Engineering Report

Aplins Weir Temporary Irrigation Pipeline

9673/06

Prepared for

Townsville Golf Club Inc

25 June 2018

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Document Information

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1 Introduction

Cardno has prepared this report on behalf of the Townsville Golf Club to outline the engineering infrastructure and impacts of the proposed installation of a temporary irrigation main from Aplins Weir to the Townsville Golf Club. The purpose of the irrigation main is to provide temporary water supply for use by the Townsville Golf Club until the completion of the permanent solution, being the Council Treated Water Reuse Scheme at the Cleveland Bay treatment plant which is expected to take another two years.

The report will discuss the envisaged impacts on the Aplins Weir water body as a result of the extraction of raw water for irrigation purposes and describes the proposed construction concept to balance the immediate irrigation requirements as well as future re-use of the pipe assets. Prior to these discussions, the basis for this irrigation main as a temporary source of water for the Townsville Golf Club's irrigation supply is discussed in the following section.

2 Background Information

The Townsville Golf Club is one of the oldest operating golf clubs in Australia, celebrating 125 years in 2018. Being a member-owned community club, the golf course is well used amongst members, visitors and participants of golf competitions without funding from Townsville ratepayers. From 2014, the Townsville Golf Club undertook a complete redevelopment of the playing course into a new 18-hole championship standard golf course which is continuing through to 2020.

As part of the redevelopment of the course, the club committee has been engage with the Townsville City Council to secure a permanent, sustainable irrigation supply to coincide with the removal of the existing on-site sewage treatment plant that has been used since 1974 as the irrigation water supply source for the course. The current on-site sewage treatment plant has reached its current operational service life and to continue using this infrastructure for irrigation supply, either significant upgrades or a replacement treatment plant is needed to meet the current environmental licence requirements. The preferred solution is to access treated water from the proposed Townsville City Council Water Reuse Scheme in which Council upgrades to the Cleveland Bay treatment plant will enable the production of treated water via reverse osmosis suitable for irrigation. With the opportunity to use treated water, the Townsville Golf Club will be able to secure a long-term irrigation water supply that conserves the potable water supply of the city while removing the need of continuing to operate an on-site sewage treatment plant in an urban area.

As the environmental licence for operating the current on-site sewage treatment plant expires in 2018, and completion of the proposed Council upgrades to the Cleveland Bay treatment expected in another two years, the Townsville Golf Club requires a temporary irrigation supply solution. To avoid burdening the potable water supply and using reticulated water, it is proposed that a temporary irrigation pipeline and pump be constructed to convey raw water from the Aplins Weir water body of the Ross River to the golf course irrigation tank. To maximise water-use efficiency and minimise the impact on the water body, the redevelopment of the new golf course has been sustainably designed to include grasses that are drought tolerant, high efficiency irrigation systems and a strategic water management plan. The Townsville Golf Club have calculated that approximately 1-1.2ML of water is used per day for irrigation of the golf course.

Although the Aplins Weir water body is not used as a source of Townsville's potable water supply, this section of the Ross River is an integral part of the river's ecosystem and a significant feature of Townsville which is widely used by the local community and user groups. Because the sustainability of this water body is essential, the envisaged impacts associated with utilising this raw water for temporary irrigation purposes required by the Townsville Golf Club is vital and is discussed in the following section.

3 Aplins Weir Waterbody

The Aplins Weir waterbody is approximately 4.5km in length and has a typical water surface area approximately 43.5ha. The storage volume of this water body is approximately 1900ML. Due to the high use of this section of the river by the local community and user groups, the Townsville Golf Club engaged Earth Environmental to investigate the ability and limits of the water body in extracting 1-1.2ML per day to meet the irrigation requirements of the golf course. The investigation report by Earth Environmental is located in Appendix A.

The findings of the Earth Environmental investigation indicates that a 1.29ML/day of water has been calculated as available for extraction from Aplins Weir. Additionally, a drawdown limit of 1.5m in water level height from the full supply level is recommended. At this level, minimal disturbances to surrounding bores is expected and that inflow from adjacent aquifers would maintain the water near this level while counteracting evaporation.

4 Aplins Weir Irrigation Pipeline

The major components of the proposed irrigation pipe project will consist of an intake, pump (with possible enclosure) and a delivery pipeline. The proposed alignment of the pipeline is approximately 3.8km and is proposed to be aligned along the high-bank of the Ross River, positioned away from areas of public use as is practical with minimal disturbance to the existing amenity and trees. Subject to the confirmation of detailed design calculations, the delivery pipeline is proposed to be a nominal 200mm diameter PE class 16 pipeline that will be pinned or secured in place above ground. The above ground installation is proposed due to the short two year use of the irrigation pipeline which will enable the comparatively easier salvaging of the pipe assets for future re-use by Council on other projects than if the pipe was installed below ground. Additionally, the above ground installation method will minimise the impacts to the existing root systems of the trees along the pipeline alignment.

For an overall understanding of the pipeline alignment, Appendix B contains concept drawings showing the proposed alignment from Aplins Weir to the Townsville Golf Club. The following sub-sections provide a more detailed description of the alignment at specific sections along the Ross River with photographs indicating the proposed concept.

4.1 Pump and Intake Infrastructure

A pump intake structure is proposed to be built near the Aplins Weir consisting of an enclosed pump located either on the lower bank set a suitable elevation or on the higher bank. The selection of the pump and enclosure will give consideration to reduce noise levels.

