



A prioritisation of Fitzroy Basin wetlands for natural resource management investment September 2015

Prepared for Fitzroy Basin Association Incorporated by Roger Jaensch, Shane Westley and Peter Smith



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Summary

In August–September 2015, the Fitzroy Basin Association Inc. (FBA) undertook a prioritisation of wetlands in its region to guide future investment in natural resource management. This project was intended to support the development of its Water Quality Improvement Plan, in the context of improving management of catchments of the Great Barrier Reef. The present report describes the methods, results and conclusions arising from the wetlands prioritisation.

The project was conducted by a consultant supported by two FBA staff and comprised desk and field components. The desk assessment involved multiple steps: identifying important or major wetland sites and aggregations in the FBA region; selecting 20 of those sites; assigning scores for 23 assessment criteria; applying weightings to the criteria to reflect FBA's targets and circumstances; and running a computer application to generate a table of rankings of sites. The application used was a Decision Support System (DSS) previously created under the Queensland Wetland Program, with criteria relating to values, threats and capacity for intervention. Inbuilt flexibility of the DSS enabled its successful use despite time and resource constraints affecting the scope of data collation and direct inquiry with site managers and relevant experts. A key part of the DSS methodology was to map the wetland site boundaries, thereby defining the values that the site supported, and enabling calculation of scores for several criteria, such as wetland area. A short program of field checking the scores was conducted, focussed on the top-ranked site from running the DSS, as well as two low-ranked sites.

Results of the project showed that Torilla Plain, Palm Tree and Robinson Creek Wetlands, and Twelve Mile Creek were the top-ranked wetlands. Field checking at Torilla Plain verified criteria scores for the site (with only minor adjustment), providing confidence that the DSS results for assessed sites were meaningful. Several of the 20 assessed sites—mostly sites involving wetland aggregations on inland floodplains—were data-poor and not well known to the authors or other wetland experts. Field checking indicated that improved knowledge would likely have led to some higher scores and rankings for some inland sites.

The authors concluded that using the DSS to prioritise wetlands for future natural resource management (NRM) investment in the Fitzroy Basin region provided useful guidance. They also recommend future consideration to conducting separate assessments for coastal and inland wetlands, largely because the DSS includes several criteria that emphasise coastal processes and values. To address substantial knowledge gaps that inhibit consistent assessment across the region, a major inventory of inland wetlands—especially aggregations on floodplains—is advocated.

1. Introduction

The Australian and Queensland governments have invested substantial funding over the past decade or more to implement the Reef Water Quality Protection Plan (SoQ 2013). The Plan recognises the global importance of the Great Barrier Reef, which is listed as a World Heritage Area. It identifies poor water quality as a major threat to condition of the reef and lagoon ecosystems, especially the high levels of sediments and nutrients emanating from river catchments of eastern Queensland. Concurrently, the plan acknowledges the role that wetlands play in detaining flood water and retaining sediments and nutrients. The plan, together with the Australian Wetlands Database (DotE 2015) and other sources (e.g. Blackman et al. 1999), further demonstrate that wetlands of the reef catchments are abundant and possess high biodiversity values. In many instances, such values are being threatened by the inadequate management of natural resources.

The Fitzroy River Basin is one of the largest catchments of the reef and is a high contributor of sediment to the reef lagoon (SoQ 2013). It also contains a substantial suite of estuarine, palustrine and riverine wetlands spread across coastal and inland locations (EHP 2015). As the primary community organisation for natural resource management (NRM) in the Basin, FBA has undertaken a number of initiatives to address water quality, land condition and biodiversity conservation (e.g. Melzer et al. 2008). FBA is currently developing a Water Quality Improvement Plan (WQIP) supported by Commonwealth funding.

A key component of the WQIP describes investment opportunities for FBA and collaborators in NRM with respect to wetlands. In order to ensure optimal outcomes, FBA sought to prioritise wetlands in the Basin for this future investment. It chose to apply a Decision Support System (DSS) that had been developed previously for the Great Barrier Reef catchments for this purpose under joint Commonwealth and State sponsorship (HLAE 2007). Use of the DSS was trialled at an initial workshop of experts arranged by FBA in 2007. However, this process was constrained by a multiplicity of opinions and recently FBA has decided to adopt a more consistent and time-efficient approach. This led to appointment in August 2015 of an independent expert—the lead author—with considerable experience of wetlands in the Basin, to work in close conjunction with the co-authors in applying the DSS.

The present report describes the methods used by the authors in deriving a prioritisation of wetlands in the Fitzroy Basin for investment in natural resource management. It also gives a summary of the results and offers several recommendations.

2. Methods

2.1. Identifying candidate wetlands

In order to identify candidate wetland sites in the Fitzroy Basin for analysis using the DSS, several sources and approaches were used, iteratively. (The candidates would be reduced to a smaller set for analysis.) The sources and methods provided reinforcement of the decision to include a site, or were complementary.

Key sources were:

1. The list of wetlands in the Fitzroy Basin that had been included in the Directory of Important Wetlands in Australia and the Australian Wetlands Database (Blackman et al. 1999; DotE 2015)—thereby also including any Ramsar Sites (one exists in the FBA region).
2. A list and map of 20 wetlands considered for similar purposes by an earlier FBA workshop, supplied by FBA.
3. State-wide wetland mapping from the Queensland Government (EHP 2015).
4. Satellite imagery of the online application Google Earth.
5. Collective personal experience of the authors in the FBA region, over more than 10 years.

Key elements of the approach employed were:

- Where possible, selection focussed on wetlands that were known or likely to contribute to water quality improvement in the Reef lagoon, wetlands that (otherwise or in addition) had biodiversity values known or likely to be high, and—at this stage to a lesser extent—wetlands where some kind of NRM investment seemed feasible.
- For inland areas, where in general the wetland estate was poorly known, considerable reliance was placed on the Queensland Department of Environment and Heritage Protection (EHP) mapping and Google Earth imagery used jointly to identify clusters of wetlands. It was considered important to ensure a reasonable geographic spread, not totally dominated by coastal sites. (Inland areas with lower rainfall are highly vulnerable to soil erosion, with some of the sediment carried seaward.)
- Some sites were a single water body or cluster; others were aggregations of sites, for example on a floodplain, that were hydrologically connected during floods or shared common features.
- Many wetlands in floodplain or marine plain landscapes were semi-continuous and/or hydrologically connected. Some of these were delineated separately for this project in order to align with separate land tenure, ownership or other practical considerations.
- Wetlands of all types were considered: tidal and non-tidal, fresh and saline, permanent and temporary; but river pools or reaches without associated off-channel wetlands were not targeted.

- Some wetlands that had been greatly modified by human intervention were included but completely artificial wetlands such as reservoirs were excluded.
- No attempt was made to create sites of similar size.

The result was a list of 40 sites needing further consideration; the sites are listed in Appendix 1 with some rationale (values and threats) for each site's inclusion. Few wetlands in the Fitzroy Basin of known significance are missing from the list.

2.2. Selection of 20 wetland sites for analysis

FBA requested that, to facilitate implementation of the project results, a final list of 20 wetland sites be selected. Key elements were:

- Sites at which significant previous investments for NRM had occurred, or were ongoing, were omitted in many cases. This was because FBA wanted to expand the geographical spread of investments in NRM for wetlands in the Basin and to engage additional landholders.
- Some sites with previous investment were nevertheless included, because there seemed to be limited prospects for further investment by other organisations in the short- to medium-term.
- Several sites that were to be targeted in upcoming or recently started projects of FBA—such as on the lower Fitzroy Floodplain—were omitted.
- Some sites with minimal information on values and threats were omitted; some others in this category—especially some inland sites—were included to ensure an adequate geographical spread of sites across the Basin's sub-catchments.
- Some sites where any form of NRM investment seemed highly improbable, or impractical in the short- to medium-term, were omitted, for example, sites that were highly remote or subject to severe flooding impacts.

A summary of reasons for exclusions is provided in Appendix 1. The final set of 20 wetlands is shown in Table 1 and Figure 1. Names applied to the sites were either pre-existing or devised only for project purposes.

Table 1: List of 20 wetland sites selected for the prioritisation

FBA01	St Lawrence Wetlands
FBA02	Waverley Plains and Bar Plain
FBA03	Wumalgi Peninsula (Broad Sound)
FBA04	Glen Prairie Wetlands
FBA05	Torilla Plain
FBA06	Lower Herbert Creek Wetlands
FBA07	Green Lake complex (Hedlow)

FBA08	Lake Mary Complex (Hedlow)
FBA09	Iwasaki Wetlands
FBA10	Joskeleigh and Long Beach Complex (includes swale wetlands)
FBA11	Nankin Plain Wetlands (Fitzroyvale, Broadmeadows)
FBA12	Twelve Mile Creek Wetlands (Bajool)
FBA13	Lower Isaac River Floodplain Wetlands
FBA14	Mackenzie Perched Wetlands
FBA15	South Yaamba Wetland Complex
FBA16	Serpentine Creek Wetlands (Fitzroy Delta)
FBA17	Lower Dawson Floodplain Wetlands (Moura to Duaringa)
FBA18	Callide–Don Junction Wetlands (Wowan Complex)
FBA19	Perch Creek Wetlands
FBA20	Palm Tree and Robinson Creek Wetlands (Taroom Complex)

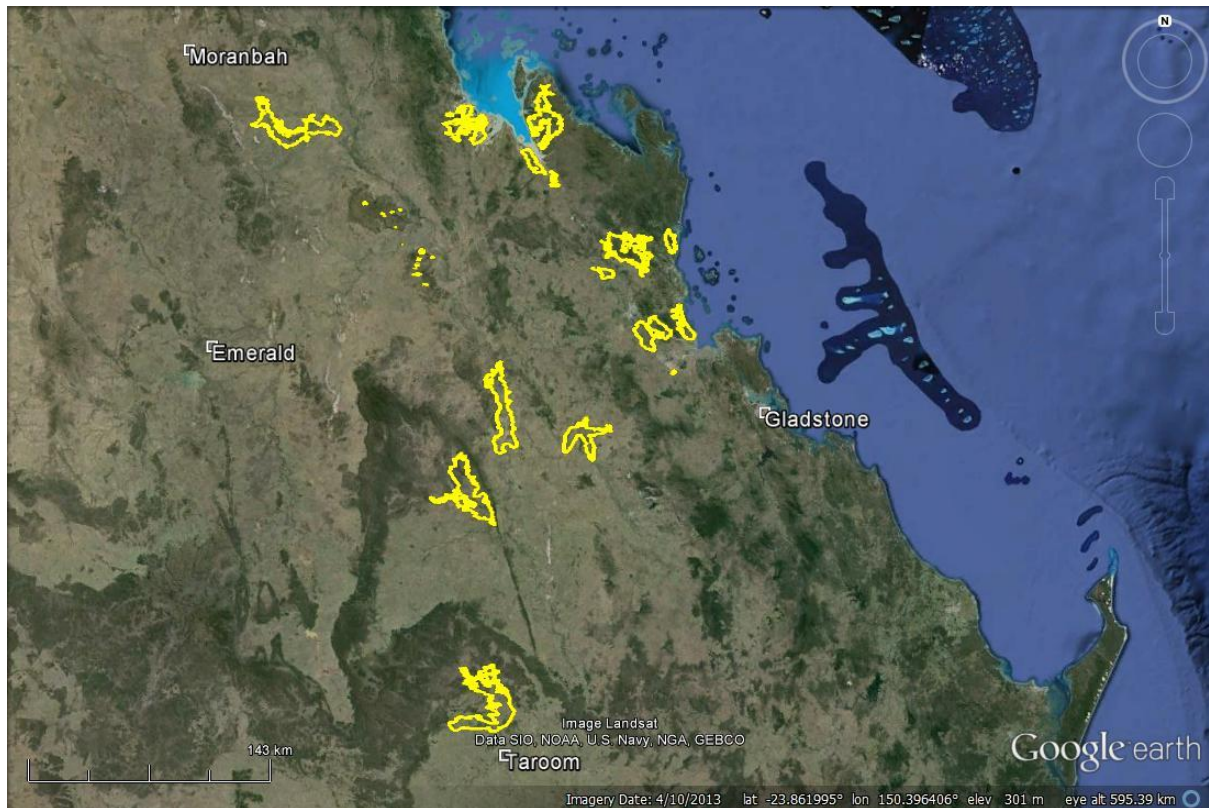
2.3. Mapping wetland boundaries

To be clear and consistent in documenting values and threats and in applying the DSS criteria, it was necessary to delineate the boundary of each wetland in FBA’s geographic information system. This was achieved by working from polygons drawn by the lead author in Google Earth, which were then imported by co-author Peter Smith into FBA’s Geographic Information System (GIS). The lead author applied personal knowledge of sites to this task, influenced by inspection of EHP wetland mapping of the sites.

