



Fish Barrier Prioritisation Update

2015

Prepared for Fitzroy Basin Association Incorporated by Tim Marsden



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1. Introduction

In 2007–2008 Fisheries Queensland on behalf of Fitzroy Basin Association Inc. (FBA) undertook the Fitzroy Basin Fish Barrier Prioritisation Project (FBFBPP). This project identified, assessed and prioritised all barriers to fish migration in the FBA region. The project was the first comprehensive fish barrier prioritisation project undertaken in the region (Moore & Marsden 2008) and only the second undertaken in Queensland. The primary objective of the prioritisation was to provide direction on the barriers most suitable for remediation in the region. The prioritisation project led to the remediation of fish passages at a number of barriers throughout the region, primarily through the construction of fishways. Fishways have been constructed on streams such as Amity (Figure 1a), Water Park (Figure 1b), Stoney, Moores (Figure 1c) and Raglan (Figure 1d) creeks, and have been effective at providing passage past those barriers (Ferguson et al. 2008; Moore & Marsden 2010; Moore & Marsden 2011; Donaldson et al. 2012; Moore & Marsden 2013).



Figure 1. Four fishways constructed in the FBA Region. A) Amity Creek rock ramp fishway (top left), b) Water Park Creek vertical slot fishway (top right), c) Moores Creek rock ramp fishway (bottom left) and d) Raglan Creek rock ramp fishway (bottom right).

FBA is currently undertaking a review of the progress made since the last barrier prioritisation and has commissioned a re-prioritisation process to provide refined guidance for future remediation works and to assist with focussing on catchments with the greatest need for attention.

2. 2008 Fitzroy Basin Fish Barrier Prioritisation Project

In 2007–2008 Fisheries Queensland on behalf of FBA undertook the Fitzroy Basin Fish Barrier Prioritisation Project (FBFBPP). This project was the first comprehensive fish barrier prioritisation project undertaken in the FBA region. The purpose of the FBFBPP was to identify all potential barriers to fish passage in the FBA region and prioritise these barriers for remediation. Barriers to fish passage identified included any structure that impeded the movement of fish, such as culverts, pipes, road crossings, weirs and dams.

The free movement of fish through river systems is of great importance for the fish communities of the Fitzroy Basin. Around 49 fish species are found in the basin's freshwater streams. Almost half (23) of the species found in the region's streams are diadromous, requiring free access to estuarine or marine waters to successfully complete their life cycles. The remaining species complete their entire life cycle in freshwater, with a large proportion of these (23) undertaking significant migrations. Fish migration between marine and freshwater habitats and within freshwater habitats is therefore a vitally important aspect of the life cycle of freshwater fishes of the basin.

Barriers affect fish community condition by preventing movement of fish species that require free passage along river systems to fulfil a number of key life stage requirements. This movement is essential for:

- maintaining populations of diadromous species, which require free passage between freshwater and marine habitats for reproduction purposes i.e. barramundi, sea mullet and mangrove jack.
- maintaining genetic diversity by preventing fragmentation of fish populations, which can leave rare and threatened fish species susceptible to disease and extinction.
- migrating adult fish to access habitats for feeding and reproduction purposes.
- migrating juvenile fish species to reach upstream nursery habitats.

Barriers preventing fish passage contribute to the loss of species diversity within fish communities, severely impacting the health of the region's aquatic ecosystems and is one of the main impacts that humans have had on the fish communities of the region.

The FBFBPP incorporated a three assessment process to prioritise barriers from most important through to least important based on the biological, social and economic benefits and the cost of remediation. A total of 10,632 potential barriers to fish passage were identified in the FBA region, with 10,502 potential barriers recorded in-stream (Figure 2). The first stage of the prioritisation process used remote geographic information systems (GIS) assessment to refine the large number of barriers into a list of 150 potential barriers for field appraisal. After field inspections were completed and a further biological assessment undertaken, 59 of the 150 potential barriers were determined to be actual barriers to fish migration. Further socio-economic assessment of the social, economic and technical feasibility of construction of fish passage remediation at the 59 barriers produced a list suggesting the top 30 barriers requiring remediation in the Fitzroy Basin.