The pump and intake infrastructure is proposed to be located on the lower bank of the Ross River. The type and specific design details are to be confirmed in the detailed design phase, however design consideration will be given to minimise the production of noise while the pump is in operation. Preliminary design options that have been considered to achieve this include either the use of a submersible type pump positioned within the river to completely remove operational noise, or an above ground pump inside an enclosure with suitable acoustic insulation.

4.2 Aplins Weir Rotary Park to Mango Avenue

The Delivery pipe is proposed to be installed under the pedestrian bridge and align behind the existing timber fence that forms the edge of the Aplins Weir Rotary Park. Detailed design and collaboration with Council on the adequacy of the concrete lining under the pedestrian bridge will be undertaken and a temporary fixing/cradle solution to support the pipe will be installed.

As the alignment traces around the edges of the existing park, the pipeline will be pinned in place at suitable intervals or strapped to suitable existing trees to secure the pipe and stop movement during pumping operation.

The section of the pathway leading away from the park towards Mango Avenue has a narrow corridor between edge of pathway and tree line. The alignment of the irrigation pipe, subject to detailed design, is proposed to be temporarily fixed to the base of the existing trees.

Figure 4-1 Proposed Alignment at Aplins Weir

Figure 4-2 Proposed alignment at Rotary Park viewing towards Aplins Weir

Figure 4-3 Proposed Alignment Rotary Park viewing towards Mango Avenue

Figure 4-4 Proposed Alignment viewing towards Mango Avenue

Figure 4-5 Proposed Alignment viewing towards Rotary Park

Figure 4-6 Proposed Alignment viewing towards Mango Avenue

4.3 Mango Avenue to Sherriff Park

In this section there is greater separation between the existing pathway and edge of the river bank and it is intended that the irrigation pipeline will be placed closely to the top of bank. Where existing drainage paths exist that the irrigation pipe will traverse, it is proposed that these sections will be installed below ground.

Figure 4-7 Proposed Alignment viewing towards Water Street

Figure 4-8 Proposed Alignment viewing towards Churchill Street

Figure 4-9 Proposed Alignment viewing towards Gowrie Street

Figure 4-10 Proposed Alignment at Sherriff Park

4.4 Sherriff Park to Bowen Road Bridge

The pipe will continue its alignment along the top of bank, pinned and secured at suitable intervals. There adequate space to provide good separation from path and park users.

The section of pathway around the back of the unit complex, before the Bowen Road Bridge is typically wide, with link-block retaining walls on the unit side, and hand rail protection with link-block retaining walls on the river side leading separating the pathway from the saltwater vegetation. In this section it is proposed to secure the pipe with temporary fixings to the posts of the outside position of the handrail structure.

The irrigation pipeline will pass under the bridge and maintain its alignment on the river side of the pathway. As the pipeline will traverse through a state-controlled road corridor, consultation with the Department of Transport and Main Roads of the engineering requirements will be undertaken for this section.

Figure 4-11 Proposed Alignment viewing from Snelham Street

Figure 4-12 Proposed Alignment viewing towards Bowen Road Bridge

Figure 4-13 Proposed Alignment viewing towards Snelham Street

Figure 4-14 Proposed Alignment viewing towards Snelham Street

Figure 4-15 Proposed Alignment viewing at Bowen Road Bridge

4.5 Bowen Road Bridge to Townsville Golf Club

Beyond the Ross River Bridge, the pipeline will traverse along the existing bank noting that no pedestrian pathway exists for this section of the river. The pipeline will continue as needed before entering into Townsville Golf Club land. The pipepline will traverse through the golf course toward the existing irrigation storage tank near the intersection of Quinn Street and Signature Drive.

