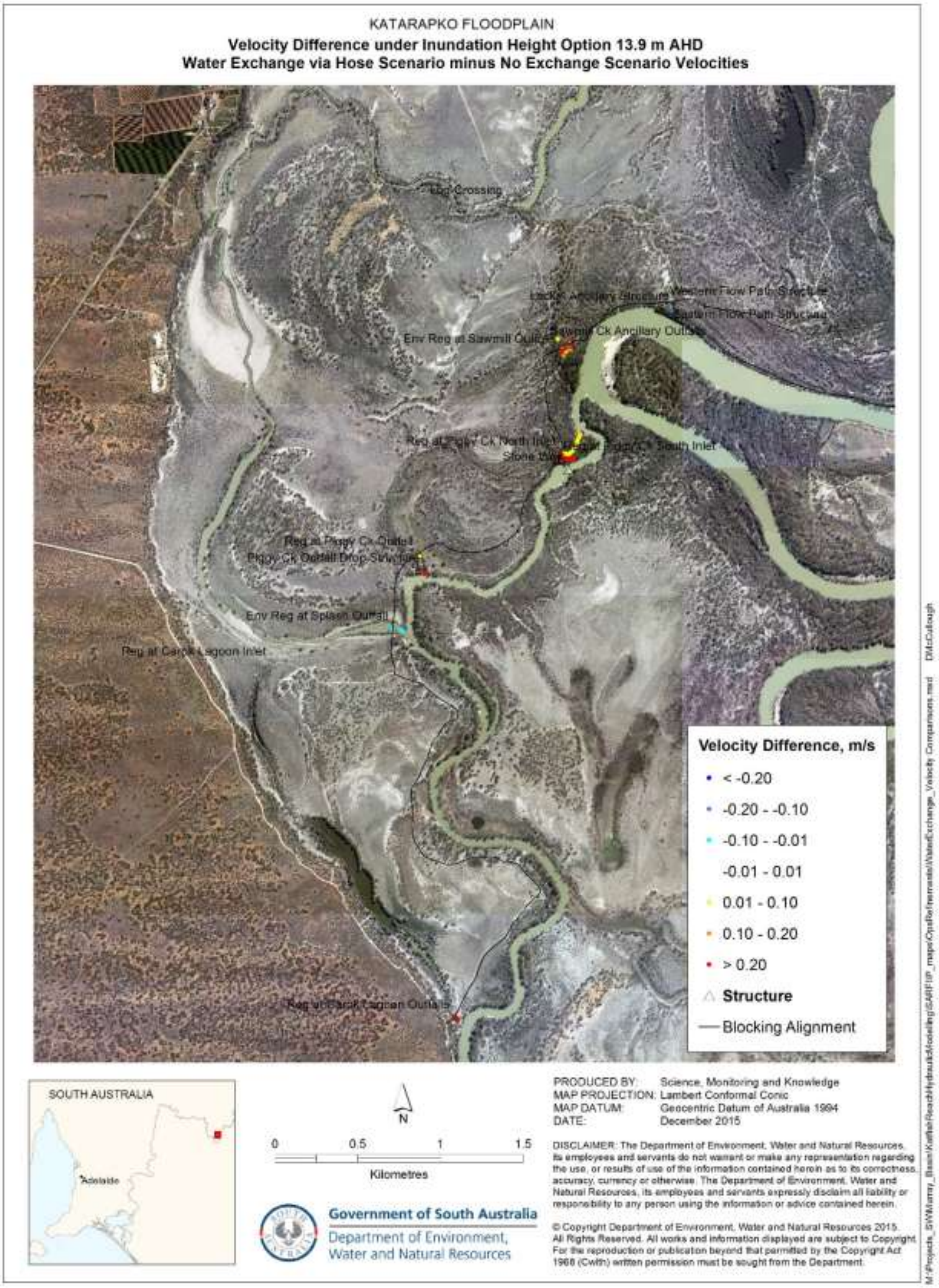

Figure 2.4 Velocity difference between Scenarios 8b (Figure 2.2) and 8a (Figure 2.1)

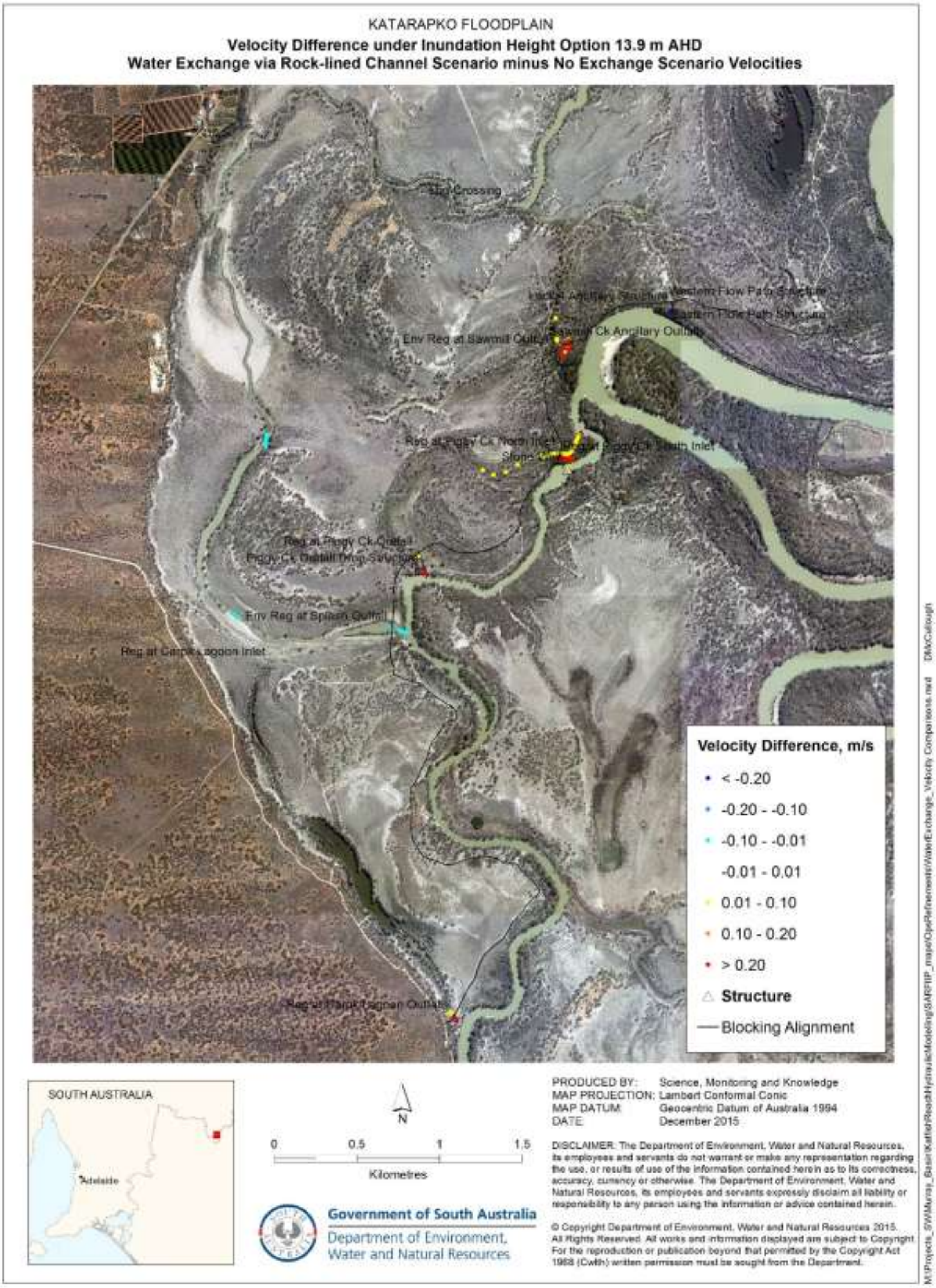

Figure 2.5 Velocity difference between Scenarios 8c (Figure 2.3) and 8a (Figure 2.1)

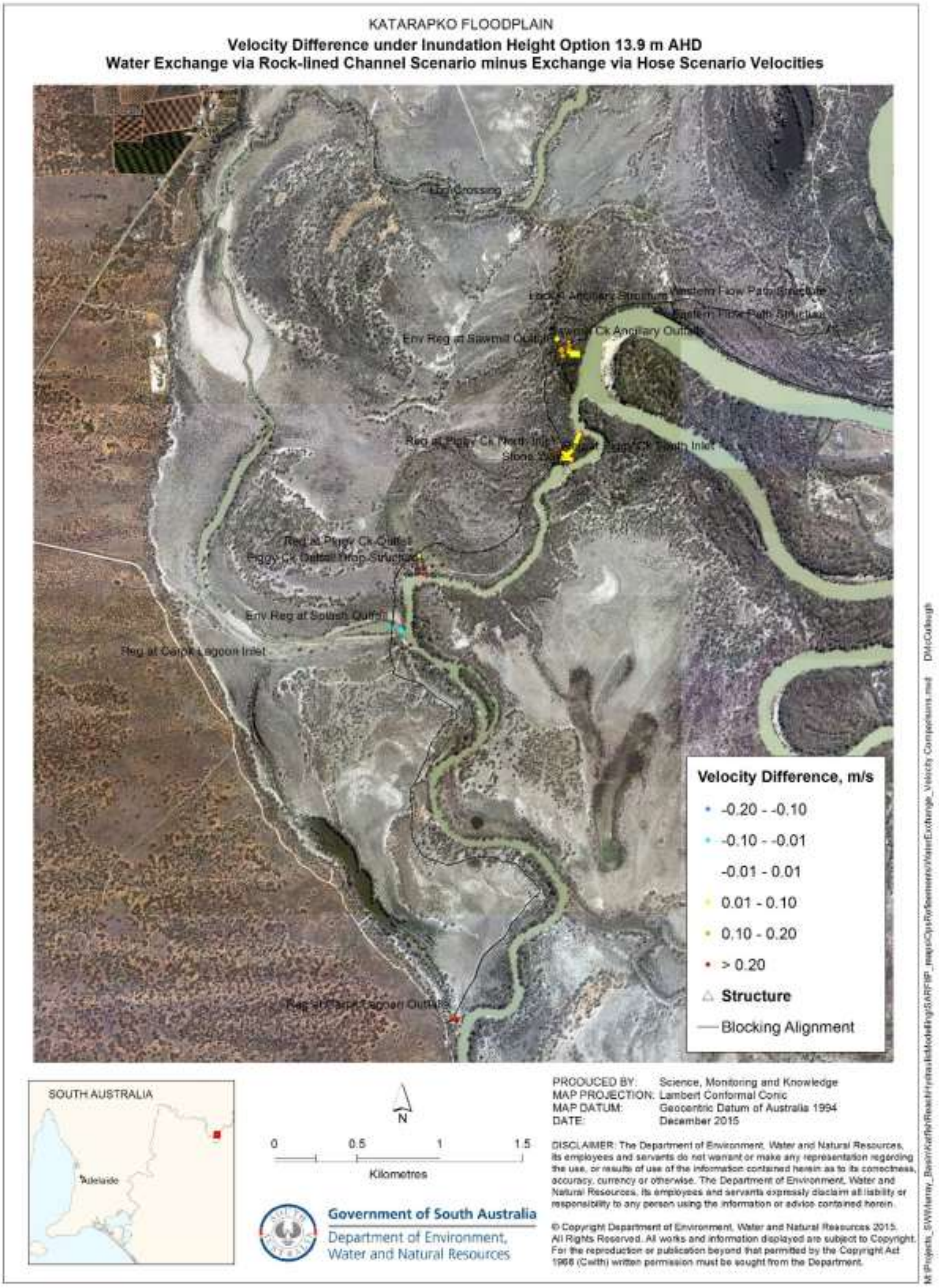

Figure 2.6 Velocity difference between Scenarios 8c (Figure 2.3) and 8b (Figure 2.2)

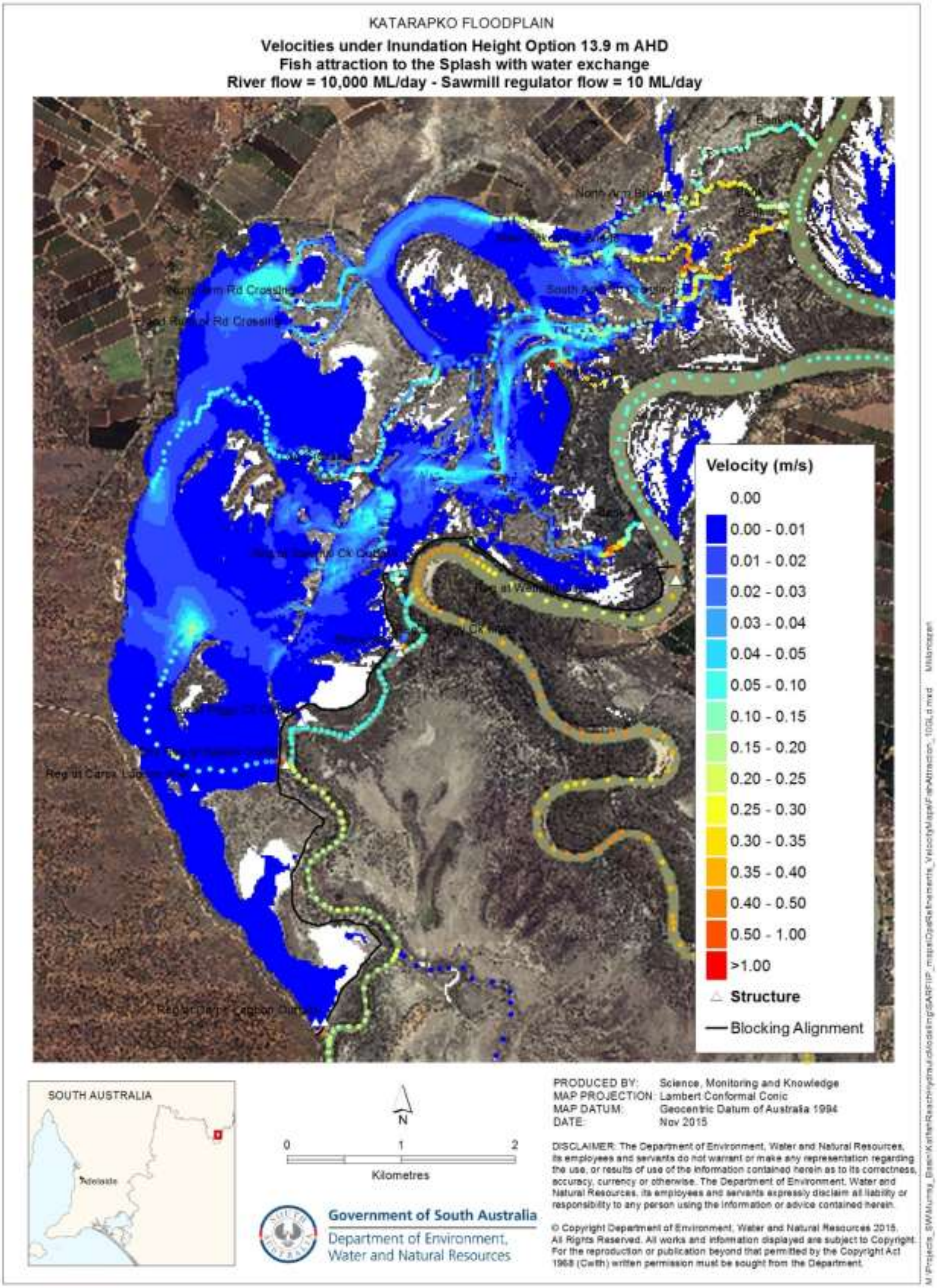

Figure 2.7 Velocity map for Scenario 8d – Sawmill and ancillary flows at 10 ML/d, River Murray flow at 10 000 ML/d