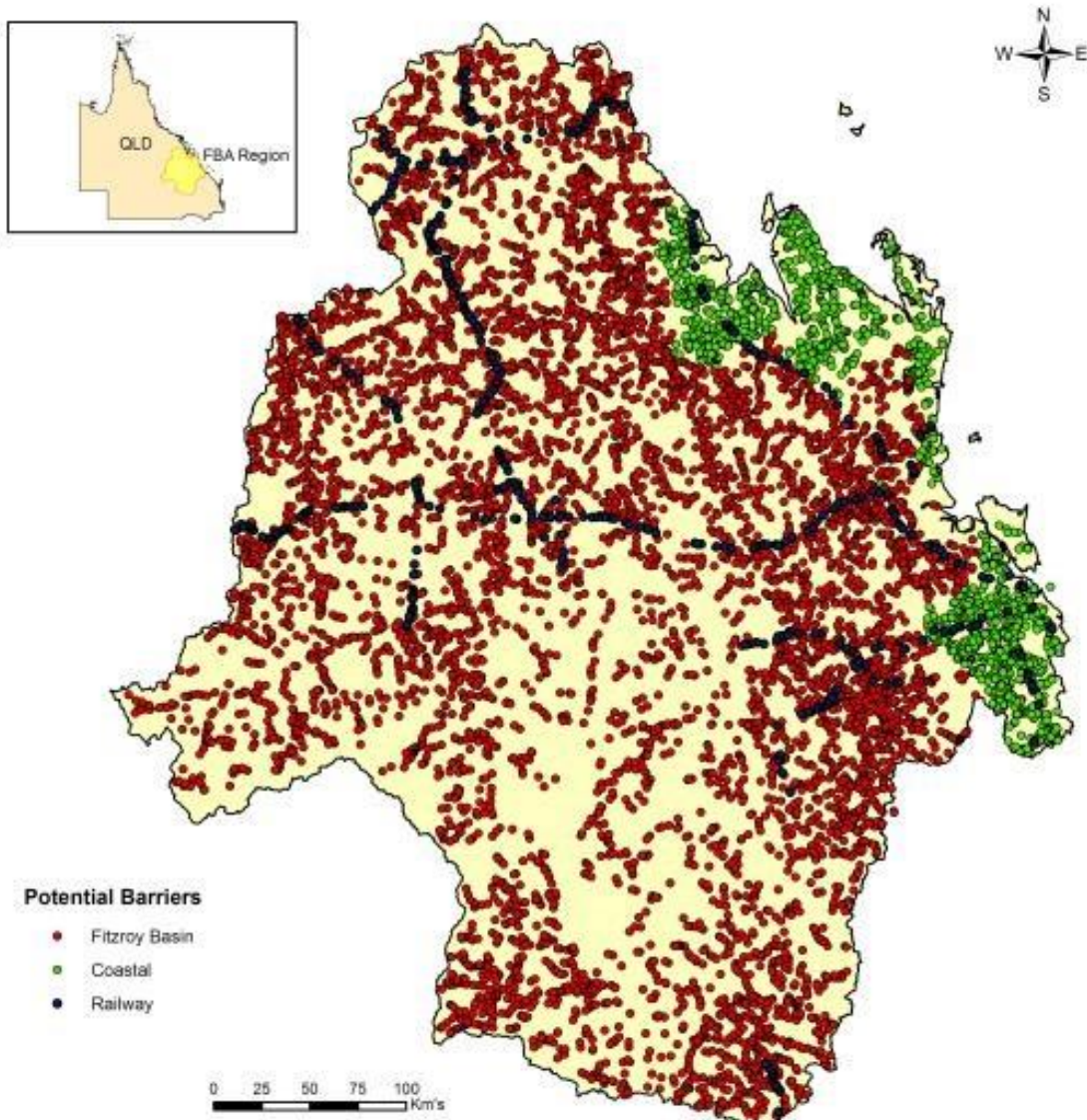


Figure 2. Potential barriers to fish passage located on streams in the Fitzroy Basin.

3. Results

3.1 Remote Assessment

A total of 10,502 potential in-stream barriers were analysed through GIS during the first stage of the prioritisation process. The highest score for this assessment was 31 out of a possible 34 points, which was attained by the Fitzroy Barrage (Table 1). A further 70 barriers scored between 20 and 30 points, while the remaining 10,431 potential barriers scored less than 20 points (Table 1). The majority of barriers within the top 20 barriers after the remote assessment were located on the Fitzroy River (Table 2).

Table 1. The number of potential barriers identified at each score from the highest score to the lowest score.

Score	Number Potential barriers	Score	Number Potential barriers
31	1	24	11
30	1	23	5
29	0	22	19
28	2	21	12
27	3	20	8
26	7	19	28
25	2	18 or less	10,403

Table 2. The top 20 barriers identified after GIS prioritisation of barriers during stage 1.

Priority	Barrier Reference Number	Stream Name	Total Score
1	6474	Fitzroy R	31
2	8785	Styx R	30
3	1	Fitzroy R	28
4	524	Fitzroy R	28
5	523	Fitzroy R	27
6	6169	Serpentine Lagoon	27
7	9348	Amity Ck	27
8	3122	Fitzroy R	26
9	3952	Fitzroy R	26
10	6168	Serpentine Lagoon	26
11	9095	Herbert Ck	26
12	9393	St Lawrence Ck	26
13	9529	Halfway Ck (Black)	26
14	9722	Boyne R	26
15	4455	Swan Ck	25
16	8906	Shoalwater Ck	25
17	78	Raglan Ck	24
18	535	Amity Ck	24
19	1000	Boyne R	24
20	3951	Fitzroy R	24

3.2 Field Appraisal and Biological Assessment

A total of 136 potential barriers were validated in the field during the second stage of the prioritisation process. Of these, 59 were found to be barriers to fish migration. The 59 barriers (Figure 3) were priority ranked (Table 3) in accordance with the biological criteria set out for the biological assessment. As the Fitzroy River is the major waterway in the region, many of the highest priority barriers were found on this river (Table 3).

Table 3. Top 59 ranked barriers to fish migration after stage 2.

Priority	Barrier ID	Stream Name	Barrier Name/Type	Stage 2 Score
1	6474	Fitzroy R	Fitzroy Barrage	49
2	1	Fitzroy R	Eden Bann Weir	45
3	9348	Amity Ck	Tidal Barrage/Bund Wall	45
4	524	Fitzroy R	Redbank Crossing	43
5	1000	Boyne R	Mann's Weir/Tidal Barrage	42
6	523	Fitzroy R	Hanrahan's Crossing	42
7	3952	Fitzroy R	Craiglee Crossing	41
8	3951	Fitzroy R	Glenroy Crossing	40
9	9001	Boyne R	Awonga Dam	40
10	6169	Serpentine Lagoon	Tidal Barrage/ Bund wall	40
11	9393	St Lawrence Ck	St Lawrence Weir	40
12	535	Amity Ck	Wumalgi Rd/Pipes	39
13	8652	Calliope R	Blackgate Road Crossing	39
14	8945	Waterpark Ck	Waterpark Ck Weir	39
15	2	Mackenzie R	Tartrus Weir	38
16	525	Mackenzie R	Duaringa Apis Ck Rd Crossing	38
17	8618	Calliope R	Mt Alma Rd Crossing/Culverts	38
18	8677	Clairview Ck	Clairview Weir	38
19	3	Mackenzie R	Bingegang Weir	37
20	9002	Cattle Ck	Old Hwy/Pipes	37
21	8354	Boyne R	Pikes Crossing	36
22	25	Raglan Ck	Langmom Rd/Pipes	35
23	9718	Lake Callemondah	Barrage/Weir	35
24	4	Mackenzie R	Bedford Weir	34
25	22	Raglan Ck	Upper Raglan/Pipes	34
26	527	Stony Ck	Creek Crossing-Byfield State Forest	34
27	534	Montrose Ck	Weir/Town water supply	34
28	8716	Amity Ck	Old Highway/Pipes	34
29	9441	Clairview Ck	Creek Crossing	34
30	9392	Wran Ck	Weir/Pipes	34
31	5	Dawson R	Neville Hewitt Weir	33
32	1042	Bridge Ck	Wumalgi/Pipes	33
33	85	8 Mile Ck	Bajool Weir	33
34	3015	Mackenzie R	Tartrus Road Crossing	33
35	9165	Unnamed Ck	Rundle Ranges	33
36	82	12 Mile Ck	12 Mile Ck Rd/ Pipes	32
37	4152	Dawson R	Boolburra/Pipes	32
38	8731	Stoodleigh Ck	Barretts Rd/Pipes	32
39	528	Stony Ck	Creek Crossing-Byfield S.Forest	31

Priority	Barrier ID	Stream Name	Barrier Name/Type	Stage 2 Score
40	9629	Sandy Ck	Next to railline/Pipes	31
41	526	Lake Callemondah	Creek Crossing	30
42	1032	Oakey Ck	Archer Station/Pipe	30
43	8784	Tooloombah Ck (Styx)	Rocky Crossing	30
44	9000	Ewen Ck	Stanage Bay Rd/Pipes	30
45	529	Stony Ck	Daddy's Crossing/Byfield State Forest	29
46	9192	Unnamed Ck	Wydham Rd-Gladstone/Pipes	29
47	9550	Block Ck	Stanage Bay Rd/Pipes	29
48	6	Dawson R	Moura Weir	28
49	69	12 Mile Ck	2nd Barrier u/stream hwy-Langmom Rd/Pipes	28
50	531	Moore's Ck	Botanical Gardens/Pipes	28
51	6348	Dawson R	Nun's Crossing	28
52	9041	Coorooman Ck	Coorooman Ck Rd/Culverts	28
53	6144	12 Mile Ck	3rd Barrier u/stream hwy-Langmom Rd/Pipes	27
54	6198	Nankin Ck	Thompsons Pt Rd/ Culverts	27
55	8642	Unnamed Ck	Harvey St - Gladstone/Pipes	27
56	530	Stony Ck	Freeman's Crossing/Byfield S.Forest	26
57	532	Moore's Ck	Simpson St/Pipes	25
58	8606	Calliope R	Pipes	25
59	2664	Dawson R	Kianga River Rd/Pipes	24