Figure 4-16 Proposed Alignment at Bowen Road Bridge

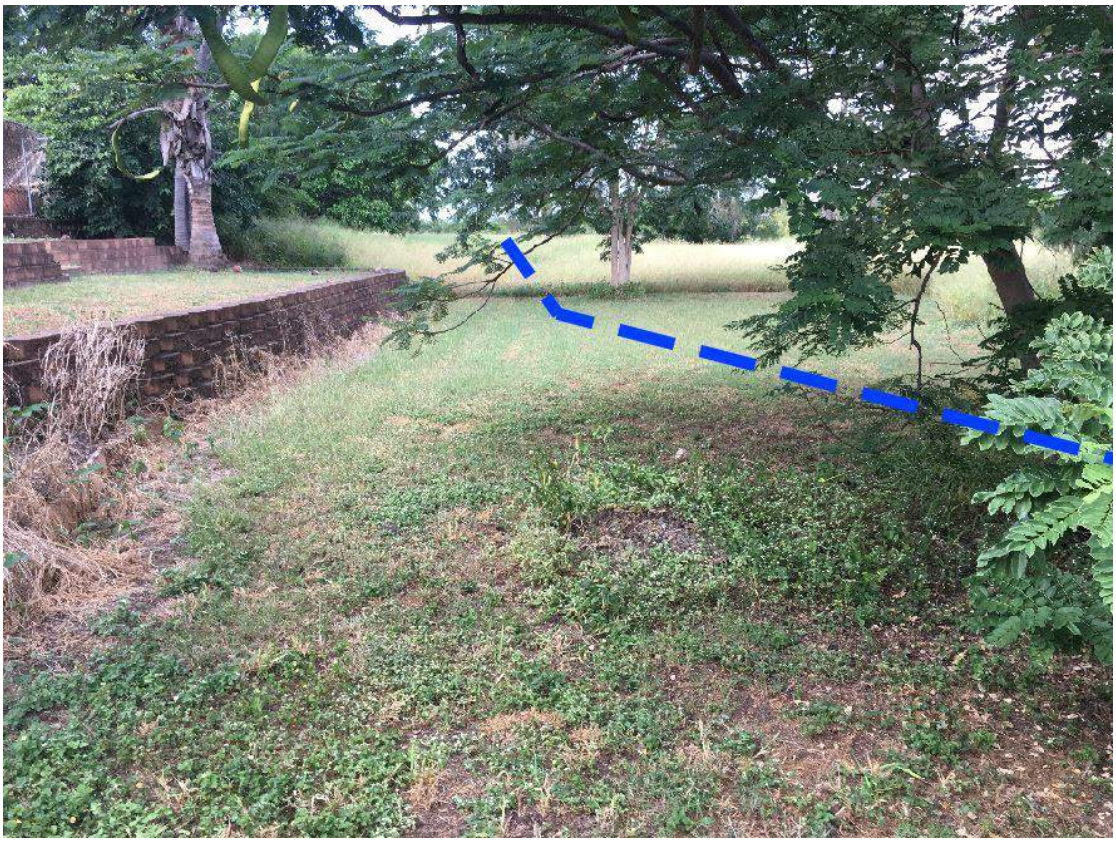

Figure 4-17 Proposed Alignment at Bowen Road Bridge viewing North to Townsville Golf Club

5 Summary

In summary, this report has outlined the proposed engineering infrastructure for the installation of a temporary irrigation pipeline from Aplins weir to the Townsville Golf Club until the Council Treated Water Reuse Scheme at the Cleveland Bay treatment plant comes online. The Aplins weir waterbody is able to provide a 1.29ML supply of raw water which adequately meets the Townsville Golf Club's irrigation requirements. The maximum drawdown of river water is set at 1.5m below top weir level to ensure minimal disturbances to users and surrounding bores. The above ground installation of the pipeline enables the easier recovery of the pipeline for future Council projects and minimises disturbance to existing trees.

APPENDIX A

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Michael Crane
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Flinders Street
Townsville 4740

19 June 2018

Dear Michael

I have reviewed the two documents I obtained from Townsville City Council and have extracted the material relevant to Aplins Weir and the potential extraction of water from the weir by the Townsville Golf Club.

I have also spoken with Rob Hunt who was the catchment manager for NQ Water and Townsville Water and had responsibility for the environmental management of the weirs and Ross River Dam catchment at the time that Aplin's Weir was being repaired i.e. 2013.

My notes about sustainable yield and use of water from Aplins Weir from a review of appropriate literature and discussions with Rob Hunt are included as an attachment.

Regards

John Gunn
Earth Environmental

Review Notes: Aplins Weir Water Extraction

Background

The Townsville Golf Course (TGC) is located on the banks of Ross River and is relatively close to the CBD due to its establishment date approximately 125 years ago. The TGC is a major water user and recognises its responsibility in minimising water use and finding more sustainable water use solutions in line with community expectations and the Townsville climate.

The water supply for the TGC golf course is currently provided by a Sewage Treatment Plant (STP) fed from the Townsville City Council (TCC) pipeline to the Cleveland Bay waste water treatment plant (WWTP). The TGC operated STP has been providing treated water for the golf course since 1974. The STP was upgraded in 1988 to increase its capacity and over the years many modifications and replacement of components has been carried out to meet water demands and comply with licence conditions (Environmentally Relevant Activity [ERA] administered by the Department of Environment and Science).

The TGC is in a re-development phase and requires an ongoing reliable supply of water over the longer term. A number of factors including the location of the aging STP in relation to the re-development along with the need for ongoing upgrades and maintenance means that the ongoing use of the STP is not feasible.

TCC is currently working on a citywide $40 million water-recycling project to supply water for irrigation to clients including the TGC. This re-use option will virtually eliminate the need to use potable water however the realisation of this solution is still some years away.

Interim measures are required to negate the use of potable water during the transition period between the decommissioning of the TGC STP and the provision of water from the TCC water recycling project. TCC has suggested that a temporary pipeline from Aplins Weir to the golf course may be the most appropriate interim measure to supply water for irrigation prior to the Cleveland Bay Purification Plant [formerly the Cleveland Bay WWTP] recycling option coming on line.

TCC Water Investigations

Wastewater Reuse

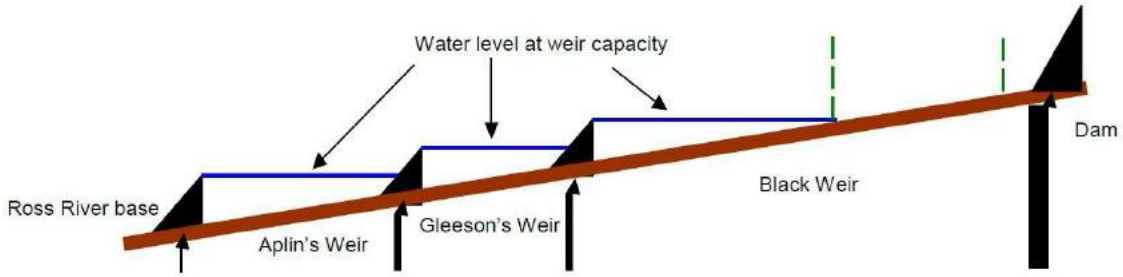
Townsville City Council is aware of the need to manage the total water cycle and reduce demand on potable water. One such solution is the use of treated waste water and this option was investigated prior to the 2006 upgrade to the Cleveland Bay Purification Plant (CPPP). At the time the finance required to implement a waste water re-use scheme was not available and TCC is again investigating options in light of recent low water levels in the Ross River Dam and the high cost of pumping water from the Burdekin to supplement raw water supply.