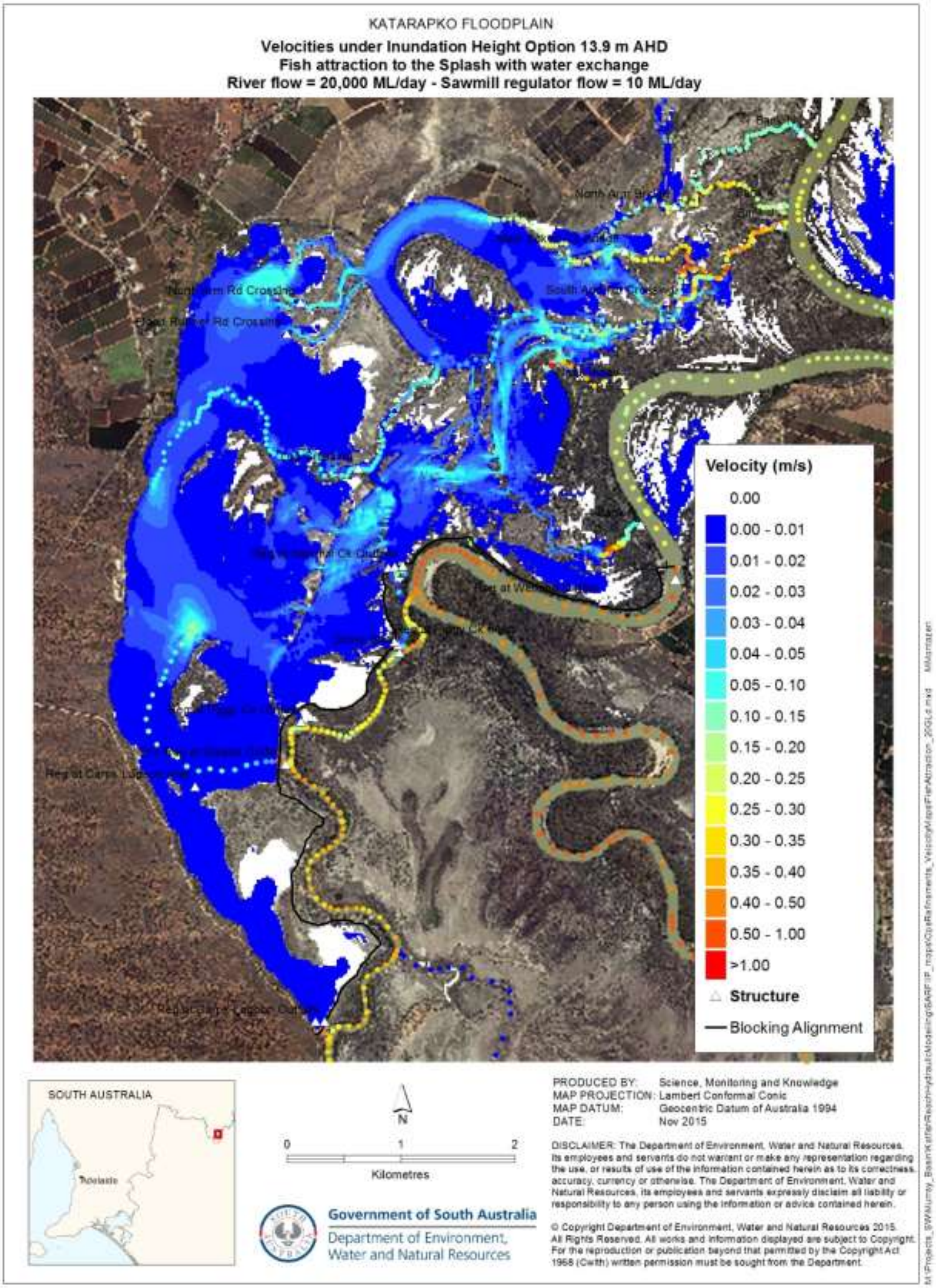

Figure 2.8 Velocity map for Scenario 8e – Sawmill and ancillary flows at 10 ML/d, River Murray flow at 20 000 ML/d

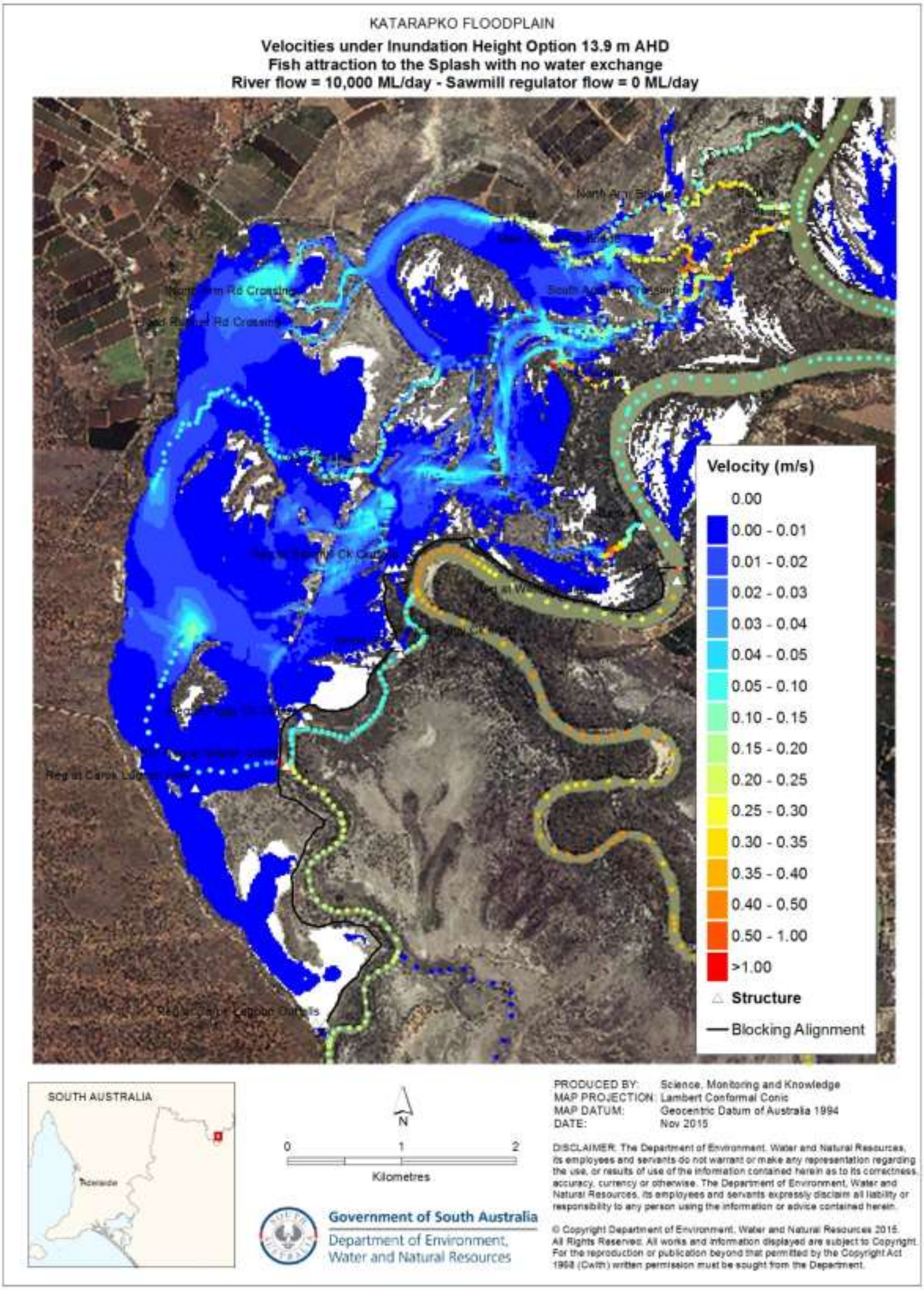

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Figure 2.9 Velocity map for Scenario 8f – No Sawmill or ancillary flow, River Murray flow at 10 000 ML/d

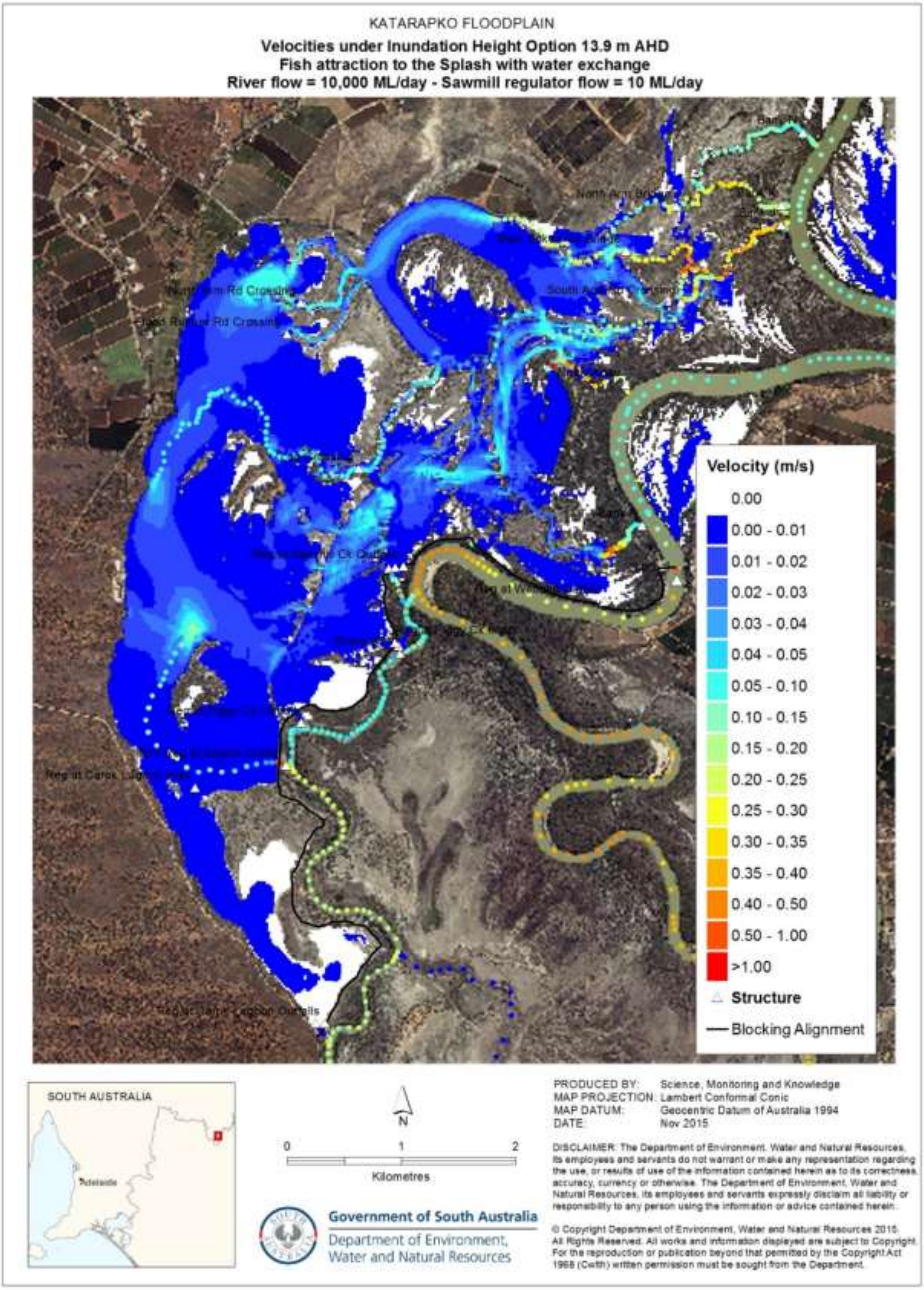

Figure 2.10 Velocity map for Scenario 8g – Sawmill flow at 10 ML/d, no ancillary flow, River Murray flow at 10 000 ML/d

3 Scenario 9 – Baseflow, high flow and managed inundation design scenarios

3.1 Summary

A number of scenarios were run primarily to supply data for design refinements of proposed infrastructure for Katarapko floodplain. These scenarios included:

- Scenario 9a – Normal flow conditions from 10 000 to 30 000 ML/d
- Scenario 9b – Natural high flow conditions from 30 000 to 80 000 ML/d
- Scenario 9c – Managed inundation conditions to 13.9 m AHD maximum inundation and modelling flow through Sawmill Creek regulator at 20 ML/d to represent approximate fishway flow only through Sawmill Creek
- Scenario 9d - Managed inundation conditions to 13.9 m AHD maximum inundation and modelling flow through Sawmill Creek regulator at 100 ML/d to represent both fishway and regulator flow through Sawmill Creek.

The general configurations of the scenarios above include:

- Inflows (and corresponding Lock 3 upstream levels based on historical data) set as indicated for each scenario, increasing in 5 000 ML/d increments for River Murray flows between 10 000 and 30 000 ML/d (i.e. Scenarios 9a, 9c and 9d), and 10 000 ML/d increments between flows of 30 000 to 80 000 ML/d (note that smaller increments of 1000 ML/d were used between 60 000 to 75 000 ML/d natural high flow conditions to pinpoint levels (a) at the inundation height of 13.9 m AHD, (b) at the top of bank height of 14.1 m AHD, and (c) bank just overtopped)
- Lock 4 upstream level set to correspond to river flows based on historical data under normal operating conditions, or to 14.2 m AHD under managed inundation scenarios (9c and 9d)
- Latest blocking alignment, including the 'northern alignment' between Sawmill Creek and Lock 4 set to a minimum elevation of 14.1 m AHD, and the southern track set to a minimum of 13.7 m AHD (incorporating the Lock 4 ancillary spillway at 13.5 m AHD crest level)
- Bank J fully open under all conditions
- Stone weir set to upgraded crest level of 10.24 m AHD
- Log Crossing set as follows:
    - Fully open for managed inundation conditions (i.e. Scenarios 9c and 9d) and for normal operating conditions from 30 000 ML/d and upwards
    - Set to a structure height of 11.1 m AHD under normal operating conditions up to River Murray flows of 25 000 ML/d, to represent the potential operation of Log Crossing under such flow conditions (note that actual operation of the structure may require the Log Crossing to be fully open under normal flow conditions when Bank J is fully open, in order to limit velocities through Sawmill Creek)
- Ancillary structures operated as follows:
    - All fully open under normal flow conditions and natural high flow conditions
    - Under managed inundation conditions, ancillary flows set to 10 ML/d at Piggy Creek south inlet, Piggy Creek outfall, and Car Park Lagoons outfall, and ancillaries fully closed at Sawmill Creek and Piggy Creek northern inlet

- Sawmill Creek regulator set to fully open under normal operating conditions, and set to pass 20 ML/d (Scenario 9c) or 100 ML/d (Scenario 9d) under managed inundation conditions
- The Splash regulator set to fully open under normal operating conditions, or set to pass the remaining flow at an upstream level of 13.9 m AHD under managed inundation operation.