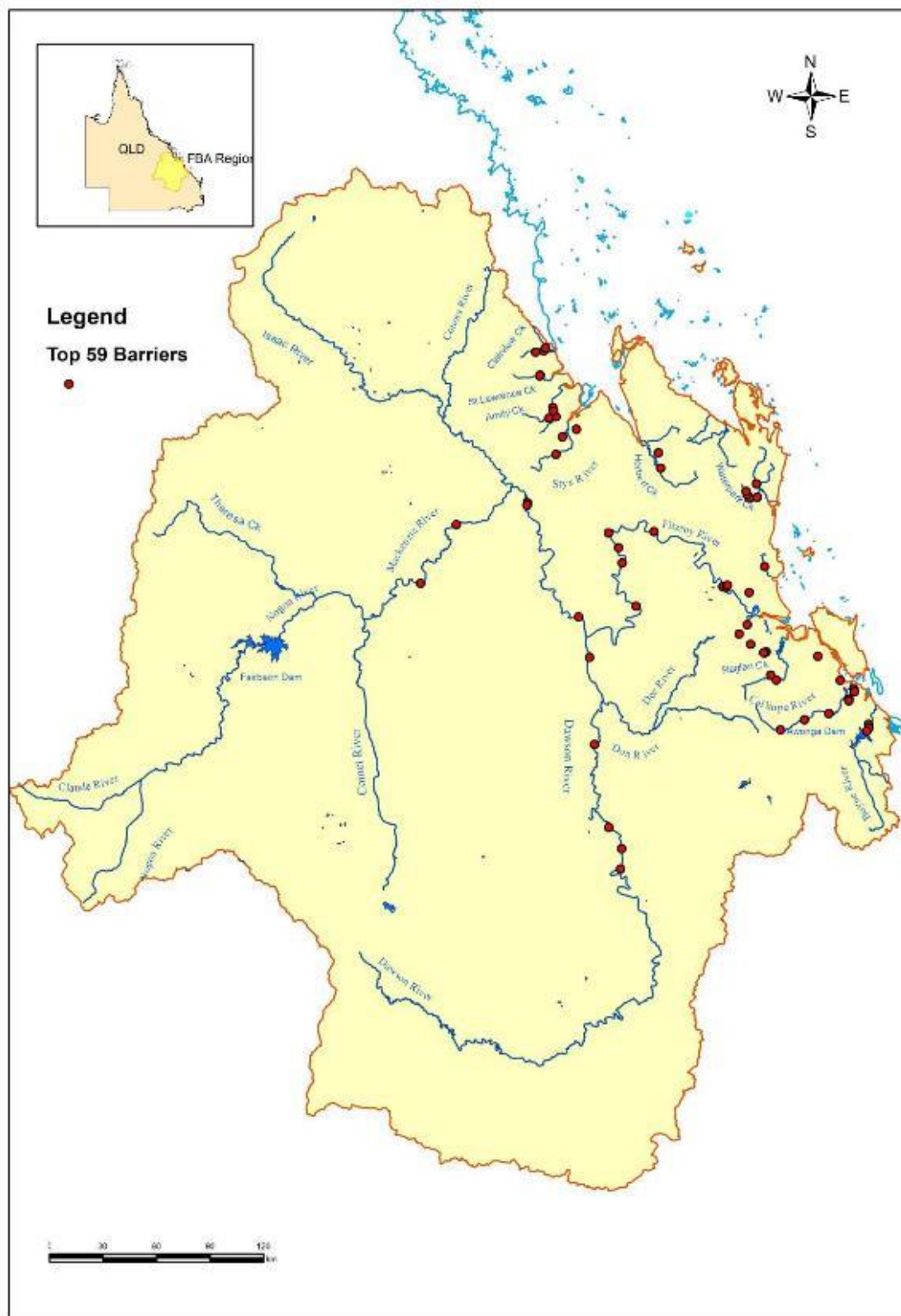


Figure 3. Location of the top 59 barriers to fish migration from stage two of the prioritisation process.

3.3 Socio-Economic Assessment

The third and final stage of the barrier prioritisation process involved analysing the top 59 barriers after the biological assessment with a number of economic, social and technical criteria. Each of the 59 barriers were prioritised in accordance with the scoring system set out for stage three of the process (Moore & Marsden 2008). The end product of the prioritisation process was a priority list of the top 30 ranked barriers to fish passage in the FBA region (Table 4 and Figure 4).

Table 4. Top 30 ranked barriers to fish migration in the FBA region in priority order for future remediation.

Priority	Barrier ID	Stream Name	Barrier Name/Type	Total Adjusted Score
1	524	Fitzroy R	Redbank Crossing	159.3
2	1000	Boyne R	Mann's Weir/Tidal Barrage	157.4
3	9348	Amity Ck	Tidal Barrage/Bund wall	149.9
4	3952	Fitzroy R	Craiglee Crossing	148.8
5	523	Fitzroy R	Hanrahan's Crossing	147.4
6	3951	Fitzroy R	Glenroy Crossing	146.9
7	9393	St Lawrence Ck	St Lawrence Weir	146.9
8	535	Amity Ck	Wumalgi Rd/Pipes	145
9	9002	Cattle Ck	Old Hwy/Pipes	144.5
10	8652	Calliope R	Blackgate Rd/Pipes	141.7
11	6474	Fitzroy R	Fitzroy Barrage	140.9
12	82	8 Mile Ck	Bajool Weir	138.2
13	85	12 Mile Ck	12 Mile Ck Rd/ Pipes	136.8
14	22	Raglan Ck	Upper Raglan/Pipes	135.4
15	8716	Amity Ck	Old Hwy/Pipes	135.4
16	8945	Waterpark Ck	Water Park Ck Weir	135
17	5	Dawson R	Neville Hewitt Weir	133.5
18	1	Fitzroy R	Eden Bann Weir	133.2
19	8618	Calliope R	Mt Alma Rd Crossing/Pipes	133.1
20	25	Raglan Ck	Langmom Rd/Pipes	127.3
21	6169	Serpentine Lagoon	Tidal Barrage	126.9
22	525	Mackenzie R	Duaringa Apis Ck Rd Crossing	126.4
23	8677	Clairview Ck	Weir	126.4
24	526	Lake Callemondah	Barrage	124.4
25	1042	Bridge Ck	Wumalgi/Pipes	123.5
26	9441	Clairview Ck	Road Crossing	122
27	3015	Mackenzie R	Tartrus Road Crossing	120.1
28	9165	Unnamed Ck	Rundle Ranges	120.1
29	2	Mackenzie R	Tartrus Weir	119.7
30	4	Mackenzie R	Bedford Weir	118.7