Ross River Weirs

Prior to the current CBPP re-use investigations TCC commissioned a study to look at options to extract water from the weirs in Ross River to supplement irrigation of its parks rather than using potable water. The study, conducted by AECOM, investigated; water volumes available from each weir i.e. Black, Gleeson's and Aplin's (see Figure A and Figure B), potential environmental and social considerations associated with extraction, and the financial viability of extraction versus the status quo i.e. using potable water.

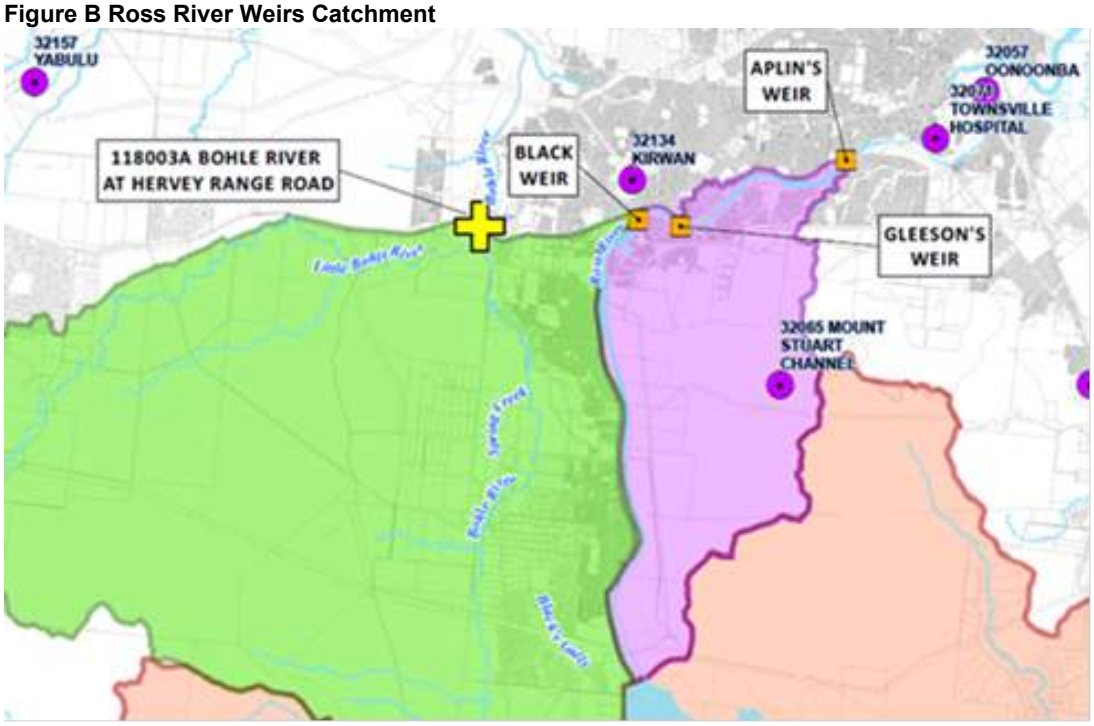
A GoldSIM water balance model was developed by WBM / AECOM to assist with calculations of available volumes and sustainable yields for each weir pool. Each of the weirs was assessed separately with a variety of inflows and losses [outflows] including in relation to the upstream weir and catchments i.e. inflow.

Figure A Schematic Diagram of Ross River Weirs



Note: Not to scale. Source is Connell Wagner (2005) as reproduced in Townsville City Council 2013.

Figure B Ross River Weirs Catchment



Note: Source diagram is AECOM (2015) Figure 2.1 Catchments, p.12. Purple indicates the Ross River catchment upstream of Aplin's Weir and shows the total catchment area for all three weirs. The green is the Bohle River catchment. The pink is the Ross Dam catchment.

"*Storage and catchment details were defined through a combination of information available in past reports, topographic and bathymetric surveys and aerial imagery*." [AECOM 2015, p.8]. Most of the model input data was derived from:

- Catchment delineations and underground stormwater system (northern bank of the Ross River) from the Ross River Flood Study (TCC 2013) and Middle and Upper Bohle Flood Study (AECOM 2014);
- Stage storage details from Ross River Dam Upgrade Stages 2 to 5 Hydrology Study (Hill and Sih 2005);
- Bathymetric survey of the ponded areas of the weirs (2014);
- LiDAR survey of the Ross River catchments flown in 2009 and 2012.

References [**Note**: The study did not provide a formal list of references mentioned in the text. References

below are from AECOM (2015), page 6]

Hill, P. and Sih, K. 2005, *Ross River Dam Upgrade Stages 2 to 5 Hydrology Study*, SKM.

Ballard, J. 2012, *Ross River Raw Water Extraction Strategy for Irrigation Use,* Northern Water Management (NWM), Townsville.

Moody, J. and Speare L. 2012, *Integrated Water Supply Strategy: Technical Report*, Townsville City Council, Townsville.

Townsville City Council 2013, *Ross River Waterway Management System: Management of Recreational Use Plan 2013 – 2015*, Townsville City Council (TCC), Townsville. [**Note**: This document based on documentation prepared by Connell-Wagner i.e. the Ross River Waterway Management System (2005). The principal author of the Connell Wagner document/s was John Gunn.]

Model inputs used for Aplin's Weir are shown in Table A.