Structure dimensions tested for all scenarios are indicated in Table 3.1.

Table 3.1 Structure details modelled in Scenario 9 simulations

Structure	Gates no.	Gate width m	Sill level m AHD
Sawmill Creek regulator	1	6	10.20
The Splash regulator	2	6	9.55
Carpark outfall	1	6	12.00
Piggy Creek outfall	1	6	9.91
Piggy Creek inlet north	1	2.1	12.00
Piggy Creek inlet south	1	2.1	12.00
Sawmill ancillary west	1	2.1	12.00
Sawmill ancillary east	1	2.1	12.00
Lock 4 road flow path culvert west	1	2.1	12.60
Lock 4 road flow path culvert east	1	2.1	12.50

Design data is presented in the Appendix 2 indicating flow, levels (upstream and downstream of structure), and velocity for each individual structure. Note that under natural high flow conditions, only the results of the finer flow modelling indicating hydraulics (a) at the inundation height of 13.9 m AHD, (b) at the top of bank height of 14.1 m AHD, and (c) bank just overtopped are presented, as per design requirements.

Velocity maps for non-managed inundation flow conditions are presented separately for River Murray flows between 10 000 to 80 000 ML/d in the available flow increments modelled (not including the finer natural high flow modelling increments) to provide an indication of the hydraulics under the latest blocking alignment, in particular for assessment of connectivity barriers at higher flow conditions.

3.2 Results

Velocity maps for non-managed inundation conditions are presented in Figure 3.1 to Figure 3.10 for River Murray flows of 10 000 to 80 000 ML/d, respectively. The results indicate that up to 60 000 ML/d the water level remains below the blocking alignment height along its length, while at 70 000 ML/d parts of the blocking bank appear overtopped, in particular alongside Piggy Creek and the bank alignment between Lock 4 and Sawmill Creek. Note that the finer natural high flow increments (refer to tabular data in Appendix 2) indicate overtopping occurs at Sawmill Creek regulator at approximately 69 000 ML/d River Murray flow, while overtopping at the Splash regulator occurs at approximately 71 000 ML/d. By 80 000 ML/d, the alignment is shown to be fully submerged under the floodwaters.

Note that under flows up to approximately 30 000–40 000 ML/d there are areas of zero velocity that appear disconnected from flow paths through the floodplain, such as in Piggy Creek, and flow paths to the west of Sawmill Creek and around the Lock 4 to Sawmill Creek section of alignment. These areas are a result of issues with the initial conditions occurring due to minor changes to the bathymetry under model refinements rather than a result of actual inundation, and can be considered dry for the purposes of these maps.

Also apparent in velocity maps at lower flows (e.g. Figure 3.1 and Figure 3.2) are isolated 1-D locations at very high velocity in comparison to adjacent model node points, specifically in the lower section of Sawmill Creek and Piggy Creek north inlet. These can be attributed to the method of connecting the relevant branches with large differences in minimum level (see review comments in Appendix 3), and are thus not true representations of the actual velocity at these points. Velocities in the adjacent locations should be considered as more reliable representations of in-stream velocity at these lower River Murray flows.

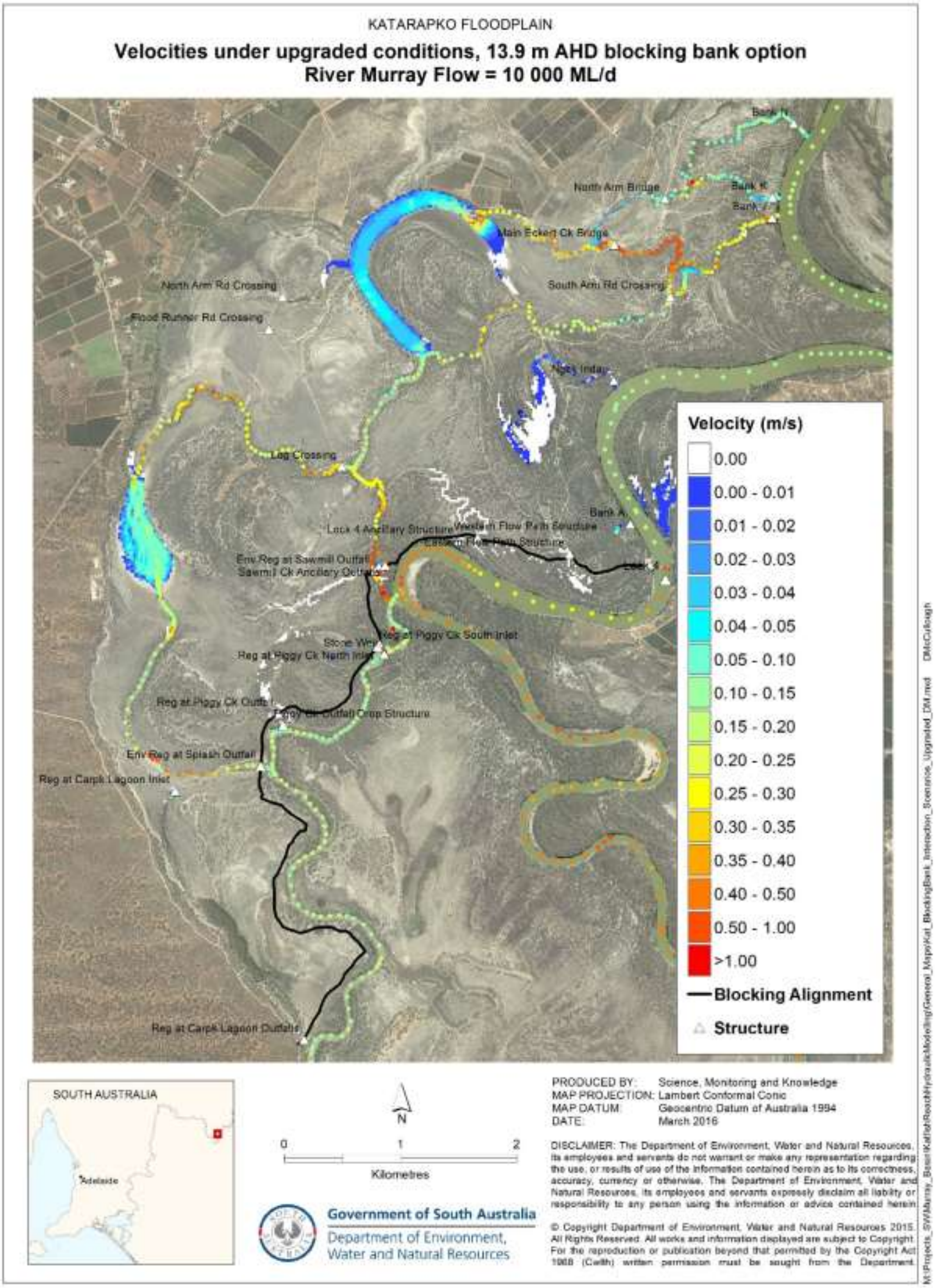

Figure 3.1 Normal floodplain flow conditions at 10 000 ML/d (under Scenario 9a)

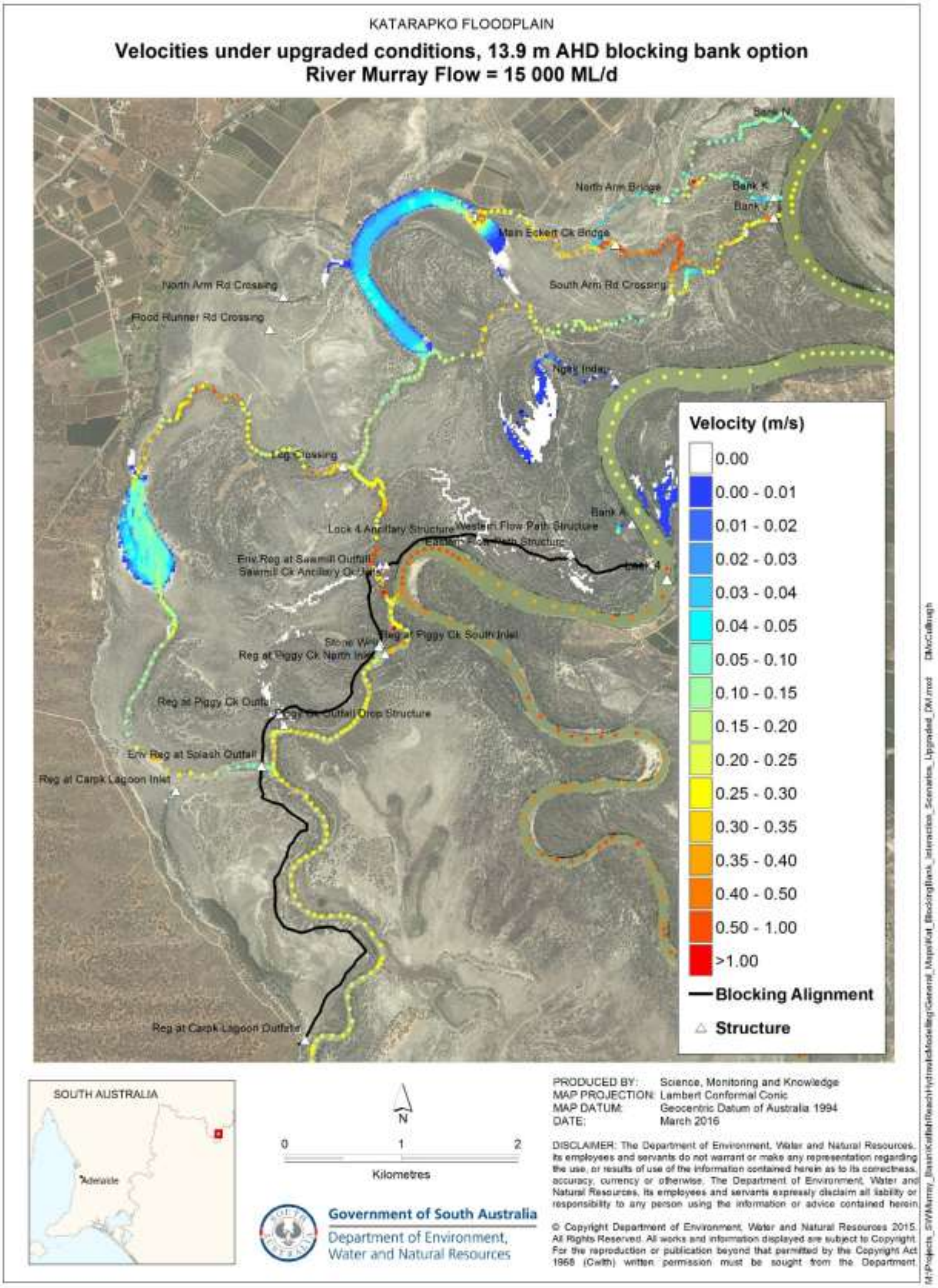

Figure 3.2 Normal floodplain flow conditions at 15 000 ML/d (under Scenario 9a)

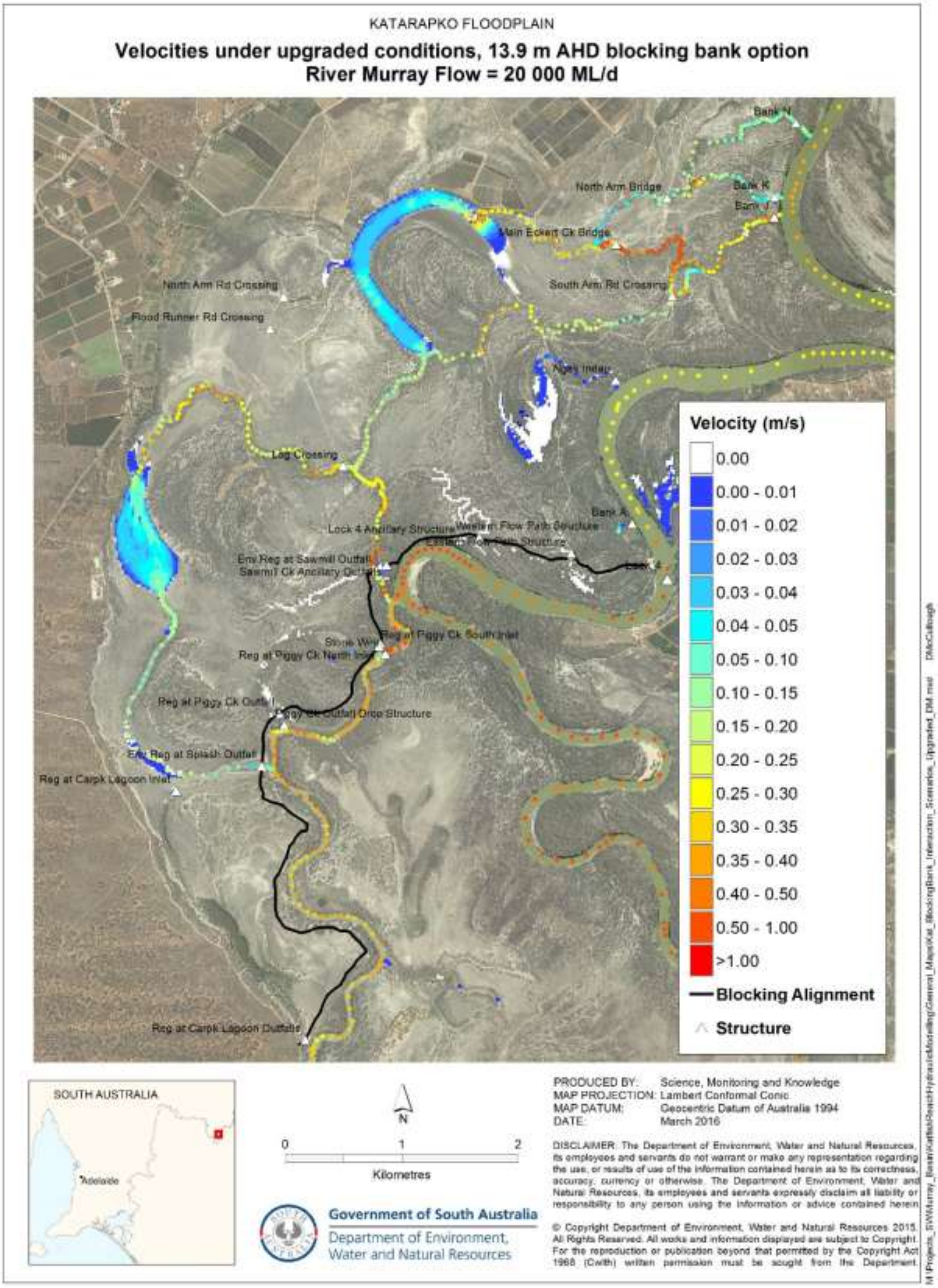

Figure 3.3 Normal floodplain flow conditions at 20 000 ML/d (under Scenario 9a)