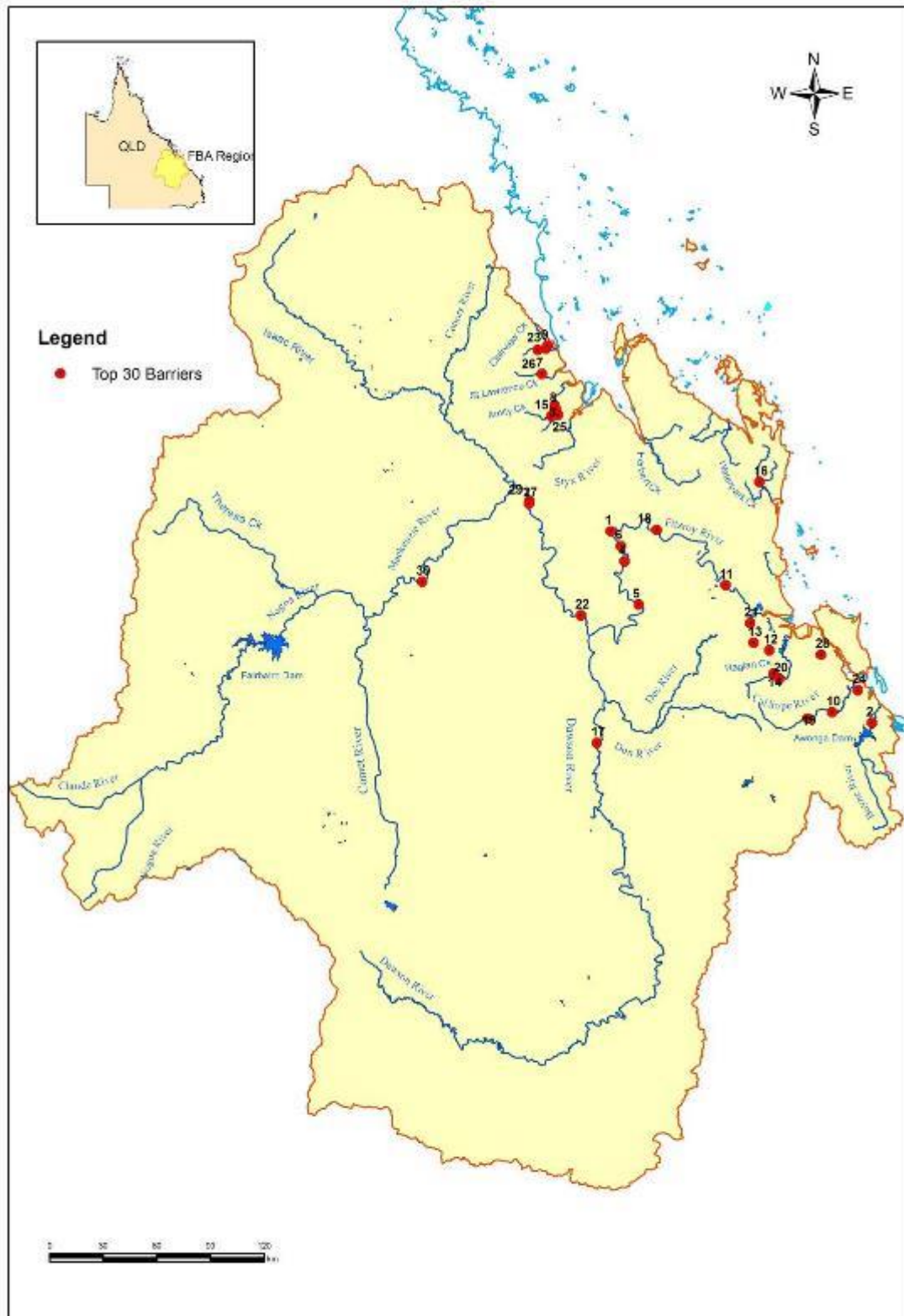


Figure 4. Location and priority rank of the top 30 barriers to fish migration in the FBA region.

4. 2015 Re-Assessment

To update the prioritisation that was undertaken in 2008, data from that assessment was reanalysed to incorporate changes that have occurred in the intervening period. This data includes further information on the barriers transparency to fish, especially if the barrier has had a fishway installed on the barrier since that time. As the 2015 re-assessment is intended to represent barriers having the greatest impact on fish communities, the re-assessment has been completed on the top 59 barriers at the completion of the biological assessment, rather than the final top 30 barriers of the 2008 prioritisation. As the 2008 prioritisation was specifically used to identify barriers that were technically feasible and affordable to FBA to remediate, it was decided that utilising the biological assessment stage would provide a more suitable list of barriers, as the focus of the prioritisation has changed slightly from the 2008 project.

In total, 13 structures have been recognised for the remediation actions that have been undertaken on them, resulting in their relegation from the prioritisation. These structures have all had fish passage provided to a greater or lesser degree, with some now completely removed as barriers, while others have partial barriers remaining. The structures that have been removed from the 2008 prioritisation have been listed in Table 5 and are shown on the map in Figure 5.

Table 5. List of barriers that have been reassessed due to remediation actions undertaken since the last prioritisation. Table indicates action type and current transparency of the barrier.

Barrier ID	Stream Name	Barrier Name/Type	Remediation action	Transparency
6474	Fitzroy R	Fitzroy Barrage	Fishway installation	Low
1	Fitzroy R	Eden Bann Weir	Fishway installation	Moderate
5	Dawson R	Neville Hewitt Weir	Fishway installation	High
6	Dawson R	Moura Weir	Fishway installation	Moderate
9348	Amity Ck	Tidal interface crossing/Bund	Fishway installation	Very High
1042	Bridge Ck	Wumalgi/Pipes	Fishway installation	Very High
9002	Cattle Ck	Old Hwy/Pipes	Removal	Very High
9441	Clairview Ck	Creek Crossing	Removal	Very High
531	Moore's Ck	Botanical Gardens/Pipes	Fishway installation	High
527	Stony Ck	Creek Crossing-Byfield State Forest	Fishway installation	Very High
529	Stony Ck	Daddy's Crossing/Byfield State Forest	Fishway installation	Very High

8945	Water Park Ck	Water Park Ck Weir	Fishway installation	Moderate
9392	Wran Ck	Weir/Pipes	Fishway installation	Moderate

The remaining 46 barriers have then been re-prioritised based on the previous scores they achieved within the 2008 prioritisation. The 2015 re-prioritised list is shown in Table 6 and on the map in Figure 5. Scores for these barriers were adjusted to take into account the removal of the 13 barriers on which remediation has been undertaken. The main readjustment related to the 'number barriers downstream' question, with the removal of the 13 barrier opening up access to these remaining barriers.