In the GIS, FBA co-authors selected applicable polygons from the EHP wetland mapping to access pre-existing attributes of the polygons, and applied purpose-driven boundaries (e.g. defined by tenure or road lines) where necessary. The Wetlands dataset used was ‘Queensland wetland data version 3 — wetland areas’, held by the Queensland Department of Science, Information Technology and Innovation. Where there were not any suitable wetland polygons, the ‘Grazing land management land types — Fitzroy’ dataset (Queensland Department of Natural Resources and Mines) was used to try to match the lead author’s initial polygons. Where the wetlands and the land types data were insufficient in some respects, the final polygons were created by following the lead author’s polygons and high-resolution imagery, or by ‘purpose-driven boundaries’ as already stated. Once polygons for the project’s 20 sites had been finalised, GIS tools were used to extract or calculate information needed for three of the criteria (6, 9 and 13: see below).

An outline of each of the 20 mapped wetlands for this project is provided in Appendix 2, drawn on a satellite image obtained online from Google Earth.

Figure 1. Location of the 20 wetland sites selected for prioritisation



2.4. Applying the DSS criteria

The DSS is based on assessment of 23 criteria within three categories: values, threats and capacity (HLAE 2007; Table 2). Following the manual (HLAE 2007) with guidance for applying each criterion, a score between 1 and 10 needs to be given to each site for each criterion. Subsequently, weightings are given to each criterion and criterion group, to reflect the particular purpose or emphasis of the project that the DSS is to inform. Finally, the DSS computer application combines scores and weightings to produce a ranking of the included sites.

The lead author followed the manual guidelines in applying the criteria, using best available knowledge. Values and threats were scored regardless of whether or not they applied to the whole site. The lead author also made some choices for project purposes and the FBA co-authors provided additional guidance specific to the project: these variations or clarifications are described in Table 2.

For several criteria, the project timeframe or other circumstances did not allow a score to be assigned to each site and an “Average” score was assigned—an option provided in the drop-down choices for each scoring cell in the DSS tool. The average was calculated by the DSS tool.

Table 2:Notes on how the DSS criteria were applied for this project.

Criterion		How applied
VALUES		
1	Recreational value	As per guidelines in the manual for using the DSS.
2	Indigenous value	Project timeframe did not allow for the level of consultation this criterion deserves. Scores set at Average (see notes below).
3	Fisheries habitat	Consideration also was given to sites with riverine or river-connected wetlands.
4	Assimilative capacity for nutrients and sediments	Scores were assigned on informed assumptions.
5	Populations of rare or threatened taxa	Applied to wetland species listed (CE, E or V) as threatened under EPBC Act 1999, NC Act 1992, or IUCN Red List and species listed as Migratory under EPBC. Non-continuous occurrence of species in the site was acceptable. Sourced from publications and reports.
6	Vegetation representativeness	Scores determined by FBA from attributes and interpretation of GIS data for polygons included in the project wetland site.
7	Wetland representativeness	As per guidelines in the manual for using the DSS.
8	Species richness/diversity	Sourced from publications and reports. Results were biased toward sites subjected to high survey effort, but estimates of species diversity were made (and scored lower to account for uncertainty) where sites were data poor.
9	Size (km ²)	Scores determined by FBA from attributes and interpretation of GIS data for polygons included in the project wetland site.
10	Water bird habitat value	Sourced from publications and reports. Non-continuous occurrence of species in the site was acceptable.
11	Wetland condition	Some care was taken to ensure this criterion was applied differently (as instructed) to Criterion 7.

Table 2 continued...

Criterion		How applied
THREATS		
12	Aquatic habitat connectivity restriction	As per guidelines in the manual for using the DSS.
13	Land-use intensity	Scores determined by FBA from attributes and interpretation of GIS data for polygons included in the project wetland site.
14	Land-use intensification	As per guidelines in the manual for using the DSS.
15	Weed invasion	Applied where serious invasive weeds such as prickly acacia and other weeds of national significance were known to occur. Comprehensive inquiry was not possible in the project timeframe.
16	Water quality	No water quality data specific to each site were accessed by the lead author. Few, if any, such data are likely to exist. Scores set at Average (see notes below).
17	Point-source pollution	Scores set at Average (see notes below).
18	Hydrological change	Known future threats were taken into consideration in some cases.
CAPACITY		
19	Level of protection	Determined from online mapping tools (EHP WetlandInfo website). Protection may apply to only part of the site. Criterion allows high score for adjacent areas being protected—a major influence for coastal sites. Lacked information on shire plans.
20	Financial incentives	Based on FBA co-authors' knowledge of past FBA and other relevant investments.
21	Industry land-use viability	A certain general level of viability of beef cattle enterprises (the dominant land-use) was assumed.
22	Engagement capacity	As per guidelines in the manual for using the DSS.
23	Best management practice feasibility	Scores set at Average (see notes below).

Scope of the accessed data, and citations or descriptions of sources, were documented wherever appropriate and possible. Time constraints did not allow for consultation with site managers and experts on subjects related to the criteria. Comprehensive WildNet (Wildlife Online) searches were

not conducted due to the very large size of many sites, their highly complex boundaries (in many cases), and the limited project timeframe. For the project purposes, it was essential to ensure that wildlife records fell inside the delineated site boundaries. Assessment for criteria related to plants and animals was confined to wetland-dependent species. For coastal sites, occurrence of marine species was largely not considered except where species (e.g. migratory shorebirds) were known to come ashore to use the wetland areas (or included dry land) that may potentially be addressed by future NRM investments.

Following review of the lead author's scores by the FBA co-authors, who were able to harness some additional information held by or known to FBA, scores reliant on the GIS data (criteria 6, 9 and 13) were incorporated and a set of final scores was achieved. These are shown in Appendix 3.

2.5. Assignment of weightings to the criteria

The lead author initially applied weightings from 1 to 10 to each criterion, keeping in mind the dual goals of the Reef Plan and WQIP to improve water quality and to enhance biodiversity values. Criteria considered likely to be influential to these goals were weighted more highly than criteria with less influence. These weightings were then discussed with the FBA co-authors who made adjustments that reflected their closer knowledge of the WQIP and of FBA expectations.

Weightings derived earlier by averaging the weightings proposed by each of the workshop participants were also considered. These numbers varied as widely as was possible (often 1 to 10) in the choices for any one criterion. Therefore, this seemed an inherently weak method to derive weightings with the well-considered choices of one or two 'experts' being a more consistent method across all criteria.

Weightings finally chosen and used in running the DSS are listed in Table 3.

Table 3: Weightings applied to each criterion.

Criterion		Weighting
VALUES Group weighting = 8		
1	Recreational value	4
2	Indigenous value	10
3	Fisheries habitat	9
4	Assimilative capacity for nutrients and sediments	10
5	Populations of rare or threatened taxa	10
6	Vegetation representativeness	8

7	Wetland representativeness	8
8	Species richness/diversity	7
9	Size (km ²)	2
10	Water bird habitat value	8
11	Wetland condition	8
THREATS Group weighting = 10		
12	Aquatic habitat connectivity restriction	8
13	Land-use intensity	7
14	Land-use intensification	7
15	Weed invasion	8
16	Water quality	10
17	Point-source pollution	10
18	Hydrological change	6
CAPACITY Group weighting = 10		
19	Level of protection	2
20	Financial incentives	10
21	Industry land-use viability	2
22	Engagement capacity	10
23	Best management practice feasibility	8

2.6. Running the DSS

The DSS application as developed by HLAE (2007) is fully automated once the criteria scores and weightings have been entered. Two additional entries were required and were made by the FBA co-authors to suit FBA purposes. The first was to assign a weighting for each criteria group, selected as 8 for the Values group, 10 for the Threats group and 10 for the Capacity group. The second was to assign cost or benefit to these groups and the decisions were Benefit for the Values and Capacity, and Cost for the Threats.

2.7. Field check of assigned scores

Time and resources prohibited an exhaustive search for data to support scoring and visits to all sites to verify scores. However, checking a small sample of sites was commissioned and undertaken by Roger Jaensch with assistance of Shane Westley at one site. Three sites were chosen: the highest-ranked site; a low-ranked site and a third site that would complement the others in its characteristics. The site visits were conducted over one week, 16–23 September 2015. Activities included discussions with landholders to tap into their knowledge and experience, driving around accessible parts of the site, observation of condition and threats, and limited recording of biodiversity (waterbirds, dominant plants). Seventeen criteria were reviewed.

3. Results

3.1. Desk assessment

Rankings from running the DSS application are shown in Table 4 and Figure 2. The highest-ranked site overall was Torilla Plain, with Palm Tree and Robinson Creek Wetlands, and Twelve Mile Creek ranked second and third respectively.

DSS scores that determined the ranks varied from around 6000 to 10,000 with a reasonably straight slope in the graph of scores (Figure 2). Nine of the 20 sites scored above the mean score value (8015) but the top three sites stood out as a somewhat distinct cluster, from the next-ranked 4–5 sites.

Table 4: Priority rankings from running the DSS application.

DSS rank	wetland code	wetland name
1	FBA05	Torilla Plain
2	FBA20	Palm Tree and Robinson Creek (Taroom)
3	FBA12	Twelve Mile Creek (Bajool)
4	FBA01	St Lawrence Wetlands
5	FBA11	Nankin Plain (Fitzroyvale, Broadmeadows)
6	FBA02	Waverley Plains and Bar Plain
7	FBA09	Iwasaki Wetlands
8	FBA04	Glen Prairie Wetlands
9	FBA08	Lake Mary Complex
10	FBA03	Wumalgi Peninsula (Broad Sound)
11	FBA10	Joskeleigh and Long Beach
12	FBA19	Perch and Mimosa Creeks
13	FBA14	MacKenzie Perched Wetlands
14	FBA06	Lower Herbert Creek Wetlands
15	FBA07	Green Lake Complex
16	FBA16	Serpentine Creek (Fitzroy Delta)
17	FBA15	South Yaamba Complex
18	FBA17	Lower Dawson Floodplain Wetlands
19	FBA13	Lower Isaac Floodplain Wetlands
20	FBA18	Callide-Don Junction Wetlands

Eight of the top 10 wetland sites were marine plain and/or estuarine systems; in all but one of these sites, threats—especially the major modifications to hydrology (tide exclusion)—were a strong influence on the outcome, as were the naturally high values (especially fisheries, threatened species and waterbirds). Only two of the top 10 were freshwater wetlands.

Tables of ranks of sites according to grouped results for Values, Threats and Capacity are provided in Appendix 4.