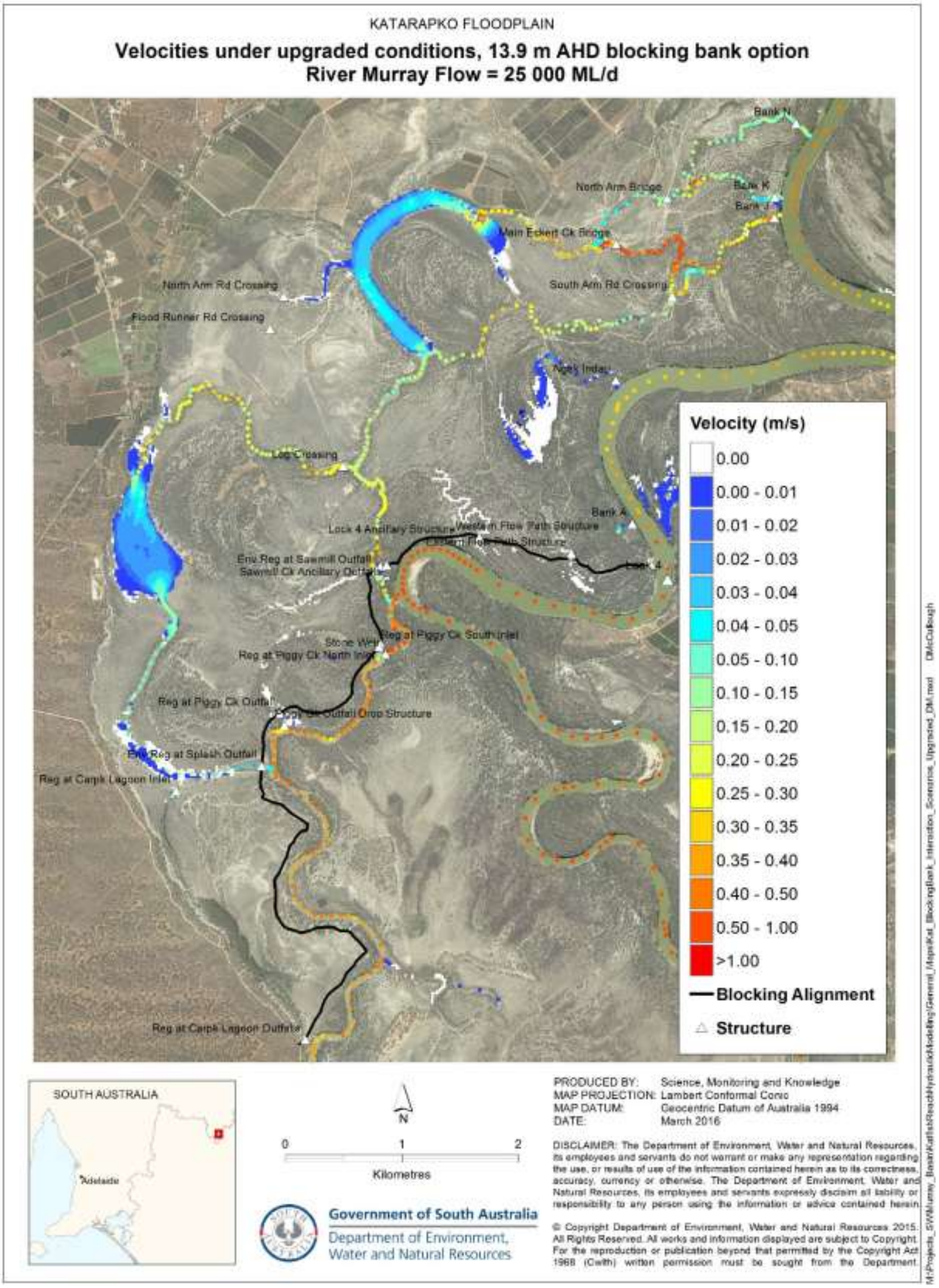

Figure 3.4 Normal floodplain flow conditions at 25 000 ML/d (under Scenario 9a)

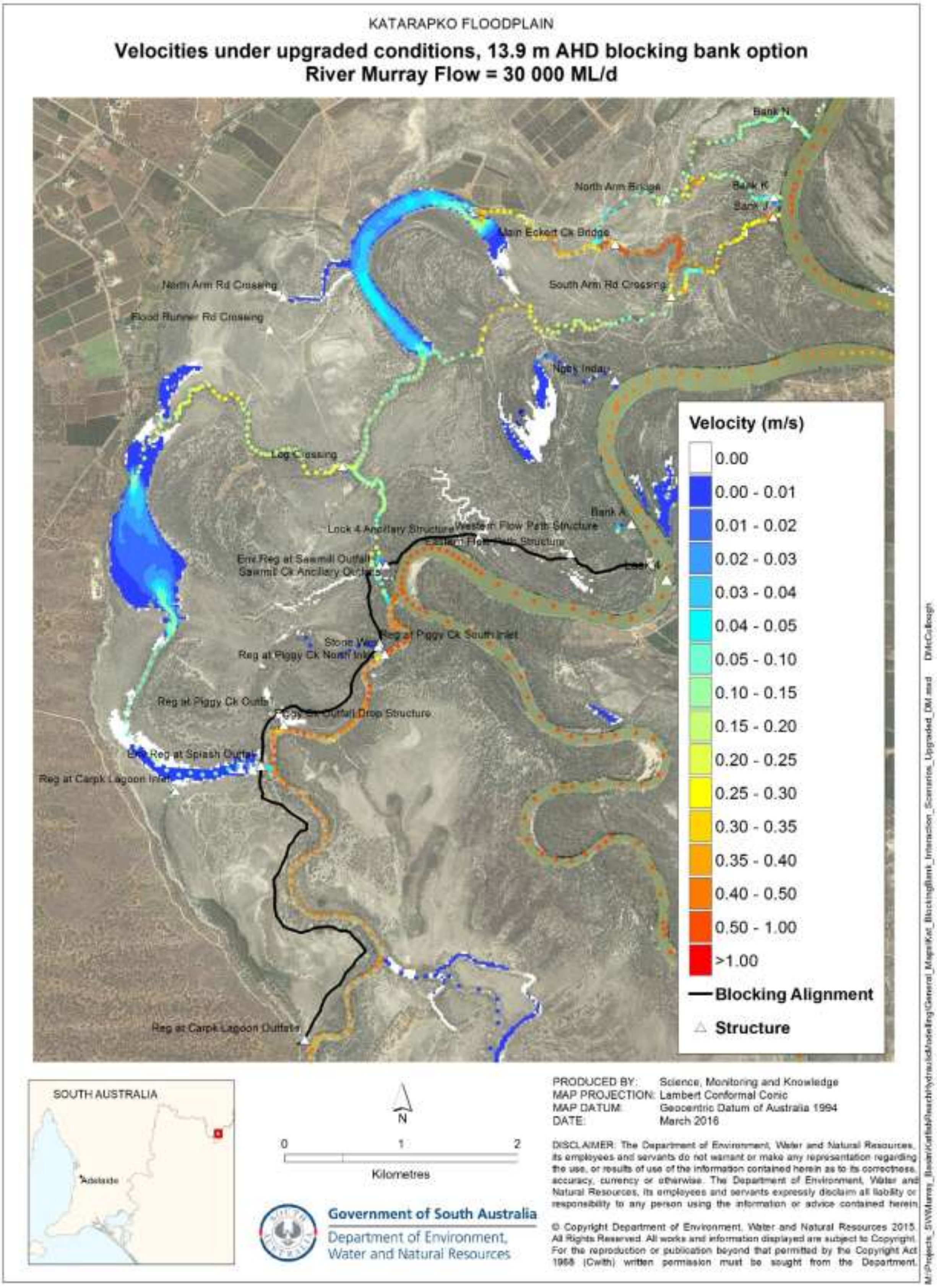

Figure 3.5 Natural high flow conditions at 30 000 ML/d (under Scenario 9b)

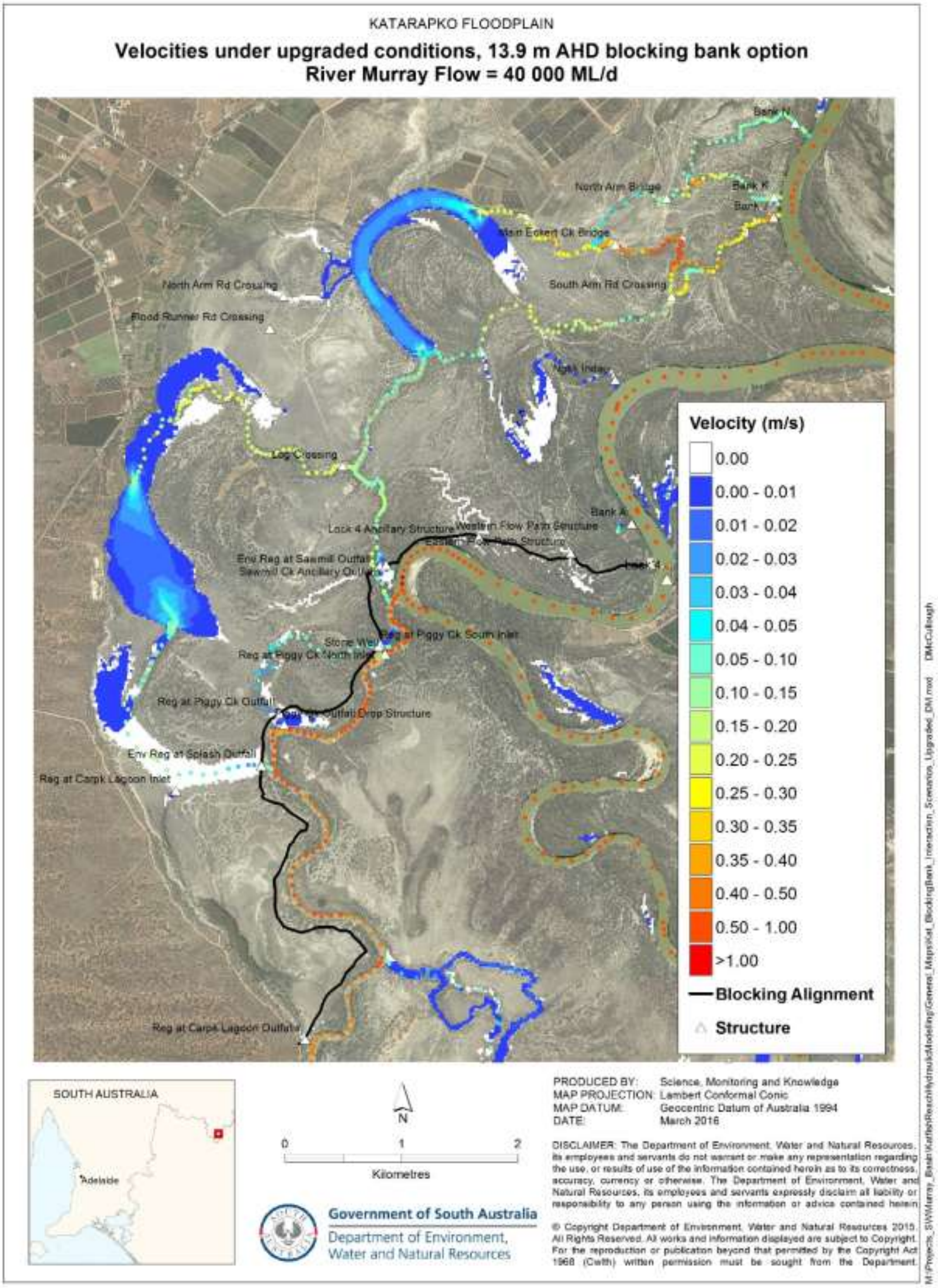

Figure 3.6 Natural high flow conditions at 40 000 ML/d (under Scenario 9b)

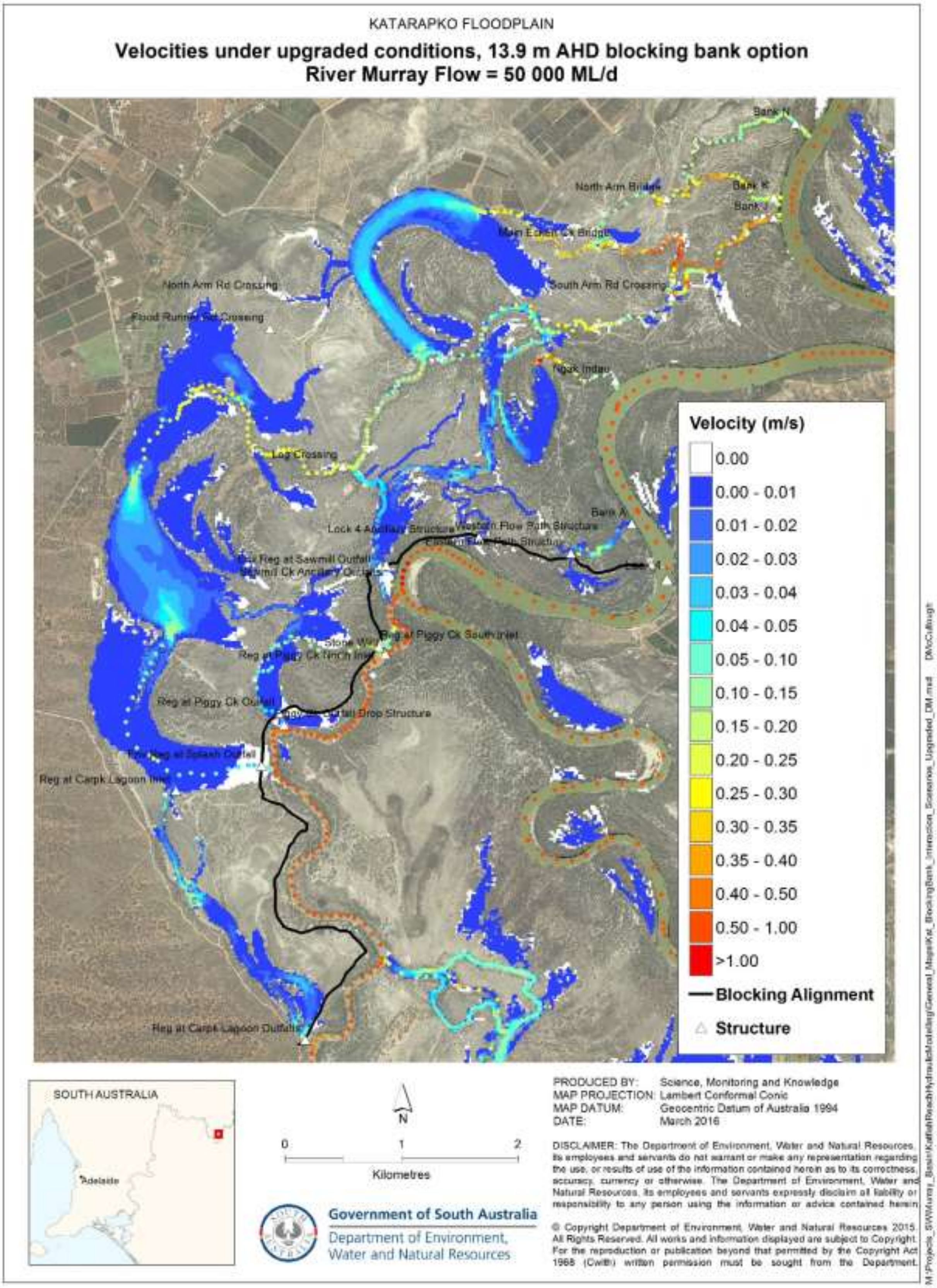

Figure 3.7 Natural high flow conditions at 50 000 ML/d (under Scenario 9b)