Table 6. List of the 2015 top 59 reassessed barriers.

Priority	Barrier ID	Stream Name	Barrier Name/Type
1	524	Fitzroy R	Redbank Crossing
2	1000	Boyne R	Mann's Weir
3	523	Fitzroy R	Hanrahan's Crossing
4	3951	Fitzroy R	Glenroy Crossing
5	3952	Fitzroy R	Craiglee Crossing
6	535	Amity Ck	Wumalgi Rd/Pipes
7	9001	Boyne R	Awonga Dam
8	6169	Serpentine Lagoon	Tidal interface bund wall
9	9393	St Lawrence Ck	St Lawrence Weir
10	8652	Calliope R	Blackgate Rd/Pipes
11	8618	Calliope R	Mt Alma Rd Crossing/Pipes
12	8677	Clairview Ck	Clairview Weir
13	2	Mackenzie R	Tartrus Weir
14	525	Mackenzie R	Duaringa Apis Ck Rd
15	3	Mackenzie R	Bingegang Weir
16	8354	Boyne R	Pikes Crossing
17	8716	Amity Ck	Old HWY/Pipes
18	9718	Lake Callemondah	Barrage
19	25	Raglan Ck	Langmom Rd/Pipes
20	4	Mackenzie R	Bedford Weir
21	534	Montrose Ck	Weir/Town water supply
22	22	Raglan Ck	Upper Raglan/Pipes
23	85	8 Mile Ck	Bajool Weir
24	9165	Black Swan Ck	Flinders Rd-Rundle Ranges
25	3015	Mackenzie R	Tartrus Road Crossing
26	4152	Dawson R	Boolburra/Pipes
27	528	Stony Ck	Byfield State Forest
28	82	12 Mile Ck	12 Mile CK Rd/ Pipes
29	8731	Stoodleigh Ck	Barretts Rd/Pipes
30	9629	Sandy Ck	Next to rail line/Pipes
31	530	Stony Ck	Freeman's Crossing

32	9000	Ewen Ck	Stanage Bay Rd/Pipes
33	526	Lake Callemondah (Police Ck)	Creek Crossing
34	1032	Oakey Ck	Archer Station/Pipe
35	8784	Tooloombah Ck (Styx)	Rocky Crossing
36	6348	Dawson R	Nun's Crossing
37	9550	Block Ck	Stanage Bay Rd/Pipes
38	9192	Unnamed	Wydham Rd-Gladstone/Pipes
39	69	12 Mile Ck	2nd Barrier u/stream Pipes
40	9041	Coorooman Ck	Coorooman Ck Rd/Culverts
41	6144	12 Mile Ck	3rd Barrier u/stream Pipes
42	6198	Nankin Ck	Thompsons Pt Rd/ Culverts
43	8642	Unnamed	Harvey St - Gladstone/Pipes
44	532	Moores Ck	Musgrave St weir
45	2664	Dawson R	Kianga River Rd/Pipes
46	8606	Calliope R	Pipes

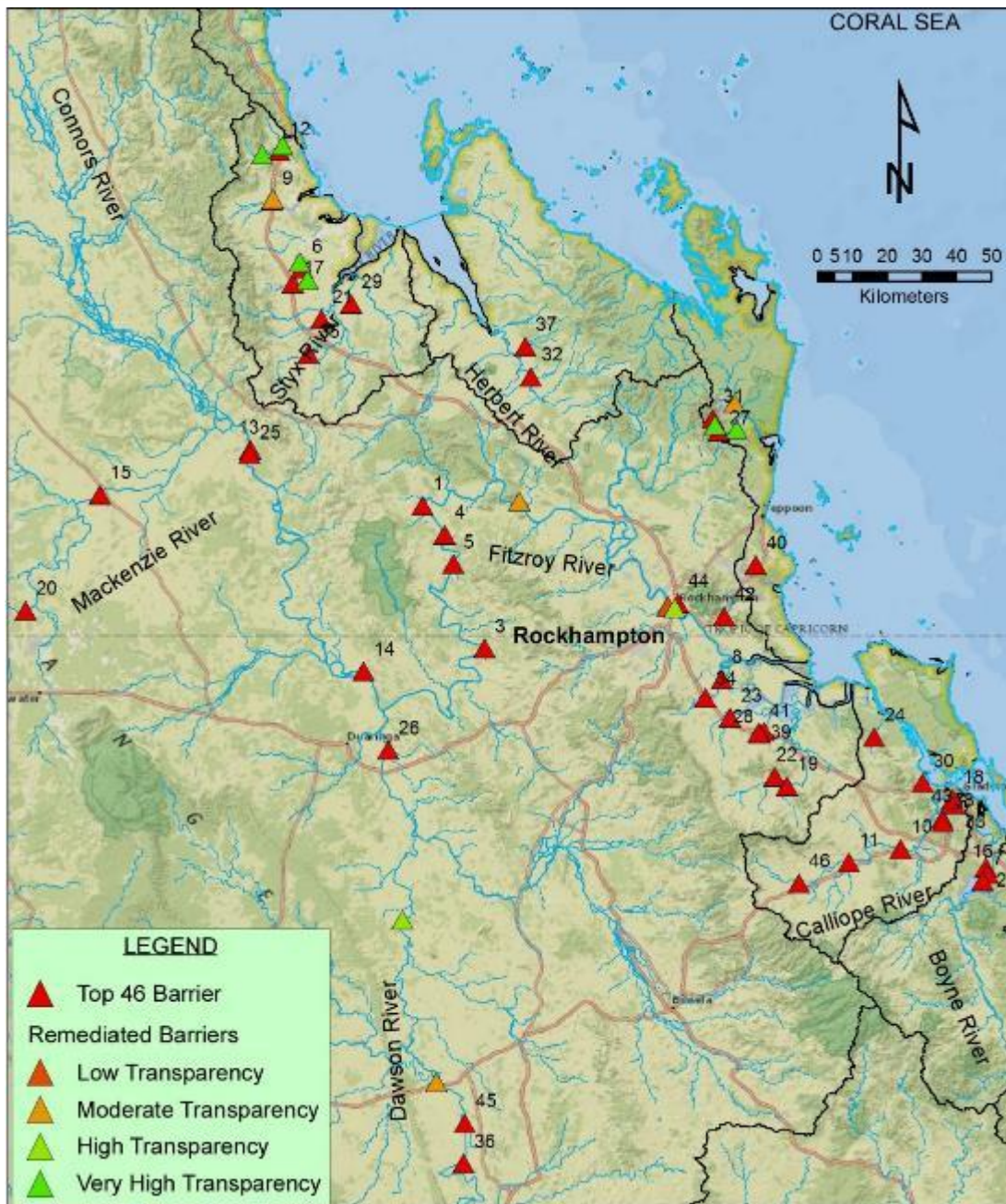


Figure 5. Location of the 2015 top 46 barriers and the 13 barriers remediated since the 2008 prioritisation.