Table A Model Input – Aplin's Weir

Storage details		
Stage Storage	Details the relationship between the volume of water in the dam and; - Depth/RL of water - Surface area	
Design Drawings	Required to inform - Stage storage - Outflow rates	
Inflows		
Rainfall	Direct rainfall applied to the ponded area of the reservoir @ FSL	See climate data
Runoff	Runoff from the catchment entering the reservoir	See AWBM
	Spare	
	Overflow through GLW spillway	See GLW
	Seepage	See GLW
Outflows		
Evaporation	Depth of evaporation applied to the surface area of ponded water in the reservoir	See climate data
Overflow through APW spillway	Relates the RL of the water in the weir to the overflow rate through the spillway based on the rating curve of the spillway	[1]Variable (broad crested Weir equation)
Seepage	Seepage rate to Ross River that will end up @ Aplin's Weir	n/a
Metered Extraction	Extraction for use by TCC	0 ML/d
Seepage and Losses	Unknown seepage and losses	Calibrated as inflow
Rules		
Ballard (2012), p.8	Aplin's weir has a minimum water level of 1.5 m below full supply level where no irrigation extraction is allowed (based on bathymetry survey undertaken for the Gleeson's Weir and Aplin's Weir refurbishment projects)	4.89 m AHD
Ballard (2012), p.12	Framework for extraction operations plan proposed by Ballard	n/a

Notes: Table derived from AECOM (2015) Appendix B, Table B-6, pp.b-8/9. [1] this may be incorrect and applies to Gleeson's Weir rather than Aplin's Weir [see AECOM (2015), p.19]. APW is Aplin's Weir. GLW is Gleeson's Weir. AWBM is the Australian Water Balance Model.

While it is stated in the report that "*Average annual lake evaporation exceeds 1.8 m in the Townsville region resulting in significant losses from the storages*" (AECOM 2015, p.19), it does not provide the actual evaporation rate figures used in the model or the surface area of ponded water that the evaporation rate was applied to.

Sub-surface hydrological connection between the weirs is extremely difficult to quantify and was not included as a model input i.e. inflow or outflow. In reality the sub-surface hydrology is not well understood and there may well be discharge and/or recharge from weir to weir via lateral flow and interactions between various paleo channel aquifers. As discovered at a recent Walking the Landscape workshop (8 and 9 March 2018) the groundwater aquifer system in the Ross catchment is relatively complex and does not consist of a single sheet aquifer. This complexity and lack of sub-surface mapping and interactions data makes the inclusion of groundwater interactions between weirs in a model impractical.

It was apparent from the recorded drawdown levels i.e. evaporation, extraction and outflow, compared to initial model simulations that there was an unidentified inflow. This was assumed to be a result of recharge from adjacent aquifers and a high level calibration of the model added a factor to account for the difference between recorded and simulated drawdown. The adjustment for inflow of groundwater for Aplin's Weir equated to 1.5ML per day (AECOM 2015, p.20).

The calibrated model was then run for each weir until a maximum yield was identified that also met key performance criteria.

The overall conclusion of the study was that "*Water balance modelling, in conjunction with financial analysis of the most suitable potential locations for irrigation identified that using river water for irrigation of TCC open space was not cost effective compared to existing arrangements*." [AECOM 2015, p.57].

The most relevant details/results from the Ross Rivers weirs irrigation investigation are summarised in the text box below.

Aplin's Weir Key Data

Current surface water extraction from Aplins Weir: 0ML.

Table B Aplin's Weir Catchment

[1]Surface Catchment (ha)				Sub-Surface Catchment (ha)			Total (ha)
Urban		Rural	Sub total	Urban		Sub total	
Pervious	Impervious	Pervious		Pervious	Impervious		
180	180	955	1,315	117	117	234	1,549

Note: [1] includes ponded area at full supply level (FSL). Adapted from AECOM (2015) Table 3.3, p.17.

Table C Elevations and Volumes

Storage Elevation (m AHD)		Storage Volume (ML)	
Full supply level	Minimum level	Full supply volume	Minimum level
6.39	[1]4.89 (6.39 - 1.5)	1,860	1,093

Notes: Adapted from AECOM (2015) Table 2.9, p.9. [1] as per rules in Table A [above].