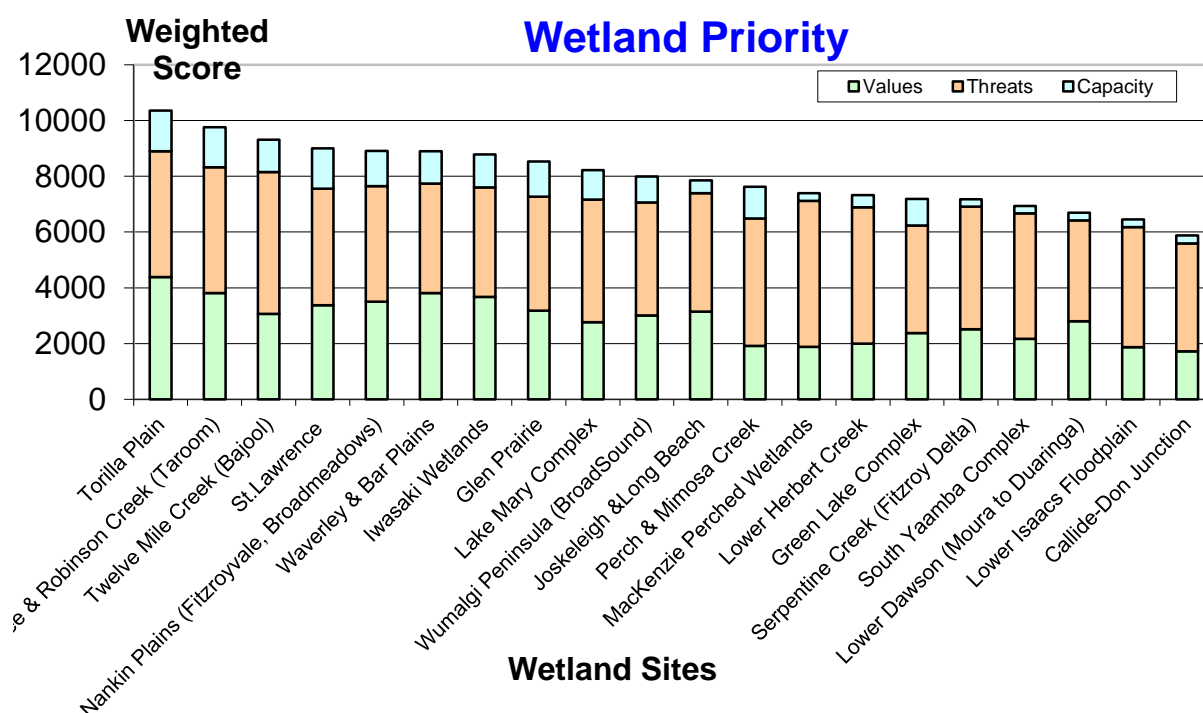


Figure 2. Final score for each wetland site, in priority order.

In terms of Values, the top two sites and one other of the five highest-ranked sites, and all but one of the sites included in the top 10, were the same as for the overall rankings—despite Values having a group weighting (Table 3) lower than for Threats or for Capacity. In terms of Threats, only four of the sites included in the top 10 (those with lowest threats, combined) were in the overall rankings, whereas for Capacity the sites included in the top 10 were identical to the overall rankings except for one site.

3.2. Field check of assigned scores

The high- and low-ranked sites chosen for field checking were Torilla Plain and South Yaamba Wetlands (Table 4). Among the low-ranked sites, South Yaamba was selected because of its relatively easy access from Rockhampton and because part of the site was traversed by shire roads.

The third site was the Callide-Don Junction Wetlands, selected because it was an example of inland floodplain wetlands, thus a complementary type to many of the top-ranked sites (marine plain wetlands), and because of its closeness to Rockhampton. Furthermore, it was one of several assessed wetlands (mostly well inland) for which information was rather scarce—hence an opportunity to see if the low ranking might have been different if data had been more comprehensive.

Field visits comprised the best part of two days at South Yaamba Wetlands, three days at Torilla Plain and two days at the Callide-Don Junction Wetlands. A significant amount of new information relevant to the assessment criteria was obtained for South Yaamba Wetlands, only a little for the well-known Torilla Plain site, and a considerable amount for the Callide-Don Junction Wetlands. A spreadsheet of comments and information against the 17 checkable criteria was compiled and provided to FBA; recommended adjustments to scores are shown in Table 5.

Table 5: Recommended adjustments to DSS criteria scores for three FBA wetlands arising from field site visits 16–23 September 2015.

DSS criterion assessed in the field	Recommended score adjustment		
	South Yaamba	Torilla Plain	Don-Callide Junction
1 - Recreational value			INC
3 - Fisheries habitat		dec	
4 - Assimilative capacity: nutrients, sediments	INC	dec	INC
5 - Populations of rare or threatened taxa	INC		inc
7 - Wetland representativeness	inc		inc
8 - Species richness/diversity	inc		inc
10 - Waterbird Habitat Value	INC		INC
11 - Wetland condition			
12 - Aquatic habitat connectivity restriction			

14 - Land-use intensification			
15 - Weed invasion			INC
16 - Water quality			
17 - Point-source pollution			INC
18 - Hydrological change	inc	dec	INC
19 - Level of protection			INC
21 - Industry land-use viability	inc		
22 - Engagement capacity			INC

INC = substantial increase; inc = small increase; dec = small decrease in score.

Blank indicates no change, or not applicable.

Not surprisingly, few changes seemed necessary for Torilla Plain other than to address slight overstatement of the (nevertheless highly scored) criteria for fisheries habitat and assimilative capacity. In contrast, upward corrections to 11 criteria were recommended for the Callide-Don Junction Wetlands, most of them significant increases. This reflects the previously sparse baseline of knowledge about the site. For South Yaamba Wetlands, seven criteria scores could be revised upwards but the majority only slightly.

In addition to information for the review of scores, the field visits generated sets of site photographs that have been copied to FBA and helped develop cooperative relationships with the landholders.

4. Conclusion and Recommendations

The project's desk-based results and field checks demonstrated that use of the DSS was suitable for purpose and produced meaningful results—within the constraints of data scope and available time. This outcome was helped by inbuilt capability of the DSS to use average scores where it was not possible or practical to score a criterion.

In terms of any limitations to the methods used for the prioritisation, the scarcity of data on inland floodplain wetlands could have been a significant influence—as shown by the field visits to two inland sites. With several floodplain aggregations included in the assessment and others within the longer list (Appendix 1), clearly a project that specifically collates information on values, threats and capacity at floodplain wetlands would be worthwhile. Quite a few sites even in coastal areas lacked some basic information, underlining the overall need for gap-filling inventories and assessments at many of the Basin's wetlands.

Recommendation 1: FBA should collaborate with potential funders to conduct adequate and gap-filling inventory of wetlands in its region that are data-deficient, with an emphasis on (or dedicated project addressing) aggregations of wetlands on inland floodplains.

Given the particular scope of the criteria in the DSS, coastal wetlands in the Reef catchments may inevitably rank higher than inland wetlands. For example, many of the coastal wetland sites were adjacent to the Great Barrier Reef World Heritage Area and other protected areas such as Fish Habitat Areas, therefore scoring highly on one criterion, whereas inland sites lacked these protected areas. Furthermore, connectivity between the sea and coastal wetlands is emphasised in the DSS. Thus it may be useful to consider wetlands in the present/former tidal zone separately from freshwater inland wetlands. In the results of this project, the top three coastal wetlands were:

- Torilla Plain
- Twelve Mile Creek
- St Lawrence Wetlands

And the top three inland wetlands were:

- Palm Tree and Robinson Creek Wetlands
- Lake Mary Complex
- Perch Creek and Mimosa Creek Complex

Recommendation 2: Given the many differences between coastal and inland wetlands and the particular structure of the DSS tool, in future assessments users

should consider the benefits or conducting separate coastal and inland prioritisations.

The project demonstrated that many of the wetlands in the FBA region scored highly (8 to 10) against one or several criteria and therefore are well deserving of NRM investment to protect/enhance values and reduce threats. Where sites were field-checked, these high scores generally were validated. The project results thus provide guidance to FBA and others to prioritise future NRM investment to enhance water quality in the Great Barrier Reef lagoon and to enhance conservation of biodiversity values in wetlands of the Fitzroy Basin.

Recommendation 3: The rankings from the present prioritisation using the DSS provide useful guidance for future NRM investment on wetlands of the Fitzroy Basin by FBA and others, with Torilla Plain, Palm Tree and Robinson Creek Wetlands, and Twelve Mile Creek as the top priority sites.

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Appendix 1. Broad list of wetland sites in the Fitzroy Basin

FBA code	Wetland name	Summary of values	Summary of threats	Outcome
FBA01	St Lawrence Wetlands	Waterbird numbers; threatened species; bird-watching and nature appreciation; aesthetic values; fish habitat.	Grazing pressure; weeds.	Included.
FBA02	Waverley Plains and Bar Plain	Waterbird numbers; migratory shorebird roost; threatened species; fish habitat; pasture for beef enterprises.	Weeds; grazing pressure; seawall damage; lost tidal connectivity.	Included.
FBA03	Wumalgi Peninsula (Broad Sound)	Migratory shorebird roost; threatened species; fish habitat; pasture for beef enterprises.	Erosion of local 'upland' catchment on the peninsula; saline intrusion on marine plain (grazed) grassland; weeds.	Included.
FBA04	Glen Prairie Wetlands	Waterbird numbers; threatened species; pasture for beef enterprises.	Erosion of local 'upland' catchment; grazing pressure; weeds; lost tidal connectivity.	Included.
FBA05	Torilla Plain	Waterbird numbers; migratory shorebird non-tidal and tidal habitat; threatened species; fish habitat; unique geomorphology; rare central Queensland example of relatively intact marine plain; pasture for beef enterprises.	Grazing pressure; weeds; erosion of local catchment; feral animals?	Included.
FBA06	Lower Herbert Creek Wetlands	Not known (potential fish habitat and waterbird habitat in season).	Erosion and/or sedimentation of floodplain wetlands; grazing pressure.	Included.
FBA07	Green Lake complex (Hedlow)	Floodwater detention; significant wetland type; remnant floodplain forest; fish habitat?	Land-use changes (tree farming); catchment salinisation; catchment erosion?	Included.

FBA code	Wetland name	Summary of values	Summary of threats	Outcome
FBA08	Lake Mary Complex (Hedlow)	Waterbird numbers; aesthetic value; significant wetland type?; pasture for beef enterprises?	Grazing pressure; weeds; catchment salinisation; feral animals?	Included.
FBA09	Iwasaki Wetlands	Waterbird numbers; nature appreciation (tours); pasture for beef enterprises?	Loss of tidal connectivity; potential changes in land-use and wetland characteristics; feral animals?	Included.
FBA10	Joskeleigh and Long Beach Complex (includes swale wetlands)	Waterbird numbers; migratory shorebird roosts; threatened species; significant wetland type (swales); fish habitat; marine turtle nesting?; pasture for beef enterprises.	Loss of original woody cover on coastal dunes; disturbance to shorebirds from vehicles on beach; feral animals?	Included.
FBA11	Nankin Plain Wetlands (Fitzroyvale, Broadmeadow)	Waterbird numbers; threatened species; pasture for beef enterprises.	Grazing pressure; lost tidal connectivity; feral animals?	Included.
FBA12	Twelve Mile Creek Wetlands (Bajool)	Threatened species; waterbird numbers; fish habitat; bird-watching.	Erosional changes to riverine and adjacent estuarine wetlands; grazing pressure; weeds?	Included.
FBA13	Lower Isaac River Floodplain Wetlands	Not known; example of floodplain wetlands on major northern tributary of Fitzroy Basin; pasture for beef enterprises?	Not known.	Included.
FBA14	Mackenzie Perched Wetlands	Rare wetland type (perched freshwater tree swamp) within Fitzroy Basin.	None known.	Included.
FBA15	South Yaamba Wetland Complex	Waterbird numbers; good example of wetland type (nested scroll wetlands); river fish habitat?; pasture for beef enterprises?	Sedimentation?; grazing pressure?; weeds?; flood damage.	Included.