5. Discussion

The re-assessment of barriers identified in the 2008 prioritisation process has produced a re-organised list of barriers that still impact fish communities within the basin. Although remediation through the construction, upgrade or recommissioning of fishways has removed some barriers since the original prioritisation, there is still considerable work to be undertaken to remove high priority barriers.

Currently the highest priority barriers are those found on major streams of the region such as the Fitzroy, Boyne, Calliope and Mackenzie rivers, as well as some smaller barriers on St Lawrence, Amity and Clairview creeks. Each of these barriers is having a continual impact on the fish communities of these river systems, particularly the diadromous species. The remediation of these barriers should be given a high priority within the systems repair programme to reduce their impact and increase the productivity of the river systems of the Fitzroy Basin.

5.1 Gaps Analysis

Through the re-assessment of the 2008 data and analysis of the remediation actions undertaken to date, it is apparent that there are a number of issues that need to be addressed. This will ensure completeness of the barrier prioritisation process in the region and perpetuate the ongoing success of remediation actions undertaken. Gap analysis for the process has identified the following issues.

5.2 Incomplete Data

A review of the 2008 data has identified a number of barriers that are now known, but were not identified in the original prioritisation. At that time, the only imagery available of the entire region was SPOT 5 satellite imagery. While this allowed the identification of most barriers, there are a number of barriers that were not picked up in the identification process due to the low resolution of imagery, the presence of obscuring structures such as trees or through the fact that they are new barriers. As there is now a ready availability of high resolution imagery, the task of identifying these barriers has been made much simpler. It is recommended that a more thorough re-assessment that includes identifying and scoring these obscured/new barriers be undertaken. This will provide a more complete picture of the barriers of highest priority, as currently some barriers that should be in the top 46 are not accounted for.

5.3 Upland Rivers

The barrier prioritisation process has been undertaken with a distinct coastal flavor. Diadromous fish must return to the sea at some point in their life cycles and as such, barriers that prevent return migrations from the sea can have a significant impact on the diadromous species upstream, sometimes leading to their extinction in these reaches. Potadromous species are not as significantly

affected as they can maintain populations either side of a barrier, because they generally can breed in each location. The 2008 prioritisation deliberately focused on barriers that affected these diadromous migrations the most, and as such, there are many smaller barriers in the coastal zone that are given a high priority. This has, however, resulted in few high priority barriers in streams such as the Dawson and Mackenzie rivers. To address this problem, consideration should be given to undertaking prioritisation processes for each of the larger catchments in the upper river systems to provide a better balance between the coastal and upland catchments and to encourage remediation in these upper catchments where free movement of potadromous species is very important.

5.4 Wetland Barriers

Wetlands in the FBA region are considered to be very important fish habitats (Figure 6), hence, potential barriers (Figure 6) on these lentic habitats may have a great impact on fisheries production and wetland operation. Wetland barriers to fish migration were not considered as part of the 2008 project objectives and as such wetland barriers in the region were not prioritised. In a more recent prioritisation (Marsden et al. 2014), wetlands barriers have been scored along with stream barriers, providing a mixed prioritisation. This was achievable through new data assessments that made the comparison of wetland barriers to stream barriers achievable. These data assessments were not available at the time of the 2008 prioritisation.

It is critically important that off-stream barriers are identified and prioritised at some stage in the future as many of these habitats are located on coastal wetlands, which are important nursery areas for catadromous species such as barramundi and tarpon. It is recommended that a new assessment that identifies and scores these wetland barriers be undertaken. This will provide a complete picture of all the wetland barriers in the region and those of highest priority for remediation.



Figure 6. Left. Tidal interface ponded pasture (Nankin) at the mouth of the Fitzroy River. Right. Barrier to fish migration (pipe), on a tidal interface ponded pasture at the mouth of Water Park Creek.

5.5 Ongoing Operation and Maintenance

Careful monitoring of those barriers that have been remediated should also be undertaken to ensure they operate efficiently. Many of these remediated barriers do not provide free passage to the same extent as an open waterway even after the installation of a fishway. Smaller structures remediated with full width, low slope fishways are likely to be highly transparent (passable) to fish, while large structures, even with successful fishways, may have only moderate or low transparency. The continued operation of these less transparent fishways must be monitored to ensure they operate as efficiently as possible.

The operation and maintenance of fishways has always been a problematic area within Queensland, with many existing fishways currently non-operational due to a lack of upkeep. This is due to the low priority such structures generally rate within the gamut of structures that organisations such as councils and water utilities own. It is recommended that all fishways in the region should be reviewed to ensure the structures have operation and maintenance plans suitable to the long-term operation of the fishways. If operation and maintenance plans do not exist then they should be developed in conjunction with the structure owners.

5.6 Fishway Functionality

In addition to a review of operation and maintenance of the remediated structures, the functionality of existing fishways on these structures should be reviewed. This will establish the increase in transparency the fishways are providing to the barrier. The transparency of barriers is determined by the size of the barrier in relation to the size of the channel of the stream on which they are built, the flows that occur within that stream and the location and design of any fishway constructed on them. A 1 metre high barrier will have a much greater impact on fish movement in a small stream than in a large river because the barrier blocks a much smaller percentage of the stream channel area, and flows that are required to drown out the structure occur more frequently in the larger stream. The smaller the structure, the greater the ability to construct a highly transparent fishway on the structure. Larger structures may only ever be partially ameliorated through the construction of a fishway.

While this review has attributed a level of transparency to each of the barriers, this is just a generalised assessment that needs to be refined. In this way, these remediated structures can be better defined and further rehabilitation works recommended for under-performing structures. It is recommended that a detailed assessment of the functionality of each of the fishways attached to remediated structures be undertaken to highlight any deficiencies and recommend further refinements to improve functionality.

6. Recommendations

- Develop an investment strategy for a fish migration barrier remediation program targeting barriers in the top 46 barriers to fish passage identified in this report. This program would include:
 - Preparation of an investment strategy for the highest priority sites based on information in this report
 - Negotiation with structure owners to permit rehabilitation of highest priority sites
 - Detailed survey of the sites and production of design documents for suitable fishways
 - Construction of agreed fishway designs
 - Establishment of ongoing maintenance agreements with local structure owners
 - Monitoring of the rehabilitated sites to ensure proper operation of the fishway
 - Pre- and post-barrier remediation fish community sampling to determine the effectiveness of providing fish passage past the barrier.
- Conduct a thorough re-assessment of barriers that includes identifying and scoring any new or obscured barriers.
- Undertake specific re-assessments of upland catchments to ensure they are adequately represented in the regional context.
- Undertake an off-stream barrier prioritisation project aimed at the region's wetland habitats. In particular, the numerous coastal and tidal interface pondage pastures. This is particularly important because of the potential fisheries and biodiversity benefits these wetland habitats can provide for the environment if free passage is provided.
- Assess current operation and maintenance plans for each of the remediated structures in the region and develop new operation and maintenance plans in conjunction with structure owners for all fishways that are not currently being managed effectively.
- Assess the functionality of each of the existing fishways in the region and suggest improvements in functionality (as opposed to operation and maintenance) that could improve the transparency achieved by the fishway.