Table D Model Input Weir Flow Parameters

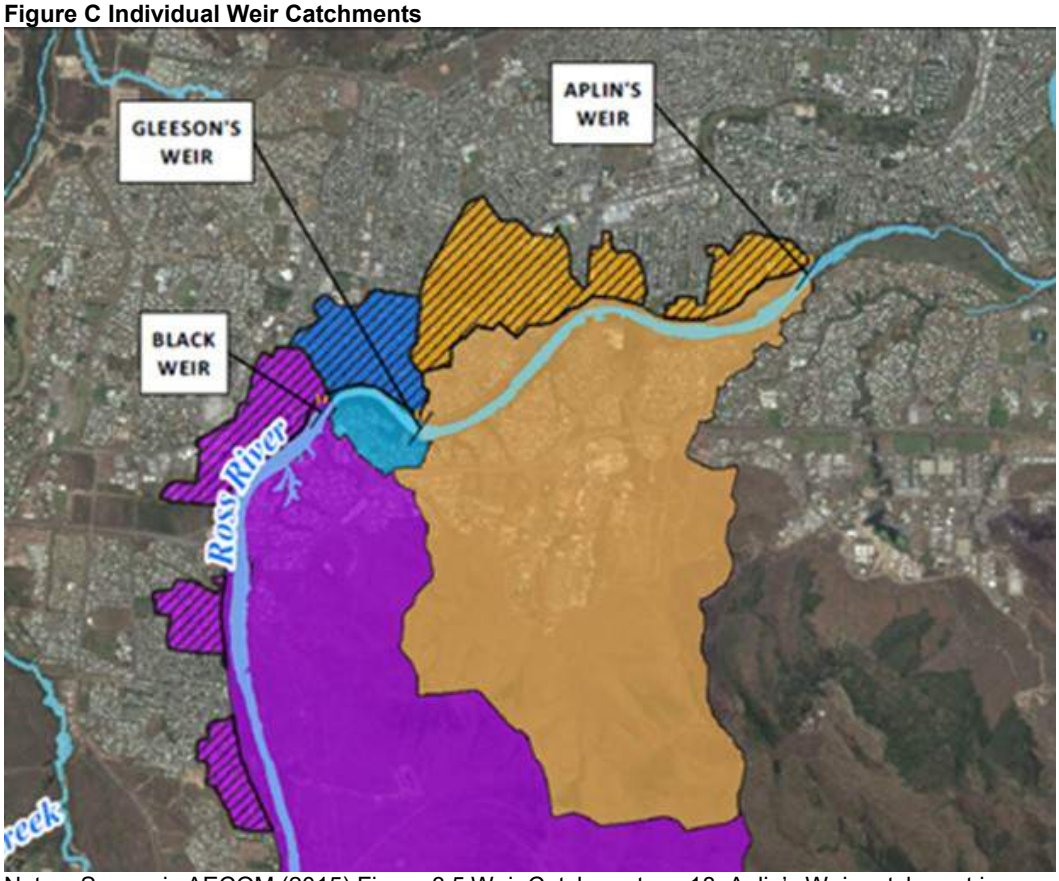
Weir level	Weir width	Weir co-efficient	Weir exponent
6.39m AHD	144 m	2.18	1.77

Notes: Source is AECOM (2015) Table 3-4 Summary of weir flow parameters applied to the water balance model, p.19 [reproduced from TCC 2013, pp.46-48].

Assumed groundwater inflow rate: 1.5ML/day (AECOM 2015, p.20)

Calculated volume of water available for extraction from Aplins Weir: 1.29ML/day (Source is AECOM (2015) Table 3-6 Summary of extraction volumes for Ross River Weirs, p.21)

Figure C Individual Weir Catchments



Notes: Source is AECOM (2015) Figure 3.5 Weir Catchments, p.18. Aplin's Weir catchment is orange with the sub surface catchment marked with slanting lines.

Figure D Storage/Elevation Relationship

Note: Source is AECOM (2015) Appendix B Figure B-4, p.B-13.

Aplins Weir Refurbishment

Construction report

"*The construction works were carried out by CivilPlus under the supervision of the Works Inspector, Mr. Leslie Walker. GHD provided Contract administration, incremental inspections and advice to CivilPlus throughout the construction works on an as needs basis*." (GHD 2013, p.1).

The construction report prepared by GHD (2013) is 2,415 pages excluding attachments e.g. concrete test reports. The actual main body of the report is only 25 pages with the remainder being appendices as listed below:

- Appendix A – Design Report;
- Appendix B – For Construction Drawings;
- Appendix C – Project Technical Specification;
- Appendix D – Site Inspection Notes;
- Appendix E – Superintendent's Contract Documentation;
- Appendix F – Contractor's Records;
- Appendix G – As Constructed Drawings;

Appendix A and D are currently being reviewed to determine if there is any relevant/useful information for the Aplins Weir extraction project.

What has been discovered from the main body of the report is that "*the water level was dropped to approximately 1.5m below the top of the weir*" as the designers deemed this necessary "*to allow safe construction works to commence*." (GHD 2013, p.15).

Townsville Water feedback

Rob Hunt was the catchment and environmental manager for Townsville Water at the time the refurbishment works were taking place. Following the reduction in water levels in Aplins Weir Rob recalls responding to two property owners in the vicinity of the weir regarding their bores. There did not appear to be any widespread impacts of the reduction in water levels and at least one of the two bores did not have a reliable supply. Jeff Ballard was in charge of the project for TCC and any information about the weirs should be included in the data book/s kept for the weirs (pers. comm. 31 May 2018). The data book/s for Aplins Weir should now be held by TCC Water and Waste.

Final Thoughts

While the AECOM (2015) report does not provide some of the model inputs i.e. weir suface area and evaporation rate, it is assumed that these have been appropriately incorporated and that the 1.29ML/day volume of water calculated as available for extraction from Aplins Weir is a reasonable estimate (AECOM (2015), p.21).

It should also be noted that the model was adjusted to account for the variation in recorded weir water levels and intitally modelled levels. The adjustment factor for Aplins Weir was 1.5ML/day inflow assumed to be from adjacent aquifers.

The relationship between weir pool surface area and evaporation rate may need to be defined to provide a better understanding of the drawdown associated with water extraction from Aplins Weir and the number of days that water could be extracted from the weir in the event of no replenishment from catchment run-off. The rule applied by the model to arrive at the available extraction rate was that the water level in Aplins Weir could not drop below 4.89m AHD.

It is assumed that the same rule would apply to the TGC and extraction from the weir would cease when the water level dropped by 1.5 metres i.e. to 4.89m AHD from the full supply level of 6.39m AHD. It is assumed that the inflow from adjacent aquifers would then maintain the water level at around the 4.89m AHD mark, and counteract evaporation.

Reviewed and relevant references

AECOM Australia Pty Ltd 2015, *Investigation Report: Extraction of Irrigation Water from the Ross River*, Prepared for Townsville City Council, Townsville.