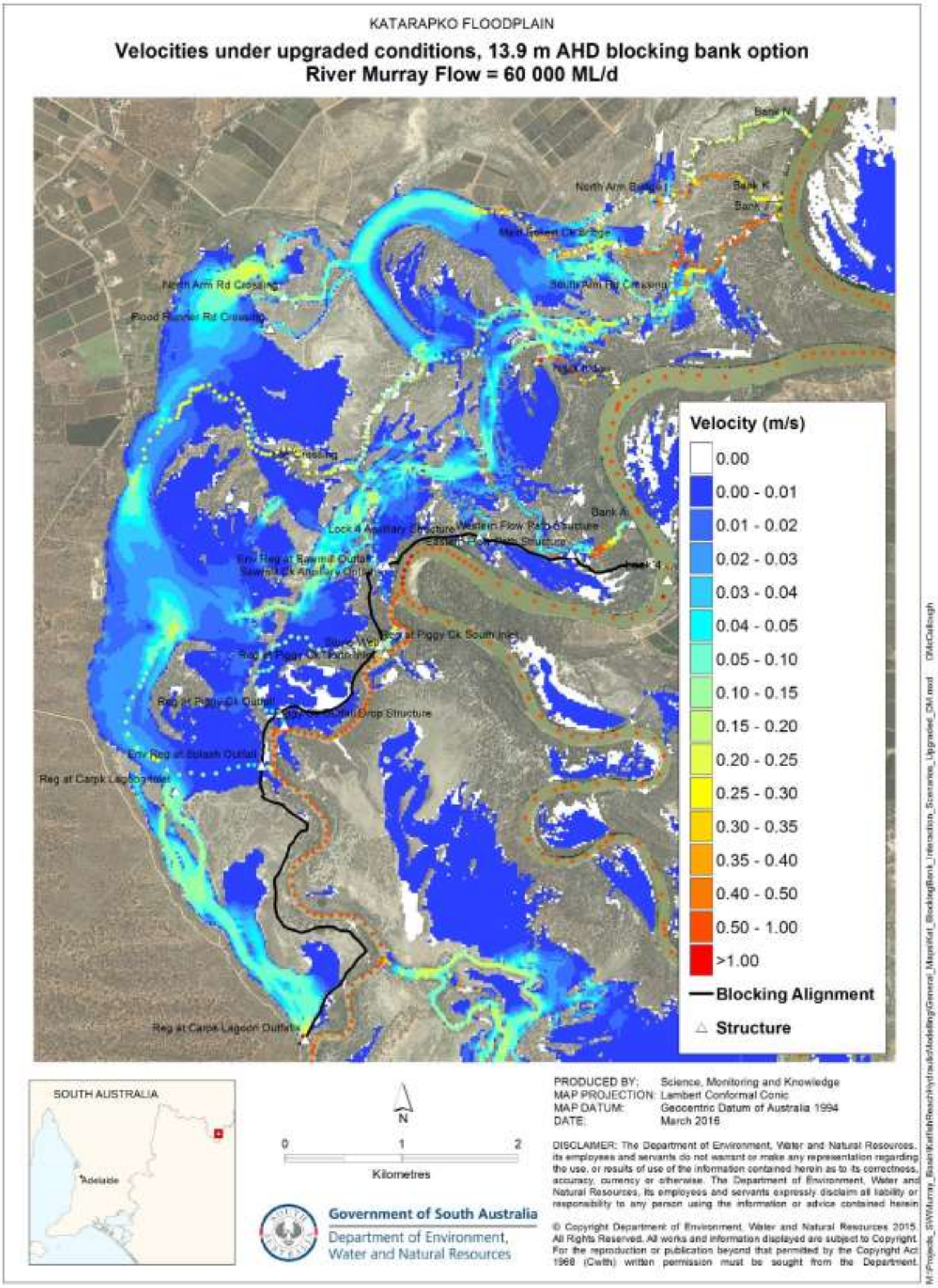

Figure 3.8 Natural high flow conditions at 60 000 ML/d (under Scenario 9b)

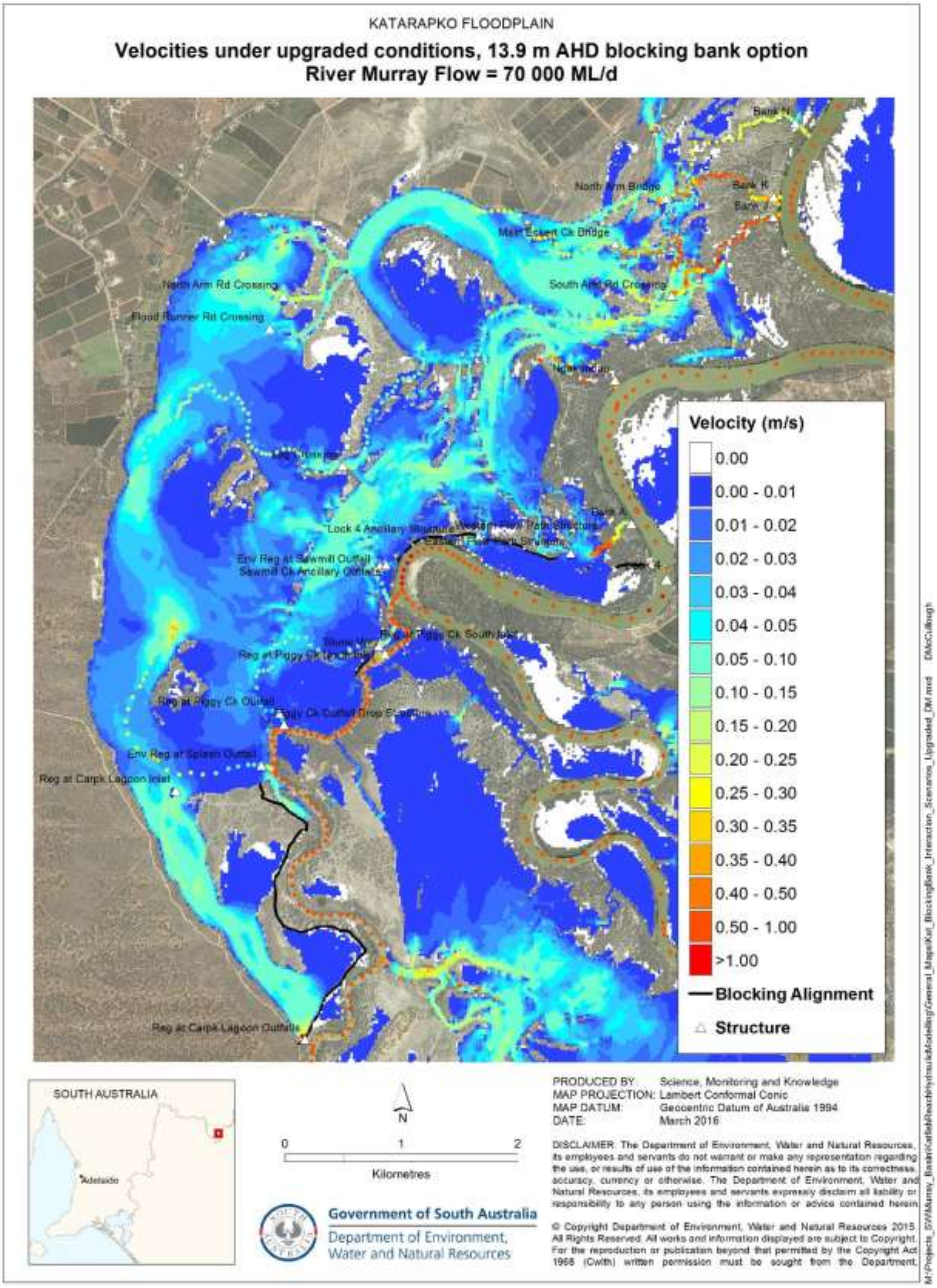

Figure 3.9 Natural high flow conditions at 70 000 ML/d (under Scenario 9b)

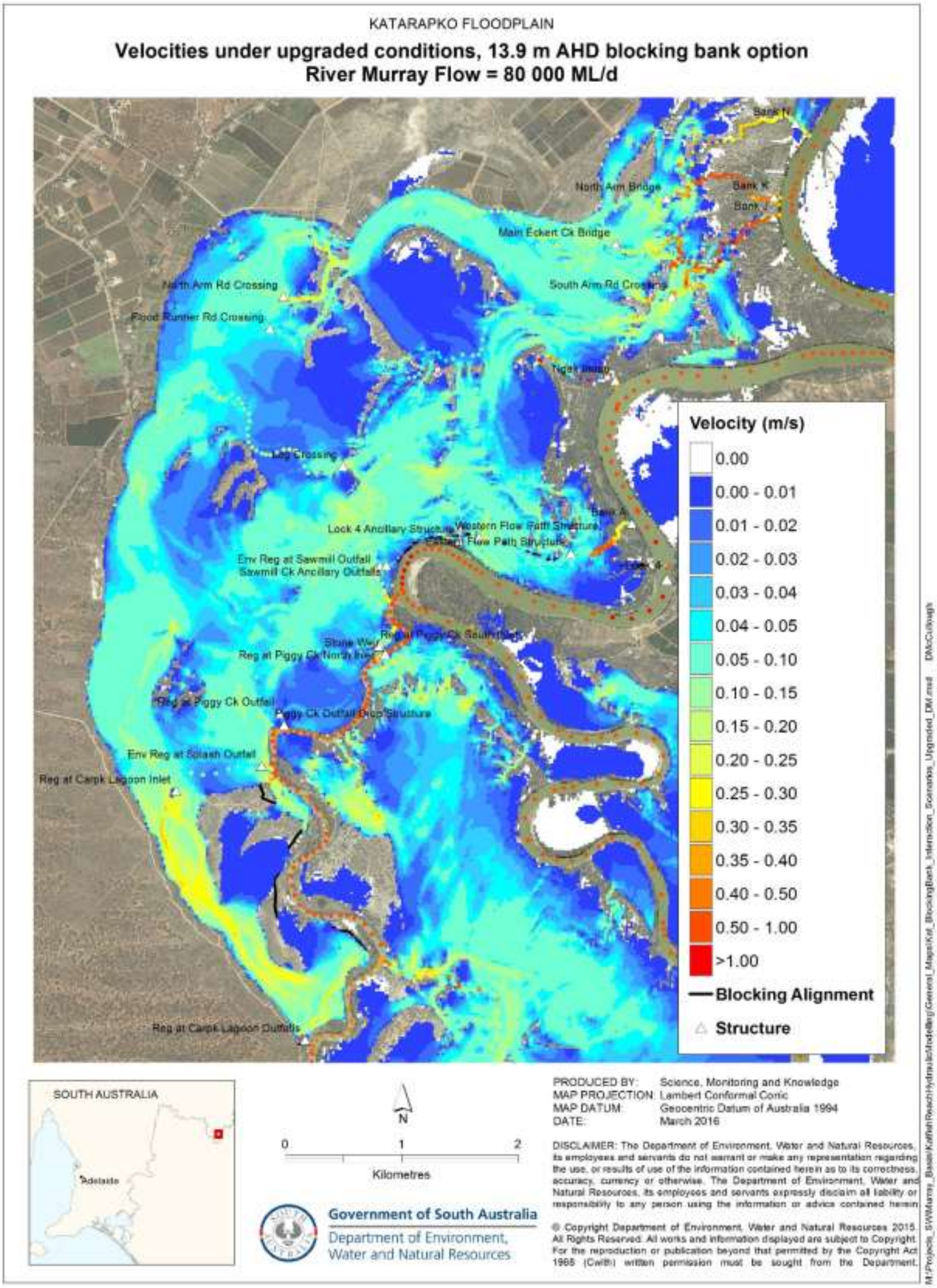

Figure 3.10 Natural high flow conditions at 80 000 ML/d (under Scenario 9b)

4 References

McCullough DP, 2016, *SARFIIP – Preliminary Investigations – Katarapko Floodplain Hydraulic Model Setup and Review,* DEWNR Technical Note 2016/06, Government of South Australia, through Department of Environment, Water and Natural Resources, Adelaide

McCullough DP, Montazeri, M, Gibbs, M, 2016, *SARFIIP – Katarapko Floodplain Hydraulic Modelling – Managed Inundation Options Assessment Scenarios – 2014–15,* DEWNR Technical note 2016/07, Government of South Australia, through the Department of Environment, Water and Natural Resources, Adelaide

Yamagata, K, 2016, *Review of the Katarapko Floodplain MIKE FLOOD models*, Reference no. 43802214, DHI Water and Environment, Sydney

Appendix A – Design data from Scenario 8 simulations

In the data presented in the following tables, The Splash regulator is modelled to possess the highest head difference across the structure (i.e. approximately 3.6 m AHD) and velocity at the structure (approximately 2.8 m/s) compared to other structures in the system, given that it passes the bulk of the flow from the system. Note however that this may differ from actual operating conditions, depending primarily on how Bank J and Lock 4 are operated during a managed inundation event. The hydraulics at other structures are dependent on the operational configuration under each scenario.

Note that flows through the Lock 4 western flow path are actually modelled to pass from the river side to floodplain side of the blocking alignment (i.e. negative flow), however this is expected to be positive flow under the latest blocking alignment configuration, in which the southern track between Lock 4 and Sawmill Creek has a maximum height of 13.7 m AHD, compared to the modelled height of 14.1 m AHD.