7. References

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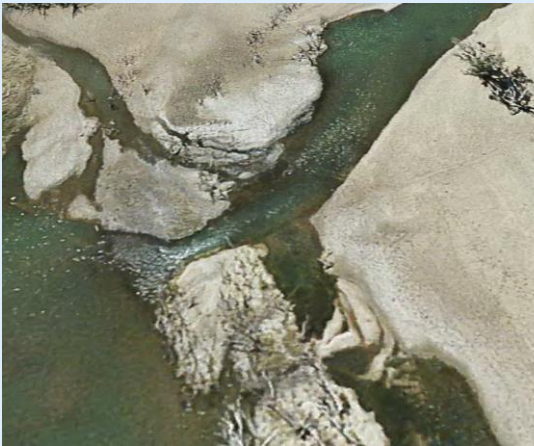
8. Glossary of Terms


Diadromous: Diadromous fishes are truly migratory species whose distinctive characteristics include that they (i) migrate between freshwaters and the sea; (ii) the movement is usually obligatory; and (iii) migration takes place at fixed seasons or life stages. There are three distinctions within the diadromous category, catadromous, amphidromous and anadromous.

- **Catadromous:** Diadromous fishes that spend most of their lives in fresh water, and migrate to sea to breed.
- **Amphidromous:** Diadromous fishes in which migration between freshwater and the sea is not for the purpose of breeding, but occurs at some other stage of the life cycle.
- **Anadromous:** Diadromous fishes that spend most of their lives at sea, and migrate to fresh water to breed.

Potamodromous: fish species whose migrations occur wholly within freshwater for breeding and other purposes.


9. Top 46 Barriers to fish migration in the FBA region


Overall Priority	1	
Barrier ID	524	
Stream Name	Fitzroy River	
Barrier Name	Redbank Crossing	
Barrier Type	Crossing	
Comments	Barrier may no longer exist, needs to be confirmed. Incorporation of fishway required if crossing established	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	2	
Barrier ID	1000	
Stream Name	Boyne River	
Barrier Name	Mann's Weir	
Barrier Type	Earthen weir	
Comments	Weir is a 3m high semi-permanent barrier. Has been more permanent in recent times	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	3	
Barrier ID	523	
Stream Name	Fitzroy River	
Barrier Name	Hanrahan's Crossing	
Barrier Type	Causeway	
Comments	Low causeway that creates 0.5m jump. Formalisation of D/S ramp required	


Remediation Solution	Rock Ramp Fishway	
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Overall Priority	4	
Barrier ID	3951	
Stream Name	Fitzroy River	
Barrier Name	Glenroy Crossing	
Barrier Type	Causeway/culverts	
Comments	Permanent crossing that is barrier at low flows. Fish passage can be provided through culverts at low flows	
Remediation Solution	Baffles/Rock Ramp Fishway	

Overall Priority	5	
Barrier ID	3952	
Stream Name	Fitzroy River	
Barrier Name	Craiglee Crossing	
Barrier Type	Causeway	
Comments	Low causeway that creates a 0.5m drop at low flows. Formalisation of downstream ramp require to prevent drops	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	6	
Barrier ID	535	
Stream Name	Amity Creek	
Barrier Name	Wamalgi Rd	
Barrier Type	Pipes	
Comments	Pipe create high velocities not passable	


	by fish. No way to use existing structure. Must be replaced.	
Remediation Solution	Baffled culverts	


Overall Priority	7	
Barrier ID	9001	
Stream Name	Boyne River	
Barrier Name	Awoonga Dam	
Barrier Type	Dam	
Comments	Large dam that would require extensive modification to provide passage	
Remediation Solution	Fish Lift	

Overall Priority	8	
Barrier ID	6169	
Stream Name	Serpentine Lagoon	
Barrier Name		
Barrier Type	Tidal Bund	
Comments	Small tidal bund required to create ponded pasture. A fixed water level fishway required	
Remediation Solution	Rock Ramp Fishway	


Overall Priority	9	
Barrier ID	9393	
Stream Name	St Lawrence Creek	
Barrier Name	St Lawrence Weir	
Barrier Type	Weir	
Comments	4m high weir located at tidal interface.	


	Difficult site but well worth consideration	
Remediation Solution	Cone Fishway	


Overall Priority	10	
Barrier ID	8652	
Stream Name	Calliope River	
Barrier Name	Blackgate Rd	
Barrier Type	Causeway/Pipe	
Comments	Low causeway with pipe, stabilisation of D/S channel to create a wet crossing	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	11	
Barrier ID	8618	
Stream Name	Calliope River	
Barrier Name	Mt Alma Rd	
Barrier Type	Culverts	
Comments	Culverts barrier at high flows, installing devices to provide low flow zone at high flow required	
Remediation Solution	Baffled culverts	


Overall Priority	12	
Barrier ID	8677	
Stream Name	Clairview Creek	
Barrier Name	Clairview Weir	
Barrier Type	Causeway	
Comments	Low weir with pipes at tidal interface. Site requires set	


	headwater level as local water supply	
Remediation Solution	Rock Ramp Fishway/Culverts	


Overall Priority	13	
Barrier ID	2	
Stream Name	Mackenzie River	
Barrier Name	Tartus Weir	
Barrier Type	Weir	
Comments	Large weir owned by Sunwater. Design for fishway partially undertaken but likely to cost around \$4M	
Remediation Solution	Vertical Slot Fishway	

Overall Priority	14	
Barrier ID	525	
Stream Name	Mackenzie River	
Barrier Name	Duaringa - Apis Rd	
Barrier Type	Pipes	
Comments	Many barrelled culvert requires baffles installed in at least two culvert barrels	
Remediation Solution	Baffles	

Overall Priority	15	
Barrier ID	3	
Stream Name	Mackenzie River	
Barrier Name	Bingegang Weir	
Barrier Type	Weir	
Comments	High weir that has facility for fish lock already incorporated	

	into design. Structure owned by Sunwater	
Remediation Solution	Fish Lock	

Overall Priority	16	
Barrier ID	8354	
Stream Name	Boyne River	
Barrier Name	Pikes Crossing	
Barrier Type	Pipes	
Comments	Pipe culvert requires baffles installed in the two outer culvert barrels. Structure generally has water through the structure	
Remediation Solution	Baffles	

Overall Priority	17	
Barrier ID	8716	
Stream Name	Amity Creek	
Barrier Name	Old Hwy	
Barrier Type	Pipes	
Comments	Old pipe culvert structure that would need to be replaced with new box culverts with baffles on the outside two culvert barrel walls	
Remediation Solution	Baffled culverts	

Overall Priority	18
Barrier ID	9718
Stream Name	Police Creek
Barrier Name	Lake Callemonda
Barrier Type	Causeway
Comments	Fishway design has been completed for this structure and will be constructed December 2015
Remediation Solution	Rock Ramp Fishway