FBA code	Wetland name	Summary of values	Summary of threats	Outcome
FBA16	Serpentine Creek Wetlands (Fitzroy Delta)	Waterbird numbers; good example of wetland type (meandering fresh-brackish creek entering estuarine delta); pasture for beef enterprises.	Loss of tidal connectivity (block banks at end of channel); grazing pressure; weeds?; feral animals?	Included.
FBA17	Lower Dawson Floodplain Wetlands (Baralaba to Duaringa)	Waterbird numbers; threatened species; example of floodplain wetlands on major southern tributary of Fitzroy Basin; pasture for beef enterprises?	Potential hydrological changes (proposed Nathan Gorge Dam); sedimentation/erosion; grazing pressure; weeds?	Included.
FBA18	Callide-Don Junction Wetlands (Wowan Complex)	Not well known; example of floodplain wetlands on major tributary of Fitzroy Basin; pasture for beef enterprises?	Not known but possibly includes sedimentation/erosion; grazing pressure; weeds?	Included.
FBA19	Perch Creek Wetlands	Not well known; example of floodplain wetlands on major tributary of Fitzroy Basin; pasture for beef enterprises?	Not known but possibly includes sedimentation/erosion; grazing pressure; weeds?	Included.
FBA20	Palm Tree and Robinson Creek Wetlands (Taroom Complex)	Major cluster of persistent wetlands in the Basin, outside of lower Fitzroy River; significant landscape feature; waterbird numbers; pasture for beef enterprises; nature appreciation.	Sedimentation/erosion; grazing pressure.	Included.
FBA21	Shoalwater Bay and Port Clinton	Ramsar site; waterbird numbers; migratory shorebird roosts; threatened species; dugong, turtle, crab and fish populations; major mangrove area; semi-wilderness area; military training facility.	Natural coastal erosion; drought-induced saline intrusion in eco-tonal wetlands around Port Clinton (tree deaths).	Omitted. Relevant NRM investment has occurred and is ongoing.
FBA22	Dismal Swamp and Clinton Lowlands	Ramsar site; threatened species; semi-wilderness area; the principal example of coastal peat wetlands in central Queensland; rare wetland type.	Fire in peatlands; insufficient awareness of values.	Omitted. Relevant NRM investment has occurred and is ongoing.

FBA code	Wetland name	Summary of values	Summary of threats	Outcome
FBA23	Corio Bay	Waterbird numbers; migratory shorebird roost; threatened species; nature appreciation; recreational fishing?	Storm-driven changes to shoreline; public disturbance of roosting shorebirds; changes to freshwater inflows.	Omitted. Uncertain as to what could be achieved at the site relevant to the project.
FBA24	Water Park Creek	Permanent source of fresh water for coastal communities; uncommon vegetation community (riparian closed forest).	Erosion on private properties beside creek; (past water extraction for towns).	Omitted. Uncertain as to what could be achieved at the site relevant to the project.
FBA25	Kinka Wetlands	Waterbird numbers; occurrence of migratory shorebirds; nature appreciation; birdwatching; fish habitat.	Changes in surrounding catchment; residual effects of past land-use.	Omitted. Relevant NRM investment has occurred and is ongoing.
FBA26	Coorooman Estuarine Wetlands	Not known but presumably the same as other local estuaries.	Not known.	Omitted. Uncertain as to what could be achieved at the site relevant to the project.
FBA27	Casuarina Island	Not known but potentially a refuge for fauna of the Fitzroy Delta, including migratory shorebirds and Yellow Chat; fish habitat; pasture for beef enterprises?	Not known.	Omitted. Possible involvement with offsets in relation to Curtis Coast industrial developments.
FBA28	Raglan Creek System	Threatened species; fish habitat; pasture for beef enterprises?	Not well known but presumably: sedimentation/erosion; grazing pressure; weeds.	Omitted. Uncertain as to what could be achieved at the site relevant to the project.

FBA code	Wetland name	Summary of values	Summary of threats	outcome
FBA29	North-East Curtis Island	Threatened species; occurrence of migratory shorebirds?; fish habitat?	Feral pig damage; changes to bird habitats; weeds?	Omitted. Possible involvement with offsets in relation to Curtis Coast industrial developments.
FBA30	Curtis Coast: The Narrows to Rodds Bay	Feeding and roosting by migratory shorebirds; waterbird numbers; threatened species; commercial and recreational fisheries; ship transport; recreational boating; habitat for marine animals?	Industrial development (gas processing; other); dredging for ship lanes; fishery harvest; recreational and urban area impacts; water quality impacted by industry and urban areas.	Omitted. Relevant NRM investment has occurred and is ongoing.
FBA31	Lake Elphinstone	Recreational use (boating?).	Not known.	Omitted. Relevant NRM investment has occurred and may be ongoing.
FBA32	Funnel Creek Braided Floodplain	Good example of wetland type that is uncommon in near-coastal part of Basin; threatened species; pasture for beef enterprises.	Impacts of severe flooding (erosion) on habitats and land condition; weeds?; feral animals?	Omitted. Site is subject to severe flooding impacts.
FBA33	Long Island Reserve (Fitzroy River)	Remnant floodplain forest; good example of floodplain scroll and lagoon wetlands; crocodile and fish habitat; nature appreciation.	Damage to trees from major floods; weeds?; feral animals?	Omitted. Relevant NRM investment has occurred and may be ongoing.
FBA34	Fitzroy Floodplain North (upriver near Barrage)	Crocodile and fish habitat; water supply; recreation (boating, fishing).	Weeds; loss of tidal connectivity; flood-induced changes to marginal vegetation.	Omitted. Site may be targeted under concurrent FBA project/s.

FBA code	Wetland name	Summary of values	Summary of threats	outcome
FBA35	Paradise Lagoon (Lower Gracemere Lagoon) and associated wetlands	Waterbird numbers; occurrence of migratory shorebirds (approaching 1% levels); threatened species; recreation (boating); pasture for beef enterprises.	Weeds; feral animals?; water quality (de-oxygenated, entering river during floods); grazing pressure.	Omitted. Site may be targeted under concurrent FBA project/s.
FBA36	Gracemere Lagoon	Waterbird numbers; nature appreciation; pasture for beef enterprises.	Weeds; water quality (pollution from urban area)?; grazing pressure.	Omitted. Relevant NRM investment has occurred and may continue.
FBA37	Fitzroy Floodplain South (Gavial Creek to Duck Pond)	Waterbird numbers; threatened species?; pasture for beef enterprises; nature appreciation; recreational fishing?	Water quality; grazing pressure; weeds?; feral animals?	Omitted. Relevant NRM investment has occurred and may continue.
FBA38	Oaky Creek Wetlands (Upper Calliope)	Not known. Included as a rare example of mapped natural wetlands in the upper Calliope catchment.	Not known.	Omitted. Insufficient knowledge of site; small size.
FBA39	Lake Nuga Nuga	Waterbird numbers; freshwater fish habitat?; nature appreciation.	Not known. Weeds?; possibly relatively few threats on site?; sedimentation?	Omitted. Relevant NRM investment has occurred and may be ongoing.
FBA40	Consuelo Wetlands Complex	Pasture for beef enterprises; otherwise not known.	Not known.	Omitted. Insufficient knowledge of site; remoteness.

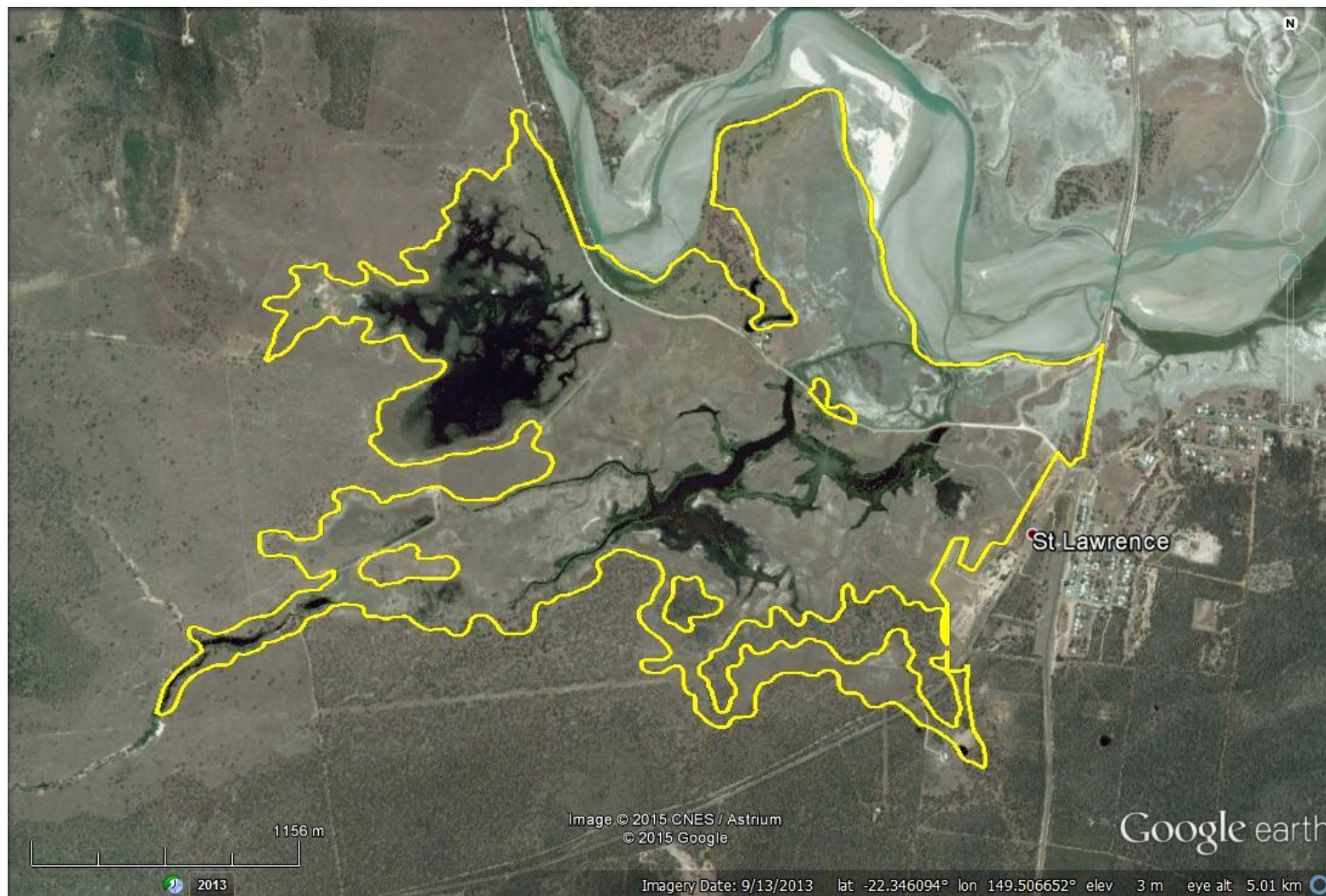
Appendix 2. Maps of each of the 20 wetlands selected for prioritisation

FBA01	St Lawrence Wetlands
FBA02	Waverley Plains and Bar Plain
FBA03	Wumalgi Peninsula (Broad Sound)
FBA04	Glen Prairie Wetlands
FBA05	Torilla Plain
FBA06	Lower Herbert Creek Wetlands
FBA07	Green Lake Complex (Hedlow)
FBA08	Lake Mary Complex (Hedlow)
FBA09	Iwasaki Wetlands
FBA10	Joskeleigh and Long Beach Complex (includes swale wetlands)
FBA11	Nankin Plain Wetlands (Fitzroyvale, Broadmeadow)
FBA12	Twelve Mile Creek Wetlands (Bajool)
FBA13	Lower Isaac River Floodplain Wetlands
FBA14	Mackenzie Perched Wetlands
FBA15	South Yaamba Wetland Complex
FBA16	Serpentine Creek Wetlands (Fitzroy Delta)
FBA17	Lower Dawson Floodplain Wetlands (Moura to Duinga)
FBA18	Callide-Don Junction Wetlands (Wowan Complex)
FBA19	Perch Creek Wetlands
FBA20	Palm Tree and Robinson Creek Wetlands (Taroom Complex)