Table A.1 Results for water exchange Scenarios 8a to 8c

	Parameter	Unit	Carpark lagoon outfall	Carpark lagoon inlet	The Splash regulator	Piggy Creek outfall	Piggy Creek southern inlet	Piggy Creek northern inlet	Sawmill Creek outfall	Sawmill Creek ancillary (west)	Sawmill Creek ancillary (east)	Lock 4 ancillary	Lock 4 western flow path	Lock 4 eastern flow path
	Invert level	**M**	11.94	11.98	9.55	9.91	11.05	11.35	10.20	12.00	12.00	13.20	12.46	12.40
	U/S bed level	**M**	11.94	11.98	9.55	9.91	11.05	11.35	10.20	12.00	12.00	13.21	12.50	12.40
	D/S bed level	**M**	11.94	11.98	9.55	9.91	11.05	11.35	10.20	12.00	12.00	7.18	12.54	12.40
Scenario 8a	**U/S water level**	**M**	13.91	13.91	13.91	13.90	13.90	13.90	13.92	13.92	13.92	13.92	13.92	13.92
	D/S water level	**M**	11.95	13.91	10.31	11.43	11.05	11.35	11.26	12.00	12.08	10.66	13.92	13.92
	Diff. head	**M**	1.96	0.00	3.60	2.47	2.86	2.55	2.66	1.92	1.84	3.26	0.00	0.00
	U/S depth	**M**	1.97	1.93	4.36	3.99	2.86	2.55	3.72	1.92	1.92	0.71	1.42	1.52
	D/S depth	**M**	0.01	1.93	0.76	1.52	0.00	0.00	1.06	0.00	0.08	3.48	1.38	1.52
	Flow	**m3/s**	0.00	0.00	26.69	0.00	0.00	0.00	1.15	0.00	0.00	0.02	-0.03	0.07
	Flow	**ML/day**	0.00	0.00	2306.02	0.00	0.00	0.00	99.36	0.00	0.00	1.87	-2.85	6.22
	Velocity	**m/s**	0.00	0.00	2.79	0.00	0.00	0.00	1.41	0.00	0.00	0.35	-0.01	0.02
Scenario 8b	**U/S water level**	**m**	13.90	13.90	13.90	13.89	13.89	13.89	13.92	13.92	13.92	13.92	13.89	13.92
	D/S water level	**m**	12.04	13.90	10.30	12.47	11.23	12.70	11.23	12.28	12.27	10.66	13.91	13.92
	Diff. head	**m**	1.86	0.00	3.60	1.42	2.66	1.19	2.69	1.64	1.65	3.26	-0.02	0.00
	U/S depth	**m**	1.96	1.92	4.35	3.98	2.85	2.54	3.72	1.92	1.92	0.71	1.39	1.52
	D/S depth	**m**	0.11	1.92	0.75	2.56	0.19	1.35	1.03	0.28	0.27	3.48	1.37	1.52
	Flow	**m3/s**	0.11	0.00	26.01	0.12	0.12	0.12	1.14	0.12	0.12	0.02	-0.03	0.07

	Flow	**ML/day**	9.86	0.00	2247.26	10.0	10.0	10.0	98.50	10.0	10.00	1.82	-2.70	5.98
	Velocity	**m/s**	0.56	0.00	2.77	0.66	0.82	0.81	1.41	0.81	0.81	0.36	-0.01	0.02
Scenario 8c	**U/S water level**	**m**	13.90	13.90	13.90	13.89	13.89	13.88	13.92	13.92	13.92	13.92	13.89	13.92
	D/S water level	**m**	12.08	13.90	10.30	12.50	11.29	12.71	11.23	12.30	12.30	10.66	13.92	13.92
	Diff. head	**m**	1.82	0.00	3.60	1.39	2.60	1.17	2.70	1.62	1.62	3.26	-0.03	0.00
	U/S depth	**m**	1.96	1.92	4.35	3.98	2.85	2.53	3.72	1.92	1.92	0.71	1.39	1.52
	D/S depth	**m**	0.14	1.92	0.75	2.59	0.25	1.36	1.03	0.30	0.30	3.48	1.38	1.52
	Flow	**m3/s**	0.23	0.00	25.24	0.23	0.23	0.23	1.15	0.23	0.23	0.02	-0.03	0.07
	Flow	**ML/day**	19.87	0.00	2180.74	19.87	20.15	20.00	99.19	19.98	19.98	1.73	-2.52	5.75
	Velocity	**m/s**	0.71	0.00	2.74	0.83	1.03	1.02	1.41	1.03	1.02	0.36	-0.01	0.02

Table A.2 Results for fish attraction Scenarios 8d to 8g

	Parameter	Unit	Carpark lagoon outfall	Carpark lagoon inlet	The Splash regulator	Piggy Creek outfall	Piggy Creek southern inlet	Piggy Creek northern inlet	Sawmill Creek outfall	Sawmill Creek ancillary (west)	Sawmill Creek ancillary (east)	Lock 4 ancillary	Lock 4 western flow path	Lock 4 eastern flow path
	Invert level	**m**	11.94	11.98	9.55	9.91	11.05	11.35	10.20	12.00	12.00	13.20	12.46	12.40
	U/S bed level	**m**	11.94	11.98	9.55	9.91	11.05	11.35	10.20	12.00	12.00	13.21	12.50	12.40
	D/S Bed level	**m**	11.94	11.98	9.55	9.91	11.05	11.35	10.20	12.00	12.00	7.18	12.54	12.40
Scenario 8d	**U/S water level**	**m**	13.90	13.90	13.90	13.89	13.89	13.89	13.92	13.92	13.92	13.92	13.92	13.92
	D/S water level	**m**	12.04	13.90	10.31	12.46	11.23	12.70	10.80	12.28	12.27	10.65	13.92	13.92
	Diff. head	**m**	1.86	0.00	3.59	1.43	2.66	1.19	3.12	1.64	1.65	3.27	0.00	0.00
	U/S depth	**m**	1.96	1.92	4.35	3.98	2.85	2.54	3.72	1.92	1.92	0.71	1.42	1.52
	D/S depth	**m**	0.10	1.92	0.76	2.55	0.19	1.35	0.60	0.28	0.27	3.47	1.38	1.52
	Flow	**m3/s**	0.12	0.00	27.05	0.12	0.12	0.11	0.12	0.12	0.12	0.02	-0.04	0.08
	Flow	**ML/day**	9.99	0.00	2336.69	10.06	10.14	9.90	10.04	9.99	9.99	1.99	-3.16	6.54
	Velocity	**m/s**	0.57	0.00	2.81	0.66	0.82	0.81	0.66	0.81	0.81	0.36	-0.01	0.03
Scenario 8e	**U/S water level**	**m**	13.90	13.90	13.90	13.89	13.89	13.89	13.92	13.92	13.92	13.92	13.92	13.92
	D/S water level	**m**	12.04	13.90	11.23	12.46	11.36	12.70	11.37	12.28	12.28	11.43	13.92	13.92
	Diff. head	**m**	1.86	0.00	2.67	1.43	2.54	1.19	2.55	1.64	1.64	2.49	0.00	0.00
	U/S depth	**m**	1.96	1.92	4.35	3.98	2.85	2.54	3.72	1.92	1.92	0.71	1.42	1.52
	D/S depth	**m**	0.10	1.92	1.68	2.55	0.31	1.35	1.17	0.28	0.28	4.25	1.38	1.52
	Flow	**m3/s**	0.11	0.00	28.09	0.12	0.11	0.11	0.12	0.12	0.12	0.02	-0.04	0.09

	Flow	ML/day	9.89	0.00	2426.98	9.94	9.68	9.74	9.94	10.06	9.94	1.99	-3.87	7.38
	Velocity	m/s	0.56	0.00	2.84	0.66	0.81	0.81	0.66	0.81	0.81	0.36	-0.02	0.03
Scenario 8f	U/S water level	m	13.90	13.90	13.90	13.90	13.90	13.90	13.92	13.92	13.92	13.92	13.92	13.92
	D/S water level	m	11.95	13.90	10.32	10.43	11.05	11.35	10.62	12.00	12.08	10.65	13.92	13.92
	Diff. head	m	1.95	0.00	3.58	3.47	2.86	2.55	3.30	1.92	1.84	3.27	0.00	0.00
	U/S depth	m	1.96	1.92	4.35	3.99	2.86	2.55	3.72	1.92	1.92	0.71	1.42	1.52
	D/S depth	m	0.01	1.92	0.77	0.52	0.00	0.00	0.42	0.00	0.08	3.47	1.38	1.52
	Flow	m^3/s	0.00	0.00	27.83	0.00	0.00	0.00	0.00	0.00	0.00	0.02	-0.04	0.08
	Flow	ML/day	0.00	0.00	2404.51	0.00	0.00	0.00	0.00	0.00	0.00	1.99	-3.42	6.85
	Velocity	m/s	0.00	0.00	2.83	0.00	0.00	0.00	0.00	0.00	0.00	0.36	-0.01	0.02
Scenario 8g	U/S water level	m	13.90	13.90	13.90	13.90	13.90	13.90	13.92	13.92	13.92	13.92	13.92	13.92
	D/S water level	m	11.95	13.90	10.31	10.43	11.05	11.35	10.80	12.00	12.08	10.65	13.92	13.92
	Diff. head	m	1.95	0.00	3.59	3.47	2.86	2.55	3.12	1.92	1.84	3.27	0.00	0.00
	U/S depth	m	1.96	1.92	4.35	3.99	2.86	2.55	3.72	1.92	1.92	0.71	1.42	1.52
	D/S depth	m	0.01	1.92	0.76	0.52	0.00	0.00	0.60	0.00	0.08	3.47	1.38	1.52
	Flow	m^3/s	0.00	0.00	27.65	0.00	0.00	0.00	0.12	0.00	0.00	0.02	-0.04	0.08
	Flow	ML/day	0.00	0.00	2388.96	0.00	0.00	0.00	10.37	0.00	0.00	1.90	-3.37	6.78
	Velocity	m/s	0.00	0.00	2.83	0.00	0.00	0.00	0.67	0.00	0.00	0.36	-0.01	0.03

Appendix B – Design data from Scenario 9 simulations

Table B.1 The Splash regulator hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	556	10.26	10.23	0.03	0.80
	Normal, 15 GL/d	571	10.73	10.71	0.01	0.48
	Normal, 20 GL/d	597	11.21	11.20	0.01	0.35
	Normal, 25 GL/d	638	11.59	11.58	0.01	0.30
	Normal, 30 GL/d	708	11.95	11.94	0.01	0.29
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	3800	13.90	13.85	0.05	0.85
	Natural Flood, 70 GL/d, Splash=14.1 m AHD	4362	14.09	14.03	0.06	0.94
	Natural Flood, 71 GL/d, Splash overtopped	4092	14.12	14.07	0.05	0.87
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	3373	13.80	13.76	0.04	0.77
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	4193	14.05	13.99	0.06	0.91
	Natural Flood, 69 GL/d, Sawmill overtopped	4325	14.09	14.04	0.06	0.93
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	1690	13.90	10.25	3.65	2.52
	Managed, 15 GL/d, 20 ML/d Sawmill	1731	13.90	10.77	3.13	2.54
	Managed, 20 GL/d, 20 ML/d Sawmill	1795	13.90	11.22	2.68	2.57
	Managed, 25 GL/d, 20 ML/d Sawmill	1873	13.90	11.59	2.31	2.61
	Managed, 30 GL/d, 20 ML/d Sawmill	1962	13.90	11.94	1.96	2.65
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	1617	13.90	10.24	3.66	2.48
	Managed, 15 GL/d, 100 ML/d Sawmill	1657	13.90	10.76	3.14	2.50

	Managed, 20 GL/d, 100 ML/d Sawmill	1720	13.90	11.21	2.69	2.53
	Managed, 25 GL/d, 100 ML/d Sawmill	1797	13.90	11.59	2.31	2.57
	Managed, 30 GL/d, 100 ML/d Sawmill	1885	13.90	11.94	1.96	2.61

Table B.2 Carpark Lagoon outfall hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	0	11.98	12.00	-0.02	0.00
	Normal, 15 GL/d	0	11.98	12.00	-0.02	0.00
	Normal, 20 GL/d	0	11.98	12.00	-0.02	0.00
	Normal, 25 GL/d	0	11.98	12.00	-0.02	0.00
	Normal, 30 GL/d	0	11.99	12.00	-0.01	0.00
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	1804	13.83	13.73	0.10	2.15
	Natural Flood, 70 GL/d, Splash=14.1 m AHD	2154	14.05	13.93	0.12	2.31
	Natural Flood, 71 GL/d, Splash overtopped	2165	14.07	13.96	0.11	2.28
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	1616	13.72	13.63	0.09	2.03
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	2071	14.00	13.89	0.11	2.27
	Natural Flood, 69 GL/d, Sawmill overtopped	2152	14.05	13.93	0.12	2.30
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	10	13.90	12.04	1.86	0.57
	Managed, 15 GL/d, 20 ML/d Sawmill	10	13.90	12.04	1.86	0.58
	Managed, 20 GL/d, 20 ML/d Sawmill	10	13.90	12.04	1.86	0.57

	Managed, 25 GL/d, 20 ML/d Sawmill	10	13.91	12.04	1.86	0.57
	Managed, 30 GL/d, 20 ML/d Sawmill	10	13.91	12.04	1.86	0.57
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	10	13.90	12.04	1.86	0.57
	Managed, 15 GL/d, 100 ML/d Sawmill	10	13.90	12.04	1.86	0.57
	Managed, 20 GL/d, 100 ML/d Sawmill	10	13.90	12.04	1.86	0.58
	Managed, 25 GL/d, 100 ML/d Sawmill	10	13.90	12.04	1.86	0.57
	Managed, 30 GL/d, 100 ML/d Sawmill	10	13.91	12.04	1.86	0.58

Table B.3 Piggy Creek outfall hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	0	10.92	10.92	0.00	0.00
	Normal, 15 GL/d	0	10.92	10.92	0.00	0.00
	Normal, 20 GL/d	0	10.92	10.92	0.00	0.00
	Normal, 25 GL/d	0	10.92	10.92	0.00	0.00
	Normal, 30 GL/d	1	11.98	11.98	0.00	0.00
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	411	13.91	13.90	0.01	0.20
	Natural Flood, 70 GL/d, Splash=14.1 m AHD	478	14.09	14.08	0.01	0.22
	Natural Flood, 71 GL/d, Splash overtopped	329	14.13	14.12	0.01	0.15
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	390	13.83	13.83	0.01	0.19
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	430	14.05	14.04	0.01	0.20

	Natural Flood, 69 GL/d, Sawmill overtopped	463	14.09	14.09	0.01	0.21
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	10	13.89	12.47	1.42	0.57
	Managed, 15 GL/d, 20 ML/d Sawmill	10	13.89	12.47	1.42	0.58
	Managed, 20 GL/d, 20 ML/d Sawmill	10	13.89	12.47	1.43	0.57
	Managed, 25 GL/d, 20 ML/d Sawmill	10	13.89	12.47	1.43	0.57
	Managed, 30 GL/d, 20 ML/d Sawmill	10	13.89	12.47	1.43	0.57
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	10	13.89	12.47	1.42	0.57
	Managed, 15 GL/d, 100 ML/d Sawmill	10	13.89	12.47	1.42	0.57
	Managed, 20 GL/d, 100 ML/d Sawmill	10	13.89	12.47	1.42	0.58
	Managed, 25 GL/d, 100 ML/d Sawmill	10	13.89	12.47	1.43	0.57
	Managed, 30 GL/d, 100 ML/d Sawmill	10	13.89	12.47	1.43	0.58

Table B.4 Piggy Creek outfall drop structure hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	0	10.92	10.19	0.73	0.00
	Normal, 15 GL/d	0	10.92	10.71	0.21	0.00
	Normal, 20 GL/d	0	10.92	11.21	-0.29	0.00
	Normal, 25 GL/d	0	10.92	11.60	-0.68	0.00
	Normal, 30 GL/d	0	11.98	11.96	0.02	0.00
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	305	13.90	13.82	0.07	1.02