GHD 2013, *Townsville Water Contract No. T6183 - Refurbishment of Aplins Weir Construction Report*, Prepared for Townsville City Council, Townsville.

Gunn, J. and Manning, C. 2010, *Black Ross (Townsville) Water Quality Improvement Plan* [WQIP], Creek to Coral/Townsville City Council, Townsville.

Townsville City Council (TCC) [January] 2013a, *Ross River Baseline Flooding Assessment: Volume 1*, Townsville City Council (TCC), Townsville.

Townsville City Council 2013b, *Ross River Waterway Management System: Management of Recreational Use Plan 2013 – 2015*, Townsville City Council (TCC), Townsville.
[**Note**: This document is based on documentation prepared by Connell-Wagner being the Ross River Waterway Management System (2005). The principal author of the Connell Wagner document/s was John Gunn.]

Additional numbers and calculations

Aplins Weir is approximately 16 km downstream of Ross River Dam and 10 km upstream of the mouth, near the suburbs of Mundingburra and Annandale. (TCC 2013a)

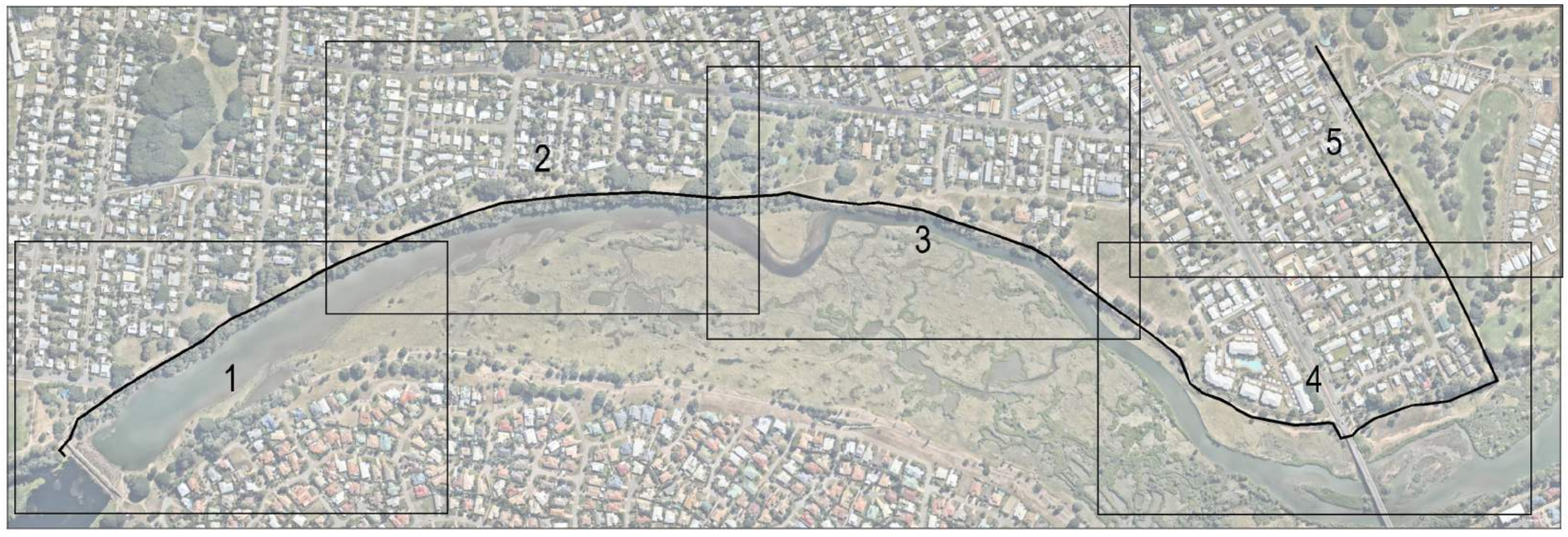
Using Google Earth

Approximatley 4km from Aplins Weir to Gleesons Weir in a straight line.
Approximatley 4.3km from Aplins Weir to Gleesons Weir along Ross River.

Surface area as defined by hand drawn polygon (see Figure E) is 434,800m^2 with a perimeter of 8.7 km. [see kmz file]

Figure E Aplins Weir Surface Area

APPENDIX B



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NORTH

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TOWNSVILLE GOLF CLUB INC
APLINS WEIR IRRIGATION PIPELINE
CONCEPTUAL ALIGNMENT
OVERALL KEY PLAN

Date	Scale	Size
22.06.2018	1:5000	A1

Drawing Number: 9673/06-SK-010
Revision: A

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TOWNSVILLE GOLF CLUB INC
APLINS WEIR IRRIGATION PIPELINE
CONCEPTUAL ALIGNMENT
LAYOUT PLAN 1 OF 5

Date	Scale	Size
22.06.2018	1:1000	A1

Drawing Number: 9673/06-SK-011
Revision: A

DATE PLOTTED: 22 June 2018 3:45 PM BY: MICHAEL CRANE

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NORTH

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TOWNSVILLE GOLF CLUB INC
APLINS WEIR IRRIGATION PIPELINE
CONCEPTUAL ALIGNMENT
LAYOUT PLAN 2 OF 5