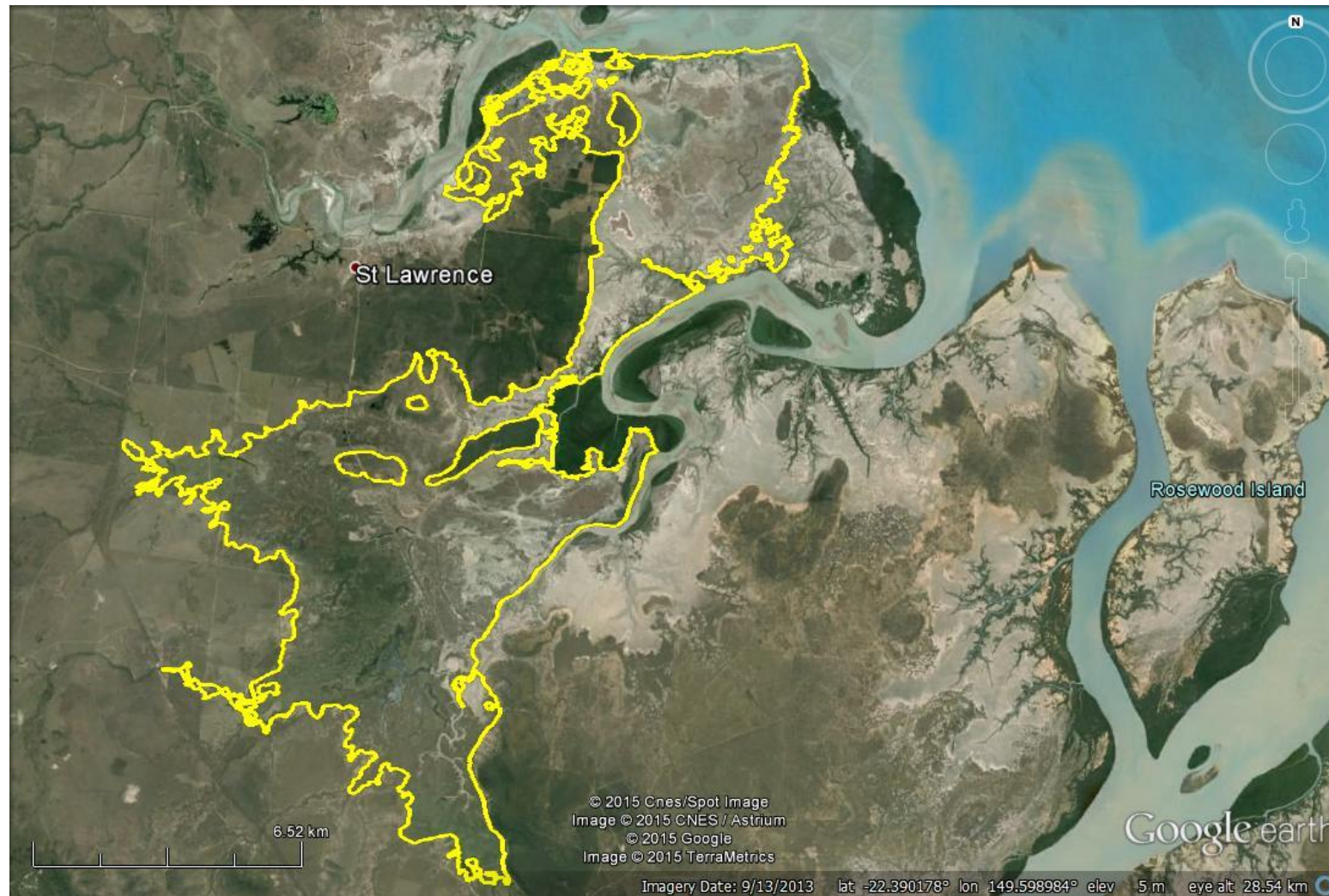
Sites vary considerably in size and shape. Accordingly, site maps on the following pages have been arranged to maximise the information visible on one page and therefore the scale (indicated in the bottom left hand corner) varies considerably between sites.

Maps were created using Google Earth and are for illustrative educational purposes only.

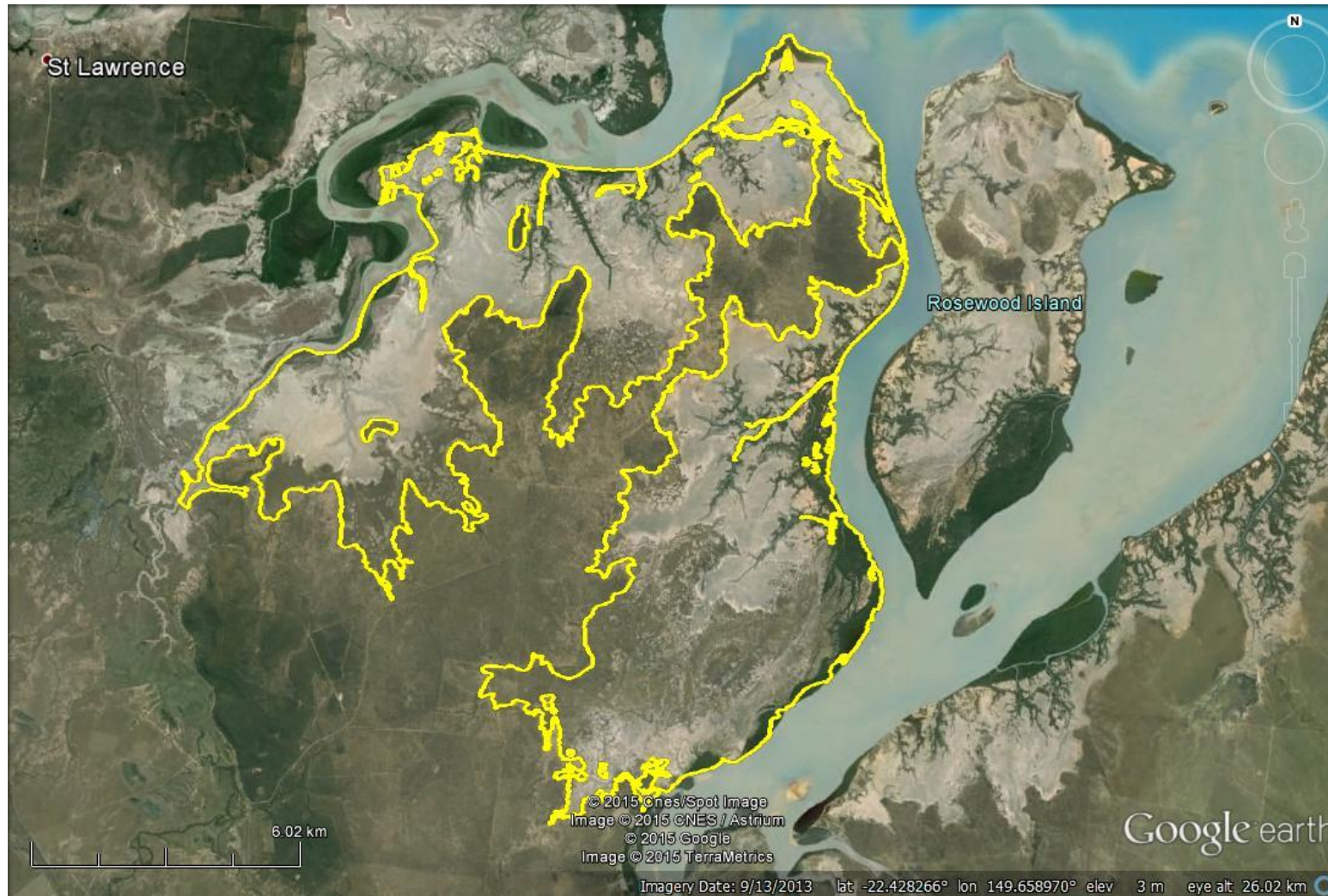
FBA01 St Lawrence Wetlands



FBA02 Waverley Plains and Bar Plain



FBA03 Wumalgi Peninsula (Broad Sound)