	Natural Flood, 70 GL/d, Splash=14.1 m AHD	313	14.08	14.00	0.08	1.05
	Natural Flood, 71 GL/d, Splash overtopped	307	14.11	14.04	0.07	1.03
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	301	13.82	13.75	0.07	1.01
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	305	14.03	13.96	0.07	1.02
	Natural Flood, 69 GL/d, Sawmill overtopped	310	14.08	14.00	0.07	1.04
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	10	12.47	10.28	2.19	0.62
	Managed, 15 GL/d, 20 ML/d Sawmill	10	12.47	10.79	1.68	0.62
	Managed, 20 GL/d, 20 ML/d Sawmill	10	12.46	11.23	1.23	0.62
	Managed, 25 GL/d, 20 ML/d Sawmill	10	12.47	11.61	0.85	0.62
	Managed, 30 GL/d, 20 ML/d Sawmill	10	12.46	11.97	0.50	0.62
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	10	12.46	10.27	2.19	0.62
	Managed, 15 GL/d, 100 ML/d Sawmill	10	12.47	10.78	1.69	0.62
	Managed, 20 GL/d, 100 ML/d Sawmill	10	12.47	11.23	1.23	0.62
	Managed, 25 GL/d, 100 ML/d Sawmill	10	12.46	11.61	0.85	0.62
	Managed, 30 GL/d, 100 ML/d Sawmill	10	12.47	11.97	0.50	0.62

Table B.5 Piggy Creek inlet south hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	0	11.05	11.18	-0.13	0.00
	Normal, 15 GL/d	0	11.08	11.18	-0.10	0.00

	Normal, 20 GL/d	0	11.38	11.18	0.20	0.00
	Normal, 25 GL/d	0	11.73	11.18	0.55	0.00
	Normal, 30 GL/d	5	12.07	11.98	0.09	0.63
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	126	13.94	13.92	0.01	0.36
	Natural Flood, 70 GL/d, Splash=14.1 m AHD	10	14.10	14.10	0.00	0.03
	Natural Flood, 71 GL/d, Splash overtopped	28	14.13	14.13	0.00	0.07
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	151	13.86	13.85	0.01	0.45
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	55	14.06	14.06	0.01	0.15
	Natural Flood, 69 GL/d, Sawmill overtopped	26	14.10	14.10	0.00	0.07
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	-10	11.17	13.89	-2.72	-0.81
	Managed, 15 GL/d, 20 ML/d Sawmill	-10	11.17	13.89	-2.73	-0.82
	Managed, 20 GL/d, 20 ML/d Sawmill	-9	11.36	13.89	-2.53	-0.80
	Managed, 25 GL/d, 20 ML/d Sawmill	-9	11.71	13.89	-2.18	-0.79
	Managed, 30 GL/d, 20 ML/d Sawmill	-10	12.06	13.89	-1.83	-0.83
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	-10	11.17	13.89	-2.72	-0.82
	Managed, 15 GL/d, 100 ML/d Sawmill	-10	11.17	13.89	-2.72	-0.82
	Managed, 20 GL/d, 100 ML/d Sawmill	-10	11.36	13.89	-2.53	-0.81
	Managed, 25 GL/d, 100 ML/d Sawmill	-9	11.71	13.89	-2.18	-0.78
	Managed, 30 GL/d, 100 ML/d Sawmill	-10	12.06	13.89	-1.83	-0.81

Table B.6 Piggy Creek inlet north hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	0	11.35	12.53	-1.18	0.00
	Normal, 15 GL/d	0	11.35	12.53	-1.18	0.00
	Normal, 20 GL/d	0	11.35	12.53	-1.18	0.00
	Normal, 25 GL/d	0	11.35	12.53	-1.18	0.00
	Normal, 30 GL/d	0	11.35	12.53	-1.18	0.00
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	277	13.97	13.94	0.03	0.79
	Natural Flood, 70 GL/d, Splash=14.1 m AHD	286	14.14	14.11	0.03	0.75
	Natural Flood, 71 GL/d, Splash overtopped	291	14.17	14.14	0.03	0.75
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	260	13.90	13.86	0.03	0.77
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	290	14.10	14.07	0.03	0.78
	Natural Flood, 69 GL/d, Sawmill overtopped	293	14.14	14.11	0.03	0.77
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	0	11.35	13.89	-2.54	0.00
	Managed, 15 GL/d, 20 ML/d Sawmill	0	11.35	13.89	-2.54	0.00
	Managed, 20 GL/d, 20 ML/d Sawmill	0	11.35	13.89	-2.54	0.00
	Managed, 25 GL/d, 20 ML/d Sawmill	0	11.35	13.89	-2.54	0.00
	Managed, 30 GL/d, 20 ML/d Sawmill	0	11.35	13.89	-2.54	0.00
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	0	11.35	13.89	-2.54	0.00
	Managed, 15 GL/d, 100 ML/d Sawmill	0	11.35	13.89	-2.54	0.00

	Managed, 20 GL/d, 100 ML/d Sawmill	0	11.35	13.89	-2.54	0.00
	Managed, 25 GL/d, 100 ML/d Sawmill	0	11.35	13.89	-2.54	0.00
	Managed, 30 GL/d, 100 ML/d Sawmill	0	11.35	13.89	-2.54	0.00

Table B.7 Sawmill Creek outfall hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	156	11.40	11.39	0.01	0.25
	Normal, 15 GL/d	159	11.42	11.41	0.01	0.25
	Normal, 20 GL/d	159	11.51	11.51	0.01	0.24
	Normal, 25 GL/d	150	11.80	11.80	0.00	0.18
	Normal, 30 GL/d	117	12.13	12.13	0.00	0.12
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	-304	13.99	13.99	0.00	-0.15
	Natural Flood, 70 GL/d, Splash=14.1 m AHD	-45	14.15	14.16	0.00	-0.02
	Natural Flood, 71 GL/d, Splash overtopped	-216	14.18	14.19	0.00	-0.10
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	-312	13.91	13.92	0.00	-0.16
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	-187	14.11	14.12	0.00	-0.09
	Natural Flood, 69 GL/d, Sawmill overtopped	-159	14.16	14.16	0.00	-0.08
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	20	13.92	11.19	2.73	0.73
	Managed, 15 GL/d, 20 ML/d Sawmill	21	13.92	11.21	2.71	0.73
	Managed, 20 GL/d, 20 ML/d Sawmill	21	13.92	11.40	2.52	0.73

	Managed, 25 GL/d, 20 ML/d Sawmill	20	13.92	11.75	2.17	0.73
	Managed, 30 GL/d, 20 ML/d Sawmill	20	13.92	12.10	1.82	0.72
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	101	13.91	11.31	2.60	1.24
	Managed, 15 GL/d, 100 ML/d Sawmill	99	13.91	11.33	2.59	1.23
	Managed, 20 GL/d, 100 ML/d Sawmill	101	13.91	11.44	2.47	1.24
	Managed, 25 GL/d, 100 ML/d Sawmill	100	13.91	11.76	2.15	1.24
	Managed, 30 GL/d, 100 ML/d Sawmill	99	13.92	12.11	1.81	1.23

Table B.8 Sawmill Ancillary west hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	0	11.89	12.00	-0.11	0.00
	Normal, 15 GL/d	0	11.89	12.00	-0.11	0.00
	Normal, 20 GL/d	0	11.89	12.00	-0.11	0.00
	Normal, 25 GL/d	0	11.89	12.00	-0.11	0.00
	Normal, 30 GL/d	0	12.12	12.12	0.00	0.00
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	-62	13.98	13.99	-0.01	-0.17
	Natural Flood, 70 GL/d, Splash=14.1 m AHD	-8	14.15	14.15	0.00	-0.02
	Natural Flood, 71 GL/d, Splash overtopped	-42	14.18	14.18	0.00	-0.11
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	-65	13.90	13.91	-0.01	-0.19
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	-36	14.11	14.11	0.00	-0.09

	Natural Flood, 69 GL/d, Sawmill overtopped	-31	14.15	14.16	0.00	-0.08
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	0	13.92	12.00	1.92	0.00
	Managed, 15 GL/d, 20 ML/d Sawmill	0	13.92	12.00	1.92	0.00
	Managed, 20 GL/d, 20 ML/d Sawmill	0	13.92	12.00	1.92	0.00
	Managed, 25 GL/d, 20 ML/d Sawmill	0	13.92	12.00	1.92	0.00
	Managed, 30 GL/d, 20 ML/d Sawmill	0	13.92	12.10	1.82	0.00
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	0	13.92	12.00	1.92	0.00
	Managed, 15 GL/d, 100 ML/d Sawmill	0	13.92	12.00	1.92	0.00
	Managed, 20 GL/d, 100 ML/d Sawmill	0	13.92	12.00	1.92	0.00
	Managed, 25 GL/d, 100 ML/d Sawmill	0	13.92	12.00	1.92	0.00
	Managed, 30 GL/d, 100 ML/d Sawmill	0	13.92	12.10	1.81	0.00

Table B.9 Sawmill ancillary east hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	0	11.93	11.38	0.55	0.00
	Normal, 15 GL/d	0	11.93	11.40	0.52	0.00
	Normal, 20 GL/d	0	11.93	11.50	0.43	0.00
	Normal, 25 GL/d	0	11.93	11.79	0.13	0.00
	Normal, 30 GL/d	0	12.12	12.12	0.00	0.00
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	-65	13.98	13.99	-0.01	-0.18

	Natural Flood, 70 GL/d, Splash=14.1 m AHD	-8	14.15	14.16	0.00	-0.02
	Natural Flood, 71 GL/d, Splash overtopped	-43	14.18	14.19	-0.01	-0.11
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	-69	13.90	13.92	-0.01	-0.20
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	-37	14.11	14.12	-0.01	-0.10
	Natural Flood, 69 GL/d, Sawmill overtopped	-31	14.15	14.16	-0.01	-0.08
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	0	13.92	11.19	2.73	0.00
	Managed, 15 GL/d, 20 ML/d Sawmill	0	13.92	11.21	2.71	0.00
	Managed, 20 GL/d, 20 ML/d Sawmill	0	13.92	11.40	2.52	0.00
	Managed, 25 GL/d, 20 ML/d Sawmill	0	13.92	11.75	2.17	0.00
	Managed, 30 GL/d, 20 ML/d Sawmill	0	13.92	12.10	1.82	0.00
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	0	13.92	11.31	2.61	0.00
	Managed, 15 GL/d, 100 ML/d Sawmill	0	13.92	11.32	2.59	0.00
	Managed, 20 GL/d, 100 ML/d Sawmill	0	13.92	11.44	2.48	0.00
	Managed, 25 GL/d, 100 ML/d Sawmill	0	13.92	11.76	2.16	0.00
	Managed, 30 GL/d, 100 ML/d Sawmill	0	13.92	12.10	1.81	0.00

Table B.10 Lock 4 ancillary spillway hydraulics for each scenario

Scenario	Scenario description	Flow	U/S water level	D/S water level	Differential head	Velocity
		ML/d	m AHD	m AHD	m	m/s
Scenario 9a	**Normal, 10 GL/d**	0	13.20	10.80	2.40	0.00
	Normal, 15 GL/d	0	13.20	11.16	2.04	0.00

	Normal, 20 GL/d	0	13.20	11.49	1.71	0.00
	Normal, 25 GL/d	0	13.20	11.86	1.34	0.00
	Normal, 30 GL/d	0	13.20	12.21	0.99	0.00
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	-188	14.01	14.08	-0.07	-1.03
	Natural Flood, 70 GL/d, Splash=14.1 m AHD	-196	14.16	14.24	-0.08	-1.07
	Natural Flood, 71 GL/d, Splash overtopped	-204	14.19	14.27	-0.09	-1.11
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	-184	13.93	14.00	-0.07	-1.00
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	-196	14.13	14.20	-0.08	-1.07
	Natural Flood, 69 GL/d, Sawmill overtopped	-203	14.16	14.25	-0.08	-1.10
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	9	13.56	10.71	2.85	0.59
	Managed, 15 GL/d, 20 ML/d Sawmill	9	13.56	11.09	2.48	0.60
	Managed, 20 GL/d, 20 ML/d Sawmill	9	13.56	11.46	2.10	0.59
	Managed, 25 GL/d, 20 ML/d Sawmill	9	13.56	11.83	1.73	0.59
	Managed, 30 GL/d, 20 ML/d Sawmill	9	13.56	12.18	1.38	0.59
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	9	13.56	10.71	2.85	0.59
	Managed, 15 GL/d, 100 ML/d Sawmill	9	13.56	11.09	2.47	0.60
	Managed, 20 GL/d, 100 ML/d Sawmill	9	13.56	11.46	2.10	0.59
	Managed, 25 GL/d, 100 ML/d Sawmill	9	13.56	11.83	1.73	0.59
	Managed, 30 GL/d, 100 ML/d Sawmill	9	13.56	12.18	1.38	0.59

Table B.11 Lock 4 road culvert west flowpath hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	0	12.77	12.83	-0.06	0.00
	Normal, 15 GL/d	0	12.75	12.80	-0.06	0.00
	Normal, 20 GL/d	0	12.72	12.78	-0.06	0.00
	Normal, 25 GL/d	0	12.69	12.75	-0.06	0.00
	Normal, 30 GL/d	0	12.65	12.71	-0.06	0.00
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	-160	13.98	14.00	-0.03	-0.64
	Natural Flood, 70 GL/d, Splash=14.1 m AHD	-127	14.15	14.16	-0.01	-0.45
	Natural Flood, 71 GL/d, Splash overtopped	-127	14.17	14.18	-0.01	-0.44
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	-149	13.90	13.93	-0.03	-0.63
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	-151	14.10	14.12	-0.02	-0.56
	Natural Flood, 69 GL/d, Sawmill overtopped	-127	14.15	14.16	-0.01	-0.45
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	5	13.91	13.56	0.35	0.63
	Managed, 15 GL/d, 20 ML/d Sawmill	4	13.91	13.56	0.35	0.61
	Managed, 20 GL/d, 20 ML/d Sawmill	5	13.91	13.56	0.35	0.64
	Managed, 25 GL/d, 20 ML/d Sawmill	5	13.91	13.56	0.35	0.64
	Managed, 30 GL/d, 20 ML/d Sawmill	6	13.92	13.56	0.35	0.69
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	5	13.91	13.56	0.35	0.63
	Managed, 15 GL/d, 100 ML/d Sawmill	6	13.91	13.56	0.35	0.68

	Managed, 20 GL/d, 100 ML/d Sawmill	5	13.91	13.56	0.35	0.65
	Managed, 25 GL/d, 100 ML/d Sawmill	5	13.91	13.56	0.35	0.66
	Managed, 30 GL/d, 100 ML/d Sawmill	4	13.91	13.56	0.35	0.61