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Revision: A

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SCALE 1:1000 @A1

NORTH

Cardno
Shaping the Future
Cardno (Qld) Pty Ltd | ABN 57 051 074 992
Level 1, 520 Flinders Street
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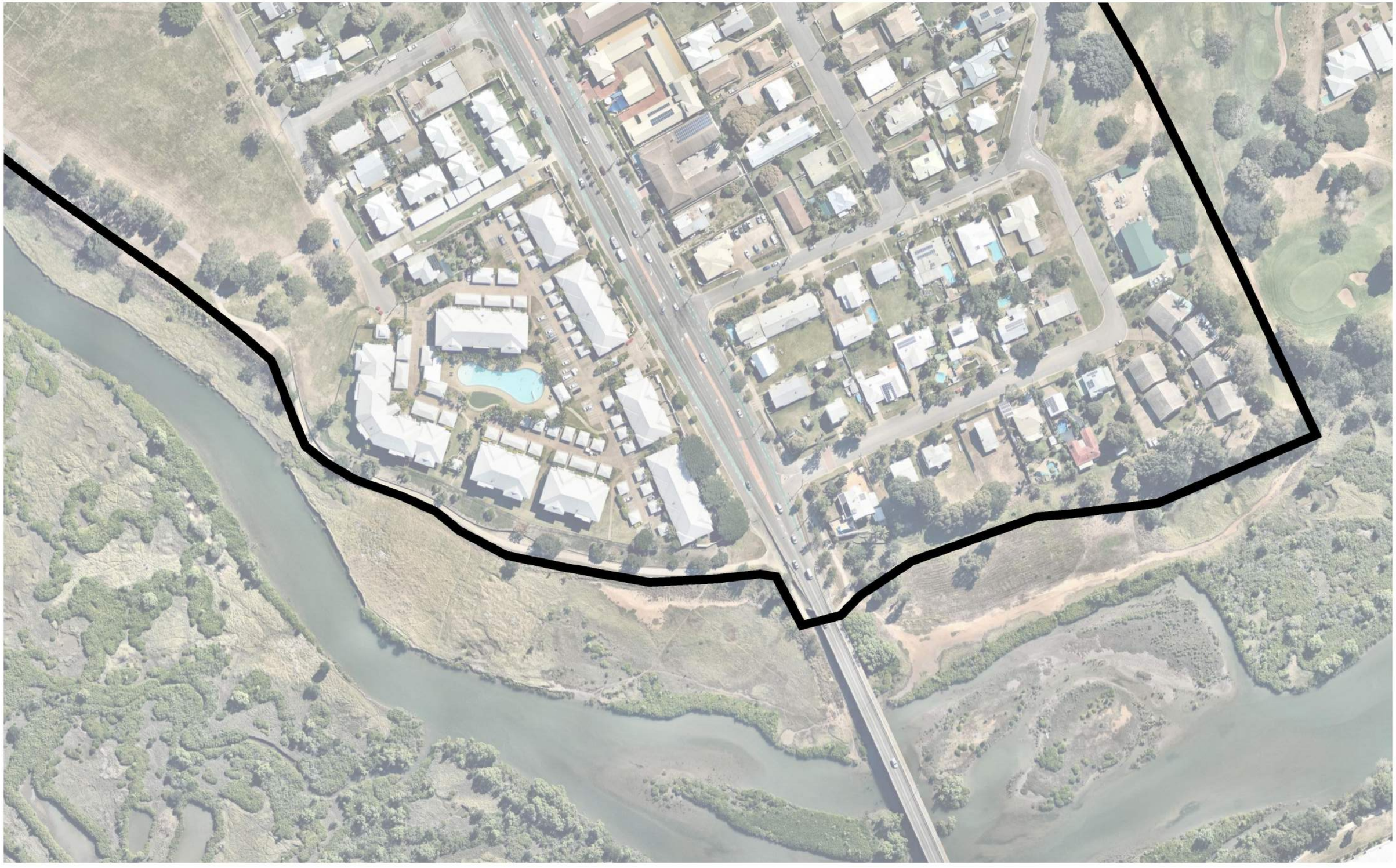
TOWNSVILLE GOLF CLUB INC
APLINS WEIR IRRIGATION PIPELINE
CONCEPTUAL ALIGNMENT
LAYOUT PLAN 3 OF 5

Date	Scale	Size
22.06.2018	1:1000	A1

Drawing Number: 9673/06-SK-13
Revision: A

XREFs:
CAD File: S:\PROJECTS\TOWNSVILLE OFFICE\96000\9673 - Townsville Golf Club\9673-06 - TGCR - Course Re-Development\ENGINEERING\DRAWINGS\9673#06-SK.dwg



0 20 40m
SCALE 1:1000 @A1

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APLINS WEIR IRRIGATION PIPELINE
CONCEPTUAL ALIGNMENT
LAYOUT PLAN 4 OF 5

Date	Scale	Size
22.06.2018	1:1000	A1

Drawing Number: 9673/06-SK-014
Revision: A

DATE PLOTTED: 22 June 2018 3:46 PM BY: MICHAEL CRANE

XREF's:
CAD File: S:\PROJECTS\TOWNSVILLE OFFICE\9600\9673 - Townsville Golf Club\9673-06 - TGCR - Course Re-Development\ENGINEERING\DRAWINGS\9673806-Sk.dwg

DATE PLOTTED: 22 June 2018 3:47 PM BY: MICHAEL CRANE

0 20 40m
SCALE 1:1000 @A1

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TOWNSVILLE GOLF CLUB INC
APLINS WEIR IRRIGATION PIPELINE
CONCEPTUAL ALIGNMENT
LAYOUT PLAN 5 OF 5

Date	Scale	Size
22.06.2018	1:1000	A1

Drawing Number: 9673/06-SK-015
Revision: A

XREF's:
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