FBA04 Glen Prairie Wetlands



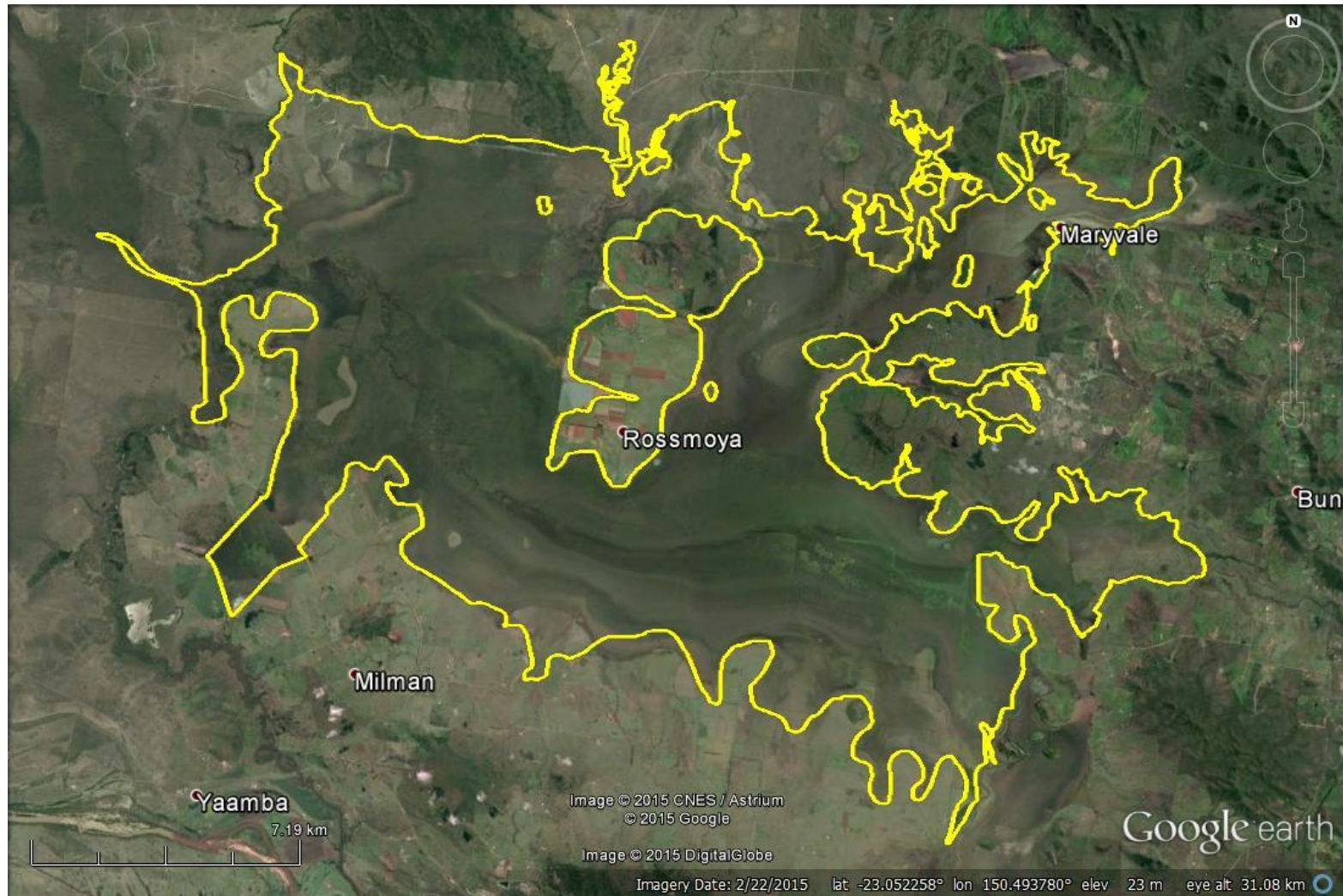
FBA05 Torilla Plain



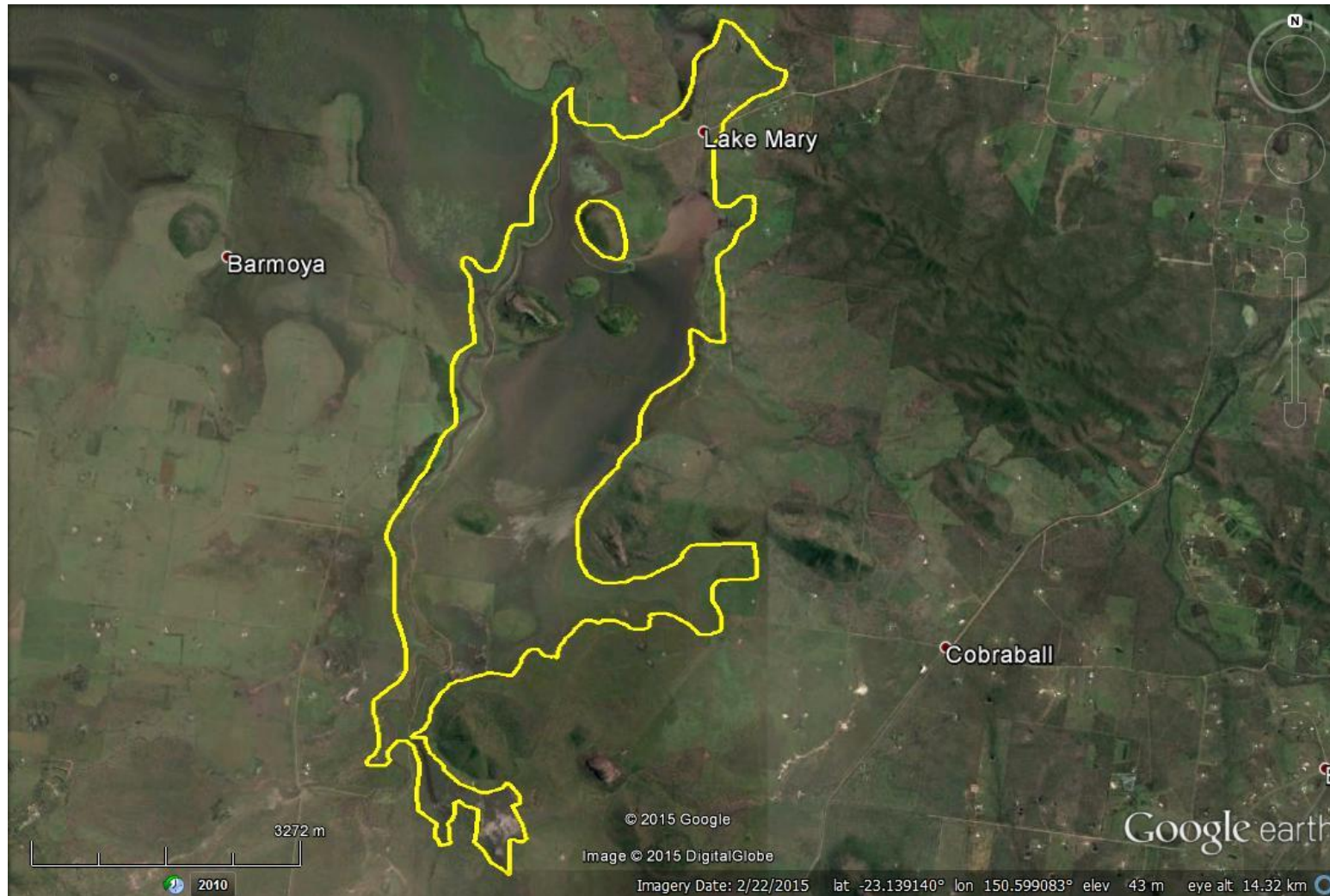
FBA06 Lower Herbert Creek Wetlands



FBA07 Green Lake Complex (Hedlow)



FBA08 Lake Mary Complex (Hedlow)



FBA09 Iwasaki Wetlands



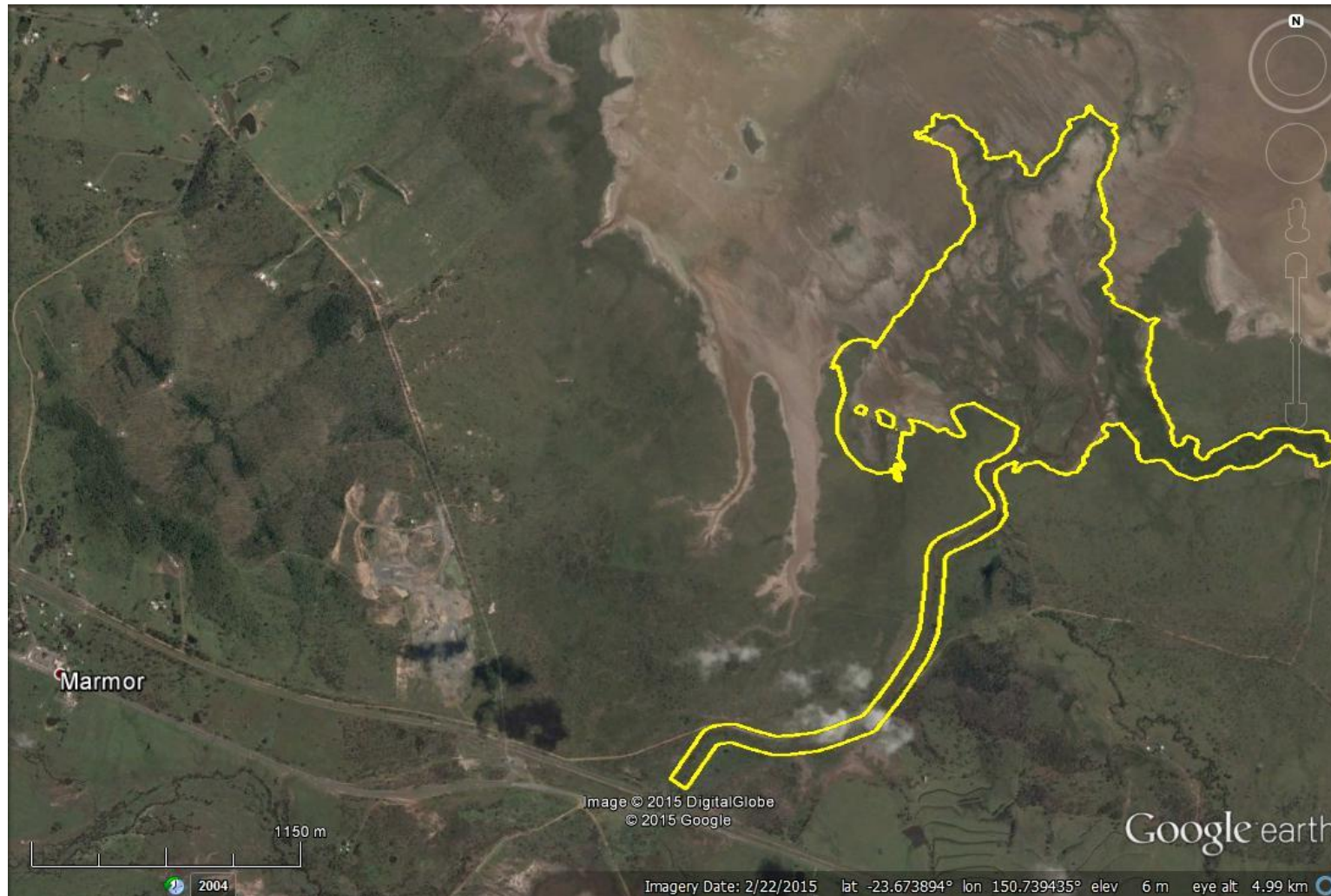
FBA10 Joskeleigh and Long Beach Complex (includes swale wetlands)



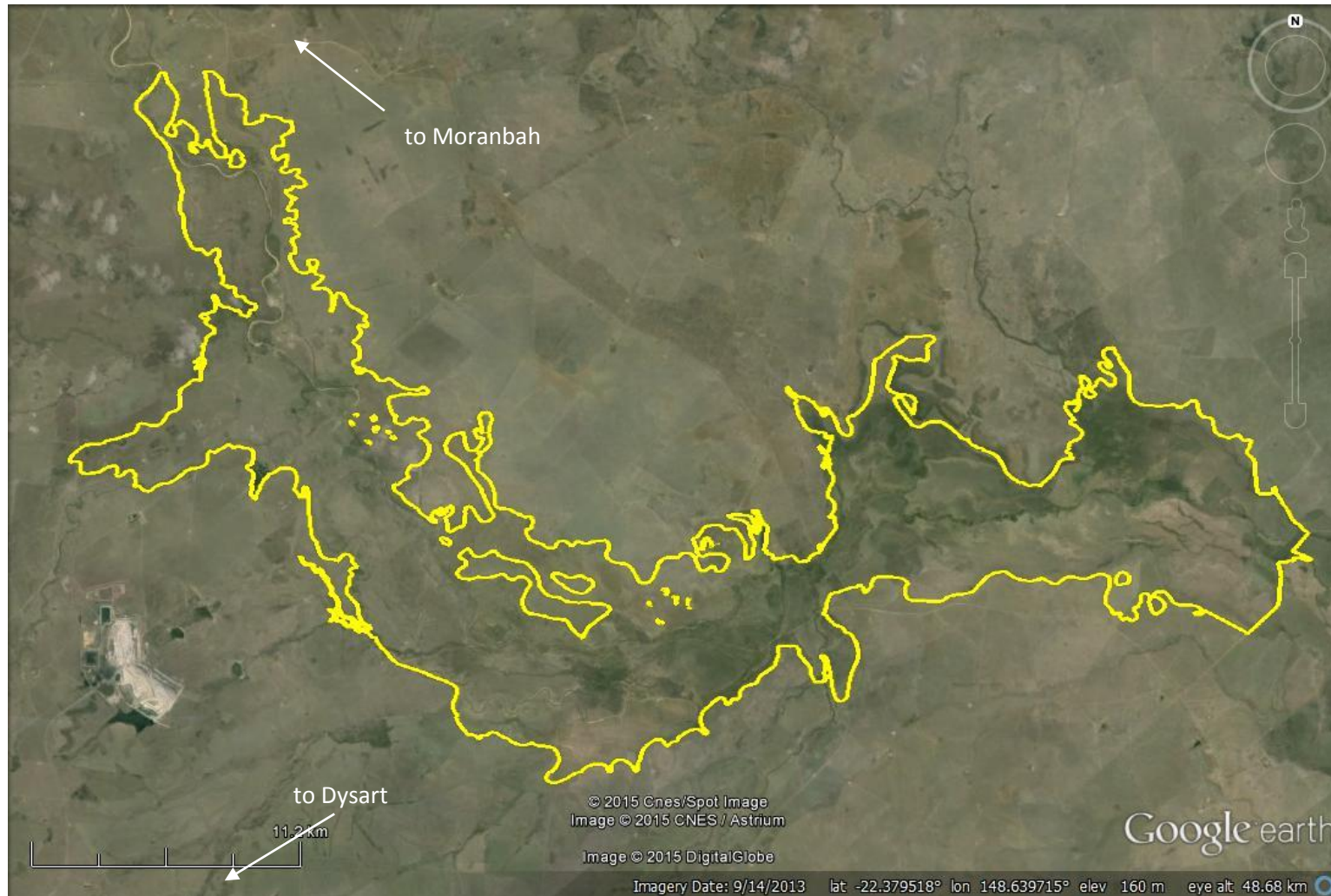
FBA11 Nankin Plain Wetlands (Fitzroyvale, Broadmeadows)