Table B.12 Lock 4 road culvert east flow path hydraulics for each scenario

Scenario	Scenario description	Flow ML/d	U/S water level m AHD	D/S water level m AHD	Differential head m	Velocity m/s
Scenario 9a	**Normal, 10 GL/d**	0	12.70	12.70	0.00	0.00
	Normal, 15 GL/d	0	12.67	12.67	0.00	0.00
	Normal, 20 GL/d	0	12.65	12.65	0.00	0.00
	Normal, 25 GL/d	0	12.62	12.62	0.00	0.00
	Normal, 30 GL/d	0	12.58	12.58	0.00	0.00
Scenario 9b	**Natural Flood, 65 GL/d, Splash=13.9 m AHD**	-35	14.00	14.00	0.00	-0.13
	Natural Flood, 70 GL/d, Splash=14.1 m AHD	-8	14.16	14.16	0.00	-0.03
	Natural Flood, 71 GL/d, Splash overtopped	-6	14.18	14.18	0.00	-0.02
	Natural Flood, 63 GL/d, Sawmill=13.9 m AHD	-40	13.92	13.93	-0.01	-0.16
	Natural Flood, 68 GL/d, Sawmill=14.1 m AHD	-50	14.12	14.12	-0.01	-0.17
	Natural Flood, 69 GL/d, Sawmill overtopped	-9	14.16	14.16	0.00	-0.03
Scenario 9c	**Managed, 10 GL/d, 20 ML/d Sawmill**	5	13.92	13.56	0.35	0.64
	Managed, 15 GL/d, 20 ML/d Sawmill	5	13.92	13.57	0.35	0.66
	Managed, 20 GL/d, 20 ML/d Sawmill	5	13.92	13.57	0.35	0.65

	Managed, 25 GL/d, 20 ML/d Sawmill	5	13.92	13.56	0.35	0.63
	Managed, 30 GL/d, 20 ML/d Sawmill	5	13.92	13.56	0.36	0.64
Scenario 9d	**Managed, 10 GL/d, 100 ML/d Sawmill**	5	13.92	13.56	0.35	0.63
	Managed, 15 GL/d, 100 ML/d Sawmill	5	13.92	13.57	0.35	0.65
	Managed, 20 GL/d, 100 ML/d Sawmill	5	13.92	13.57	0.35	0.64
	Managed, 25 GL/d, 100 ML/d Sawmill	5	13.92	13.56	0.35	0.63
	Managed, 30 GL/d, 100 ML/d Sawmill	5	13.92	13.56	0.36	0.64

Appendix C – Comments and responses relating to external review of MIKE FLOOD Model

Table C.1 Peer reviewer comments and context of impact on modelling

Review report section	Reviewer comment	Consequence on modelling	DEWNR response	Recommendation
Calibration – Overall model setup	Potential double counting of flows in Katarapko Creek branch due to bathymetry being filled in to 12.5 m AHD, which is often lower than the river bank levels.	Modelled flows may differ to an extent to actual flows. Potentially reduces accuracy of calculated flows through Katarapko Creek under certain hydraulic conditions, when levels exceed 12.5 m AHD.	For 2014–15 managed inundation scenarios this is not a specific issue, as flows through Katarapko Creek are outside the impounded area behind the blocking alignment, while level in Kat Creek is generally below 12.5 m AHD at typical flows (modelling indicates 12.5 m AHD is exceeded above flows of ~40,000 ML/d). This issue is addressed for scenarios conducted in 2015–16, some of which supersede the high flow runs conducted in 2014–15.	Already implemented in 2014–15 model. In terms of the upgraded flexible mesh (FM) model currently under development, this is not an issue as Katarapko Creek is converted to the 2-D domain, and linkages are specified differently to the gridded model in any case.
	Potential for double-counting in the lower reach of the Splash branch when water fills to exceed 12 m AHD.	Potentially reduces accuracy of flows in the lower part of the Splash in localised areas - may be overestimated to an extent when levels exceed 12.0 m AHD.	There may be issues in localised areas of double counting occurring in the Splash when level is above 12 m AHD, and so may act to reduce accuracy of the Splash flows above flow specified above, however the likely impact is expected to be within the error of the model. The blocking bank, present in the 2-D topography, also prevents flow from the Splash to Katarapko Creek in the 2-D domain, so all flow out of the Splash is existing through the 1-D domain.	Appropriately 'block out' the Splash in 2-D domain for any future modelling with the MIKE FLOOD model to ensure double counting is not an issue. In terms of the FM model, this is not an issue as the mesh is differently set up to have bathymetry removed where it underlays 1-D branches.

Review report section	Reviewer comment	Consequence on modelling	DEWNR response	Recommendation
	Only selected parts of River Murray and Katarapko Creek have lateral links.	If water level exceeds bank level in parts of model that do not have links, then exchange won't occur at these locations. May be reduced accuracy in overbank flows in the natural high flow scenarios	Location of links originally cover low points in the floodplain but not higher levels in the terrain due to overbank flows in these areas not necessarily being active under low to medium flows at least. Not an issue for previous managed inundation scenarios or river levels below the level of the river banks/blocking alignment as connectivity is not an issue. May be an impact on connectivity between river and floodplain in certain areas of floodplain at higher flows in early modelling, however configuration of the latest 2015–16 scenarios identified these gaps in the links as potential issues at high flows and have been addressed in the model addressed.	Ensure future modelling with the MIKE FLOOD model adds linkages to high elevations of the floodplain bathymetry to ensure any potential overbank spill at high flows are accounted for. In the FM model, River Murray and Katarapko Creek are in the 2-D domain, and are unaffected by this issue.
	Some lateral links are not directly adjacent to the blocked out cells at the River Murray - gap of ~ 1 cell width between blocked cells and links present in some locations.	Potential for water to be trapped between links and blocked cells during overbank flow. No impact on overall results.	In the 2015–16 modelling this issue has been addressed. Overall, not an issue to results even in 2014–15 results.	Ensure any future defined lateral links from comment above are set directly adjacent to blocked out cells. In the FM model, River Murray and Katarapko Creek are in the 2-D domain, and are unaffected by this issue.
	Overbank spills set to be triggered by M21 bathymetry levels instead of M11 levels, except for branches at Eckert_Ck_S_Arm, Bank_K_Ck, Bank_K_Sth, Eckert_BankJ_S (these are set to spill at highest of M21 and M11 levels instead)	Difference in the way overbank spills are handled. May have impact on results at higher flows regarding overbank spills, depending on whether M21, M11, or highest of M21 and M11 are most appropriate for the respective branches.	Default setting for overbank spill control parameter is the highest of M11 and M21, which was applied to the four exceptions indicated in the comment. All the remainder are set to M21. Each of these identified branches are in the upper floodplain, and hence the impact on results is minimal.	Ensure that future modelling with the MIKE FLOOD model uses consistent specification for the overbank spill parameter for all branches, both floodplain and river channels. Also update as applicable in FM model.

Review report section	Reviewer comment	Consequence on modelling	DEWNR response	Recommendation
	'dx' parameter (i.e. spacing between calculation points) is ~ 500 m in some parts of M11 model	Causes water level averaging across multiple linked cells under the 20 m^2 grid cell size. May reduce accuracy of results via interpolation and averaging of 1-D/2-D linkages.	Main impact is with averaging of water levels through 1-D/2-D River Murray linkages. The impact is only relevant where overbank spills occur at high flows, and may only be a minimal impact on result accuracy, especially in the context of inherent model error.	For future modelling with the MIKE FLOOD model reduce maximum dx values to reduce averaging. Not an issue in FM model as River Murray represented in 2-D domain.
	dx in other branches - Eckert_Ck_S_Weeds, Eckert_Ck_N_Weeds may benefit from being more closely spaced	As in above comment, wider spacing results in more averaging. May reduce accuracy of results.	As above, the impact is only relevant where overbank spills occur at higher flows, and may only be a minimal impact on result accuracy, especially in the context of inherent model error.	For future modelling with the MIKE FLOOD model reduce maximum dx values to reduce averaging.
	Total length of linked grids significantly different from the total length of linked M11 branch	Results in interpolation and averaging of water levels and flow along links. May reduce accuracy of results.	Likely to have similar impact to large dx spacing issue as in above comments, and may only be minimal impact on results. Investigation of model configuration suggests that the majority of linked cells are difficult to reduce in length owing to the coarseness of the 20 m^2 grid cells, and thus in many cases it is difficult to identify unnecessary cells to remove from the links.	For future modelling with the MIKE FLOOD model, refine linked cells wherever possible.
	In standard links, depth adjustment parameter was switched off for all standard links	Links standard links with only one cell to the M11 model. Generally not problematic to do this, however is recommended to switch them on to link to multiple cells.	Depth adjustment parameter is switched off by default when creating standard links, which is the reason behind all links being switched off. Not a major issue for results as identified by reviewer.	Switch on depth adjustment parameter for future modelling for best practice approach. FM model has already had this recommendation implemented as part of the model upgrade work.

Review report section	Reviewer comment	Consequence on modelling	DEWNR response	Recommendation
	dx spacing (i.e. calculation points in 1-D domain of model) is small in some M11 locations	Requires a small time step to avoid instabilities. Instabilities may arise if time step not sufficiently small.	Mainly an issue at higher flows to avoid model errors, but investigation of previous results indicate minimal impact on those scenarios conducted. Increasing dx value may allow higher flows to be modelled than currently (e.g. up to approximately 100,000 ML/d before errors occur).	For future modelling using the MIKE FLOOD model, ensure cross-sections, branch connections and structures are appropriately spaced to avoid small dx values.
	Opening width of structures (i.e. weir specifications) is greater than U/S and/or D/S cross-sections	Can lead to instability in M11. Potential impact on results e.g. erratic behaviour of hydraulics at relevant locations in the model.	Check of results indicates no major instabilities arising from these structure specifications. Cross-sections at structure locations should however be adjusted for future modelling to ensure instabilities are avoided.	For future modelling with the MIKE FLOOD model, adjust cross-sections/weir dimensions as applicable to avoid instabilities.
	Cross section cannot be used at Bank A Ck branch, as structure is defined at same location	Cross-section is disregarded in calculations in preference to structure. No further impact on results	No apparent impact on results as cross-section is not considered in calculations.	Remove cross-section to optimise the model configuration in future scenarios, and may assist with increase in dx spacing as identified in previous comment.
	Delta in M11 is set to 0.9, slightly greater than recommended value of 0.85.	Improves stability in model. May have impact on maximum inundation extent when dynamic modelling is considered.	In the majority of runs this is not an issue as they are typically operated to steady state rather than dynamically based. Value of delta can be reduced however if model stability is improved by implementing some of changes above.	Increase model stability by implementing measures in comments above, and reduce delta value to 0.85 if possible.

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	Discharge through Lock 4 is adjusted (up or down) to a single value rather than a small gap between upper and lower thresholds	Operation of lock structure in model adjusts flow more rapidly than if a margin between upper and lower levels is used, resulting in a more erratic looking water level trace. Average upstream water level matches the target level, but varies more rapidly over time than would a margin-based water level control.	Inspection of result files indicates at steady state the water level and flow downstream of Lock 4 are stable, resulting in no significant impact on scenarios.	For future modelling with MIKE FLOOD model, operate Lock 4 to a target margin rather than a single value, to optimise model configuration.
	Noted that a number of branches in the M11 model are not linked with M21 model, namely B_2_6, B_2_7, B_4_3, B_7_1, B_7_2	Branches are not considered in model calculations. Flow only occurs through 2-D grid at these locations.	B_2_6, B_2_7 and B_4_3 are small branches on minor paths, introduced in the original model scheme, where flow is conveyed by the 2-D grid in any case. Thus the lack of linking does not appear to have any noticeable negative impact on results. B_7_1 and B_7_2 are Carpark inlets and outlets, respectively. B_7_2 was identified as not linked following initial managed inundation modelling in 2014–15 and addressed in Scenario 6 onwards, and B_7_1 was linked in 2015–15 scenarios for design work. Note that the earlier results for 2014–15 managed inundation scenarios were not revised with these linkages applied, as for the purposes of those scenarios only general hydraulics such as total outflow was required, and thus the results in those cases remained applicable.	Issues have been addressed.

Review report section	Reviewer comment	Consequence on modelling	DEWNR response	Recommendation
Calibration performance	Instabilities indicated at Eckert_BankJ_S and Eckert_Ck_1 in larger flow events in verification runs	May impact results at certain high flows.	Investigating high flow results in the most recent 2015–16 modelling, minor instability is present at about 80 000 ML/d but not below this flow, mainly applicable Bank J south inlet. May be a problem occurring from the weir specification being greater than the surrounding cross-sectional width, as noted elsewhere in the review. This problem has no impact on results at managed inundation conditions, and only at the very high end of flows considered. Also at the high flow end of the spectrum, there is also little impact on the critical assessments as these flows overtop the blocking bank in every option case. Also, Bank J inlets will require modification in future modelling to reflect structure upgrades, including channel realignment.	Little impact on modelling conducted to date, while future updates to the model should observe and fix any instabilities occurring, particularly if the preceding recommendations are implemented.
Scenarios	Car Park inlet and outlet are not linked to the model in Scenarios 1-5, and are only set to closed up to a certain level, above which the control level is set to the inundation level.	Flow is governed by the 2-D grid instead of the 1-D branches in these locations due to the lack of linking.	Impact of this is noted above, with no impact on the initial managed inundation scenarios in 2014–15 due to the intention of the scenarios, and beyond these scenarios the issue was addressed.	No specific action required.

Review report section	Reviewer comment	Consequence on modelling	DEWNR response	Recommendation
	Large instability in BankJ_S was found in the verification runs	Instability may be present in the scenarios as well. Needs checking to determine whether instability is present.	Not an issue for the majority of scenarios. No instability is apparent in Bank J south inlet under the options scenarios, other than at natural high flows (~80,000 ML/d) as indicated previously. At these high flows however, there is minimal impact on the results, as all blocking bank options are overtopped at this flow, and the results are a relative comparison rather than absolute, and so the impact occurs equally between the scenarios.	Implement recommendations in model for future scenarios to minimise instabilities in the model.

Review report section	Reviewer comment	Consequence on modelling	DEWNR response	Recommendation
	Dummy slots are present in some terminating cross-sections of branches to ensure connections meet at the same minimum depths, which may be contributing to an artificially high velocity at the end of branches where implemented, in particular Sawmill Creek.	Potentially misrepresents velocity at the very end of affected branches, particularly Sawmill Creek. Needs to be considered when assessing the results.	Note that this measure is an acceptable method to link branches of different minimum depths, however can create higher velocities at the terminating ends of these branches under certain conditions if not implemented correctly. Note however the impact on results is more of a display issue than creating any specific problem in the results. The high velocities downstream of Sawmill Creek regulator in the scenarios referred to by the reviewer are all high due to non-optimised flow through this branch, whereas later scenarios control this flow at reduced levels and hence reduces the velocity throughout the lower section of Sawmill Creek. The reviewer also notes that the bed resistance value at the 'slot' created in the cross-section requires higher resistance applied to slow flow down through the slot, and review of the model configuration confirms that resistance was raised by a factor of 10 for all slots created.	As this measure is an acceptable method for connecting mismatched branch elevations, no specific action is required for future scenarios with the MIKE FLOOD model, however slot resistances may be raised even further (e.g. factor of 100) to attempt to reduce the appearance of higher velocities at the end of branches.

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