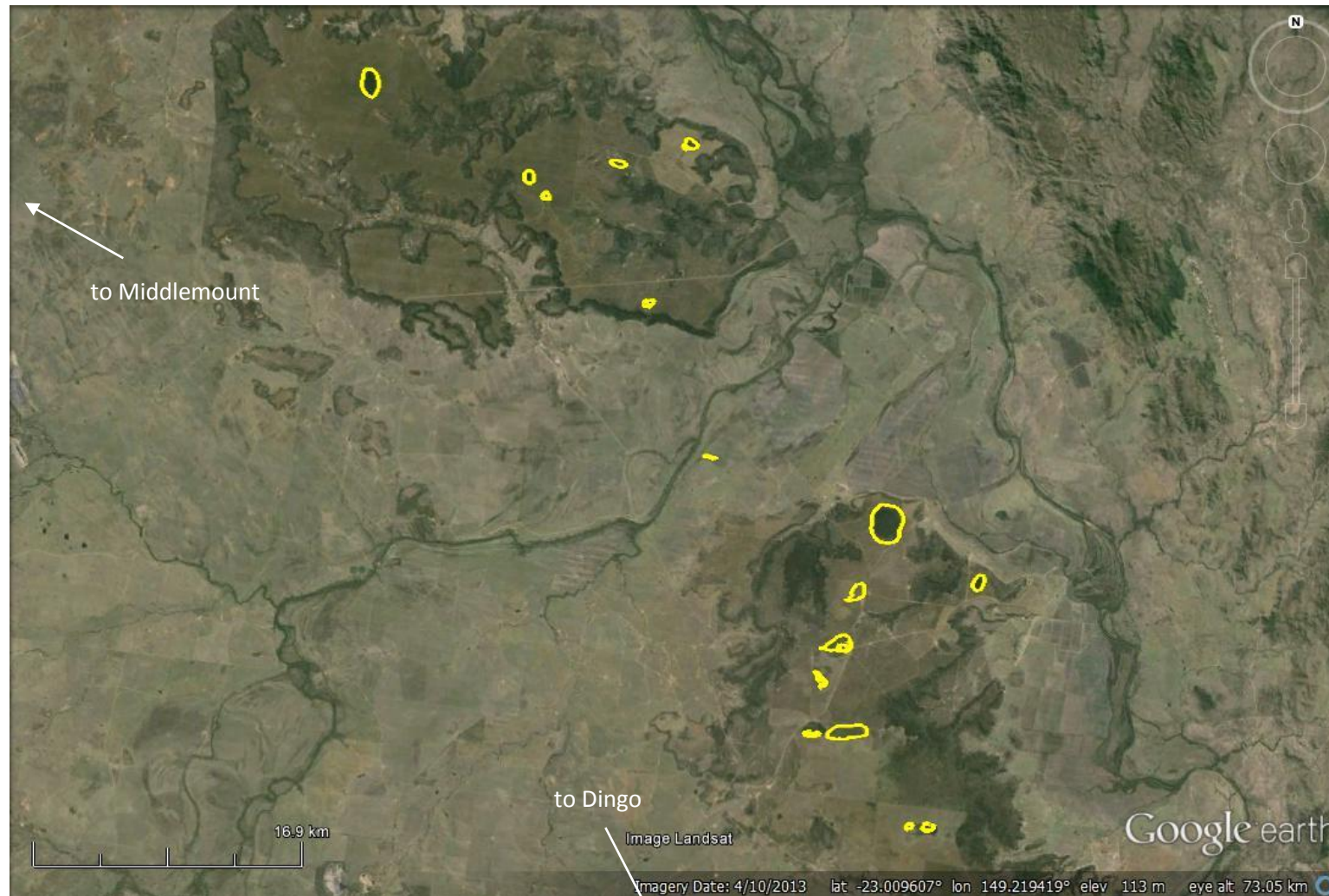
FBA12 Twelve Mile Creek Wetlands (Bajool)



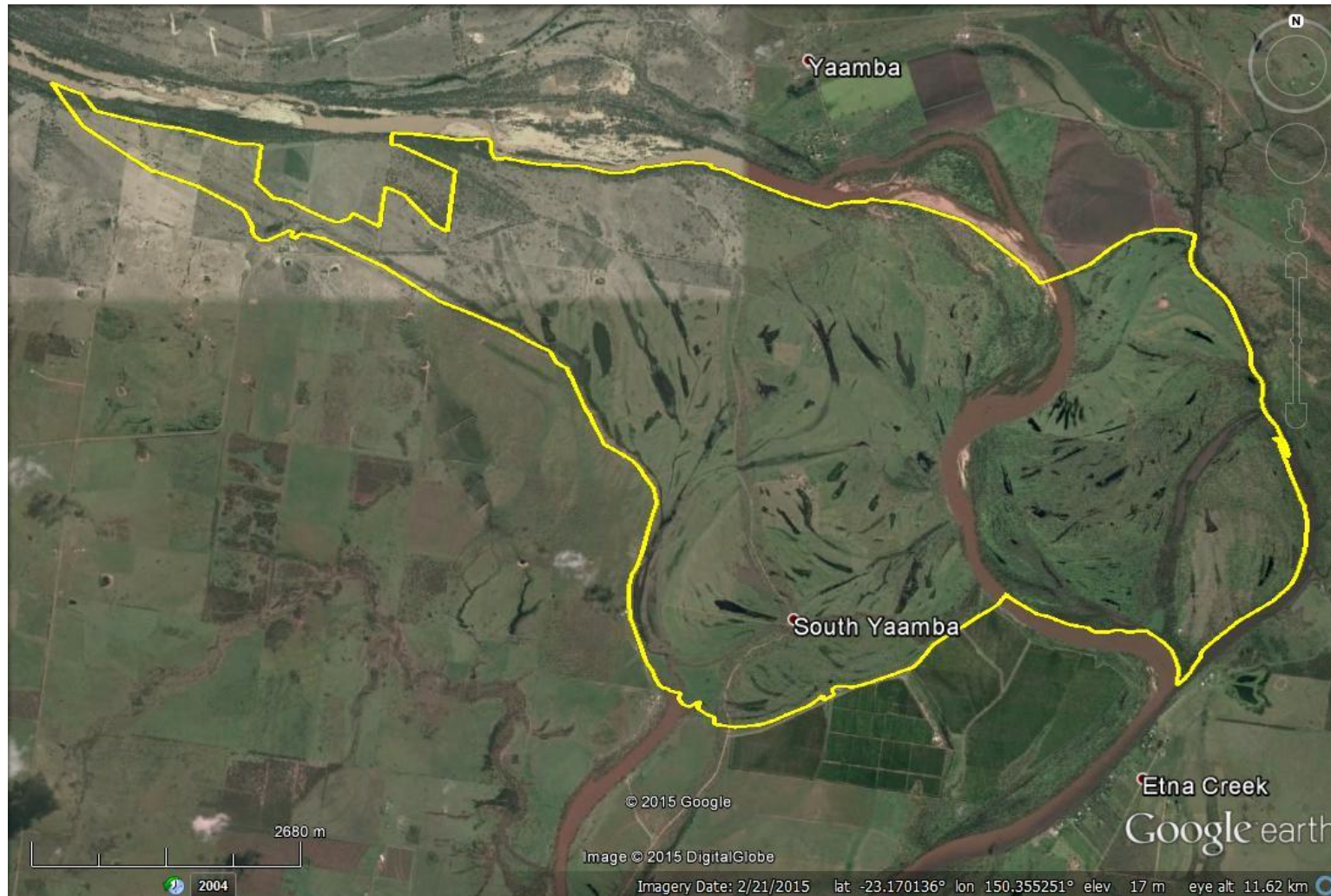
FBA13 Lower Isaac River Floodplain Wetlands



FBA14 Mackenzie Perched Wetlands



FBA15 South Yaamba Wetland Complex



FBA16 Serpentine Creek Wetlands (Fitzroy Delta)



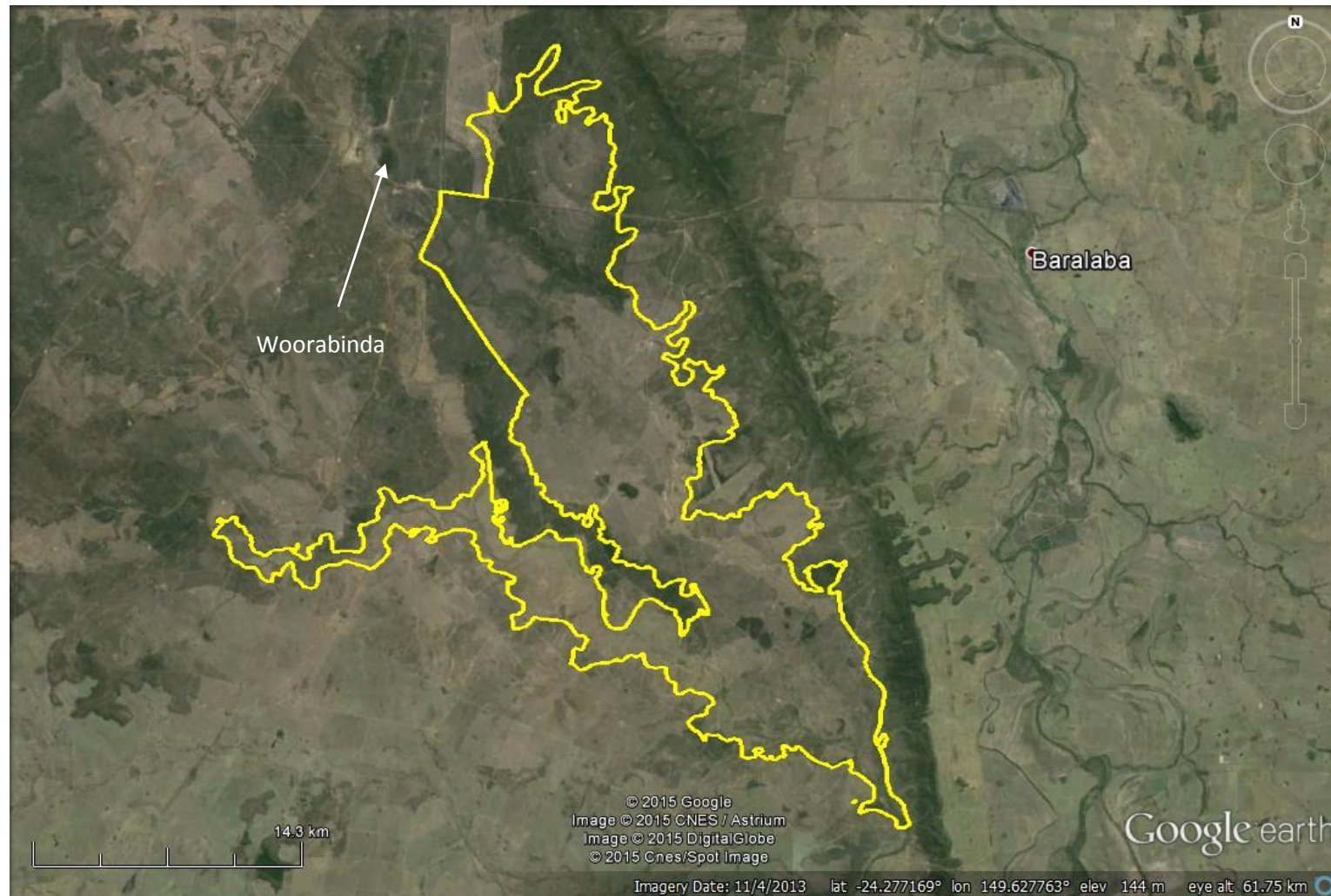
FBA17 Lower Dawson Floodplain Wetlands (Moura to Duaringa)



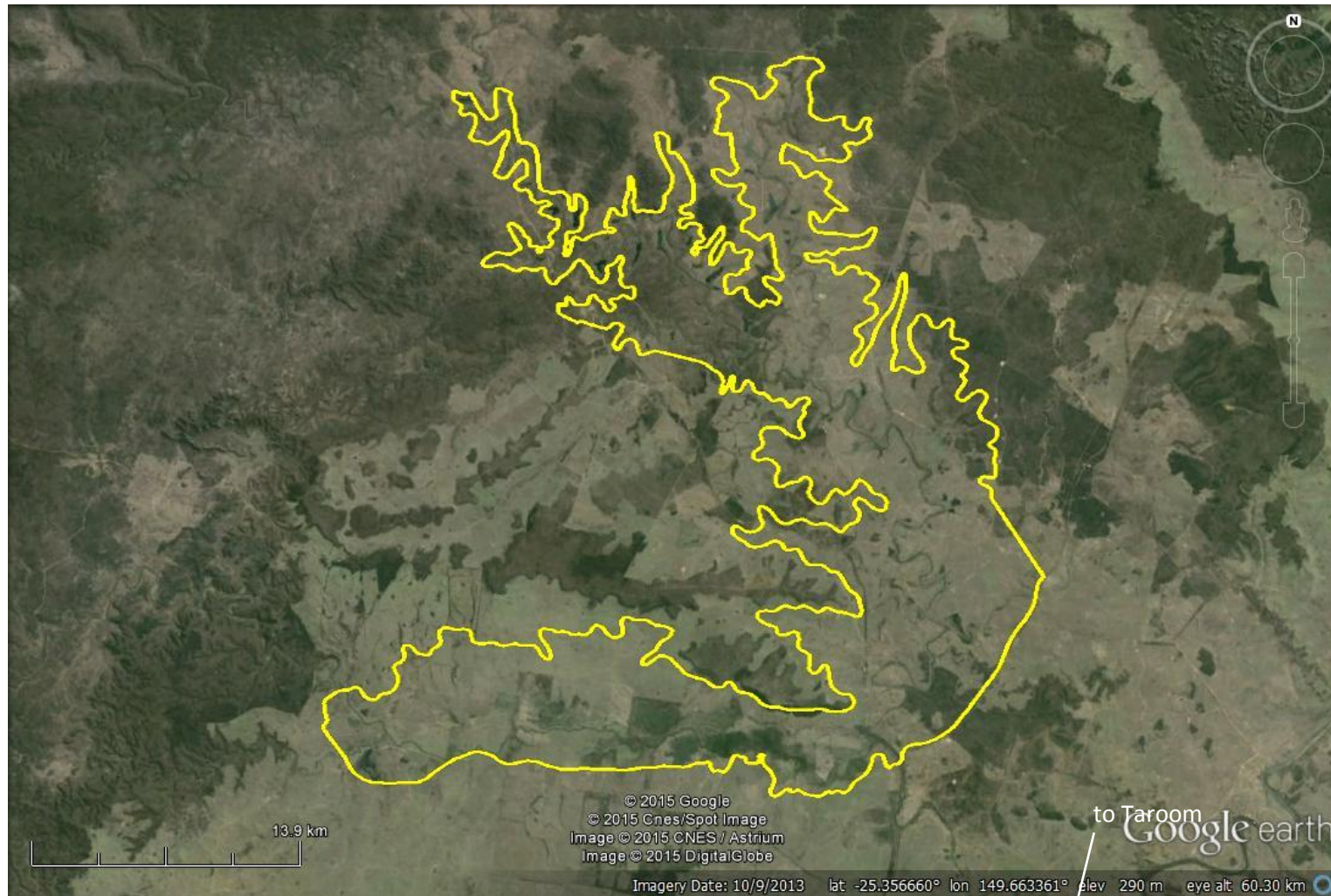
FBA18 Callide-Don Junction Wetlands (Wowan Complex)



FBA19 Perch Creek Wetlands



FBA20 Palm Tree and Robinson Creek Wetlands (Taroom Complex)



Appendix 3. Final criteria scores used in running the DSS

Value Weight		VALUES										THREATS							CAPACITY				
		8										10							10				
		Recreational Value	Indigenous Value	Fishery Habitat	Assimilative Capacity for nutrients and sediments	Populations of Rare or Threatened Taxa	Vegetation Representativeness	Wetland Representativeness	Species Richness / Diversity	Area / Size (m2)	Waterbird Habitat Value	Wetland Condition	Aquatic Habitat Connectivity Restriction	Land-Use Intensity	Land-Use Intensification	Weed Invasion	Water Quality	Point-source pollution	Hydrological Change	Level of protection	Financial Incentives	Industry Land-use Viability	Engagement Capacity
Criteria:																							
Criteria Weight	4	10	9	10	10	8	8	7	2	8	8	8	7	7	8	10	10	6	2	10	2	10	8.0
Total Weight:	32	80	72	80	80	64	64	56	16	64	64	64	70	70	80	100	100	60	20	100	20	100	80.00
Cost/Benefit:	b	b	b	b	b	b	b	b	b	b	b	c	c	c	c	c	c	c	b	b	b	b	b

Clear Sheet

WETID	Wetland Name	REP								AREA				ILU											
FBA01	St.Lawrence	7	Average	8	3	8	0.3555	5	10	4917308	7	5	6	0.0012	5	2	Average	Average	6	9	2	3	10	Average	
FBA02	Waverley & Bar Plains	1	Average	8	8	10	0.5346	6	8	98608934	9	4	8	0	4	3	Average	Average	8	9	2	4	7	Average	
FBA03	Wumalgi Peninsula (BroadSound)	0	Average	8	2	9	0.7926	4	7	109306614	6	6	7	0	4	3	Average	Average	7	9	2	3	5	Average	
FBA04	Glen Prairie	0	Average	6	7	9	0.263	5	7	64396165	7	4	8	0	4	1	Average	Average	8	9	2	4	8	Average	
FBA05	Torilla Plain	3	Average	6	9	10	0.2605	10	9	237769746	10	7	3	0	4	2	Average	Average	5	9	2	4	10	Average	
FBA06	Lower Herbert Creek	0	Average	8	4	1	0.1629	4	3	16588549	2	7	3	0.0048	3	1	Average	Average	1	9	2	3	0	Average	
FBA07	Green Lake Complex	0	Average	8	7	2	0.0715	6	4	242711915	2	4	7	0.0283	8	1	Average	Average	7	0	2	3	7	Average	
FBA08	Lake Mary Complex	3	Average	7	7	2	0.0347	6	5	19885108	7	5	8	0	3	1	Average	Average	4	5	2	3	7	Average	
FBA09	Iwasaki Wetlands	7	Average	8	7	2	5.1618	7	5	45009338	8	4	7	0.0038	7	1	Average	Average	8	9	2	5	7	Average	
FBA10	Joskeleigh &Long Beach	0	Average	8	5	7	0.1914	9	5	79298304	5	6	7	0.0272	5	1	Average	Average	4	9	2	4	0	Average	
FBA11	Nankin Plains (Fitzroyvale, Broadmeadows)	1	Average	8	8	9	0.2031	5	7	79433360	9	3	8	0.0036	3	1	Average	Average	8	9	2	4	8	Average	
FBA12	Twelve Mile Creek (Bajool)	6	Average	7	3	9	0.5024	1	8	1522955	6	7	0	0	3	1	Average	Average	1	5	2	3	8	Average	
FBA13	Lower Isaacs Floodplain	0	Average	7	5	1	0.0929	2	2	390533009	4	4	8	0.0987	4	1	Average	Average	0	0	2	4	0	Average	
FBA14	MacKenzie Perched Wetlands	2	Average	6	1	1	0.1376	8	1	16076559	2	8	0	0.0003	3	0	Average	Average	0	0	2	4	0	Average	
FBA15	South Yaamba Complex	3	Average	6	5	2	0.0526	5	3	33252857	4	5	8	0.0001	4	1	Average	Average	1	0	2	3	0	Average	
FBA16	Serpentine Creek (Fitzroy Delta)	1	Average	7	4	4	0.0163	5	5	103451278	7	4	5	0.001	4	1	Average	Average	6	0	2	3	0	Average	
FBA17	Lower Dawson (Moura to Duaringa)	0	Average	6	5	7	0.0336	2	7	353095031	7	5	8	0.2431	4	1	Average	Average	5	0	2	4	0	Average	
FBA18	Callide-Don Junction	0	Average	6	5	1	0.0243	2	2	193735723	4	4	8	0.2619	4	1	Average	Average	0	0	2	4	0	Average	
FBA19	Perch & Mimosa Creek	0	Average	5	5	1	0.11	5	2	387772311	4	4	8	0.0001	4	1	Average	Average	0	8	2	4	7	Average	
FBA20	Palm Tree & Robinson Creek (Taroom)	8	Average	7	8	4	0.1057	10	8	502225322	8	5	8	0.051	2	1	Average	Average	1	8	2	4	10	Average	

Appendix 4. Ranking of sites according to grouped criteria

By Criteria for Values

Sum	Rank	WETID	Name
4388.0	1	FBA05	Torilla Plain
3813.1	2	FBA20	Palm Tree & Robinson Creek (Taroom)
3809.7	3	FBA02	Waverley & Bar Plains
3670.3	4	FBA09	Iwasaki Wetlands
3498.5	5	FBA11	Nankin Plains (Fitzroyvale, Broadmeadows)
3373.6	6	FBA01	St.Lawrence
3181.1	7	FBA04	Glen Prairie
3145.0	8	FBA10	Joskeleigh & Long Beach
3062.8	9	FBA12	Twelve Mile Creek (Bajool)
3005.1	10	FBA03	Wumalgi Peninsula (BroadSound)
2796.7	11	FBA17	Lower Dawson (Moura to Duaringa)
2762.6	12	FBA08	Lake Mary Complex
2515.0	13	FBA16	Serpentine Creek (Fitzroy Delta)
2374.2	14	FBA07	Green Lake Complex
2169.1	15	FBA15	South Yaamba Complex
2001.5	16	FBA06	Lower Herbert Creek
1921.2	17	FBA19	Perch & Mimosa Creek
1886.2	18	FBA14	MacKenzie Perched Wetlands
1871.9	19	FBA13	Lower Isaacs Floodplain
1728.7	20	FBA18	Callide-Don Junction

By Criteria for Threats

Sum	Rank	WETID	Name
5229.2	1	FBA14	MacKenzie Perched Wetlands
5090.0	2	FBA12	Twelve Mile Creek (Bajool)
4885.3	3	FBA06	Lower Herbert Creek
4567.6	4	FBA19	Perch & Mimosa Creek
4511.7	5	FBA20	Palm Tree & Robinson Creek (Taroom)
4508.0	6	FBA05	Torilla Plain
4507.6	7	FBA15	South Yaamba Complex
4398.0	8	FBA08	Lake Mary Complex
4397.3	9	FBA16	Serpentine Creek (Fitzroy Delta)
4304.3	10	FBA13	Lower Isaacs Floodplain
4249.3	11	FBA10	Joskeleigh & Long Beach
4182.8	12	FBA01	St.Lawrence
4148.5	13	FBA11	Nankin Plains (Fitzroyvale, Broadmeadows)
4088.0	14	FBA04	Glen Prairie
4052.0	15	FBA03	Wumalgi Peninsula (BroadSound)
3931.9	16	FBA09	Iwasaki Wetlands
3928.0	17	FBA02	Waverley & Bar Plains
3868.0	18	FBA18	Callide-Don Junction
3856.3	19	FBA07	Green Lake Complex
3618.2	20	FBA17	Lower Dawson (Moura to Duaringa)

By Criteria for Capacity

Sum	Rank	WETID	Name
1460.0	1	FBA05	Torilla Plain
1440.0	2	FBA01	St.Lawrence
1440.0	2	FBA20	Palm Tree & Robinson Creek (Taroom)
1260.0	4	FBA04	Glen Prairie
1260.0	4	FBA11	Nankin Plains (Fitzroyvale, Broadmeadows)
1180.0	6	FBA09	Iwasaki Wetlands
1160.0	7	FBA02	Waverley & Bar Plains
1160.0	7	FBA12	Twelve Mile Creek (Bajool)
1140.0	9	FBA19	Perch & Mimosa Creek
1060.0	10	FBA08	Lake Mary Complex
960.0	11	FBA07	Green Lake Complex
940.0	12	FBA03	Wumalgi Peninsula (BroadSound)
460.0	13	FBA10	Joskeleigh & Long Beach
440.0	14	FBA06	Lower Herbert Creek
280.0	15	FBA13	Lower Isaacs Floodplain
280.0	15	FBA14	MacKenzie Perched Wetlands
280.0	15	FBA17	Lower Dawson (Moura to Duaringa)
280.0	15	FBA18	Callide-Don Junction
260.0	19	FBA15	South Yaamba Complex
260.0	19	FBA16	Serpentine Creek (Fitzroy Delta)

Our country, Our future.

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