Overall Priority	19
Barrier ID	25
Stream Name	Raglan Creek
Barrier Name	Langmom Rd
Barrier Type	Culverts
Comments	Many barrelled culvert requires baffles installed in at least two culvert barrels
Remediation Solution	Baffles




Overall Priority	20
Barrier ID	4
Stream Name	Mackenzie River
Barrier Name	Bedford Weir
Barrier Type	Weir
Comments	High weir that has facility for fish lock already incorporated into design. Structure owned by Sunwater
Remediation Solution	Fish Lock





Overall Priority	21	
Barrier ID	534	
Stream Name	Montrose Creek	
Barrier Name	Town weir	
Barrier Type	Weir	
Comments	Small weir structure with bedrock base, a channel and cone fishway could be constructed across rock bar	
Remediation Solution	Cone Fishway	

Overall Priority	22	
Barrier ID	22	
Stream Name	Raglan Creek	
Barrier Name	Upper Raglan	
Barrier Type	Causeway/Pipes	
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	


Overall Priority	23	
Barrier ID	85	
Stream Name	8 Mile Creek	
Barrier Name	Bajool Weir	
Barrier Type	Weir	
Comments	Large weir/road, design of fishway previously completed, but would require redesign to bring to modern specification. Main road makes construction difficult	


Remediation Solution	Cone Fishway	
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Overall Priority	24	
Barrier ID	9165	
Stream Name	Black Swan Creek	
Barrier Name	Flinders Rd	
Barrier Type	Pipes	
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	25	
Barrier ID	3015	
Stream Name	Mackenzie River	
Barrier Name	Tartrus Rd	
Barrier Type	Causeway	
Comments	Low causeway that creates a 0.5m drop at low flows. Formalisation of downstream ramp required to prevent drops	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	26	
Barrier ID	4152	
Stream Name	Dawson River	
Barrier Name	Boolburra Rd	
Barrier Type	Causeway/Pipe	
Comments	Moderate-sized pipe culvert crossing that should be replaced	


	with baffled box culverts	
Remediation Solution	Baffled culverts	


Overall Priority	27	
Barrier ID	528	
Stream Name	Stoney Creek	
Barrier Name	Daddys Crossing	
Barrier Type	Causeway/Pipes	
Comments	Moderate sized pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	


Overall Priority	28	
Barrier ID	82	
Stream Name	12 Mile Creek	
Barrier Name	12 mile Rd	
Barrier Type	Pipes	
Comments	Moderate-sized pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	


Overall Priority	29	
Barrier ID	8731	
Stream Name	Stoodleigh Creek	
Barrier Name	Barretts Rd	
Barrier Type	Pipes	
Comments	Small pipe culvert crossing that should	


	be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	30	
Barrier ID	9629	
Stream Name	Sandy Creek	
Barrier Name	Railway Line Rd	
Barrier Type	Pipes	
Comments	Moderate-sized pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	31	
Barrier ID	530	
Stream Name	Stoney Creek	
Barrier Name	Freemans Crossing	
Barrier Type	Causeway	
Comments	Low causeway that creates a small drop at low flows. Formalisation of downstream ramp required to prevent drops	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	32	
Barrier ID	9000	
Stream Name	Ewan Creek	
Barrier Name	Stanage Bay Rd	
Barrier Type	Pipes	
Comments	Moderate sized pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	33	
Barrier ID	526	
Stream Name	Police Creek	
Barrier Name		
Barrier Type	Causeway	
Comments	Low causeway that creates a small drop at low flows. Formalisation of downstream ramp required to prevent drops	
Remediation Solution	Rock Ramp Fishway	

Overall Priority	34	
Barrier ID	1032	
Stream Name	Oakey Creek	
Barrier Name	Archer Station Rd	
Barrier Type	Pipe	
Comments	Small pipe culvert crossing that should be replaced with low ford crossing	
Remediation Solution	Ford	

Overall Priority	35
Barrier ID	8784
Stream Name	Tooloombah Creek
Barrier Name	Rocky Crossing
Barrier Type	Causeway/Pipes
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts
Remediation Solution	Baffled culverts





Overall Priority	36
Barrier ID	6348
Stream Name	Dawson Rver
Barrier Name	Nun's Crossing
Barrier Type	Causeway/Pipes
Comments	Moderate-sized pipe culvert crossing that should be replaced with baffled box culverts
Remediation Solution	Baffled culverts




Overall Priority	37
Barrier ID	9550
Stream Name	Block Creek
Barrier Name	Stanage Bay Rd
Barrier Type	Causeway/Pipes
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts
Remediation Solution	Baffled culverts





Overall Priority	38	
Barrier ID	9192	
Stream Name	Clyde Creek	
Barrier Name	Wydham Rd	
Barrier Type	Pipes	
Comments	The crossing has been replaced by a new bridge and is no longer required. Should be removed unless there is local usage of the structure	
Remediation Solution	Remove	

Overall Priority	39	
Barrier ID	69	
Stream Name	12 Mile Creek	
Barrier Name	Langmom Rd	
Barrier Type	Causeway/Pipes	
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	40	
Barrier ID	9041	
Stream Name	Cooraman Creek	
Barrier Name	Cooraman Ck Rd	
Barrier Type	Culverts	
Comments	Many barrelled culvert requires baffles installed in at least two culvert barrels. Marine inundation requires that baffles are stainless steel	


Remediation Solution	Baffles	
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Overall Priority	41	
Barrier ID	6144	
Stream Name	12 Mile Creek	
Barrier Name	San Jose Rd	
Barrier Type	Causeway/Pipes	
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts	
Remediation Solution	Baffled culverts	

Overall Priority	42	
Barrier ID	6198	
Stream Name	Nankin Creek	
Barrier Name	Thompsons Point Rd	
Barrier Type	Culverts	
Comments	Large box culvert that have a drop on the downstream side, will require rock ramp to allow fish to enter culverts	
Remediation Solution	Rock Ramp Fishway/Baffles	

Overall Priority	43	
Barrier ID	8642	
Stream Name	Clyde Creek	
Barrier Name	Harvey St	
Barrier Type	Culverts	
Comments	Large box culverts that require baffles on the two outer barrels	

Remediation Solution	Baffles	 
Overall Priority	44	
Barrier ID	532	
Stream Name	Moore's Creek	
Barrier Name	Musgrave St	
Barrier Type	Weir	
Comments	Small weir with significant erosion downstream under bridge. Last barrier now blocking Moore's Ck	
Remediation Solution	Cone Fishway	

Overall Priority	45	
Barrier ID	2664	
Stream Name	Dawson River	
Barrier Name	Kianga River Rd	
Barrier Type	Culverts	
Comments	Large box culvert that have a drop on the downstream side, will require rock ramp to allow fish to enter culverts	
Remediation Solution	Rock Ramp Fishway/Baffles	

Overall Priority	46
Barrier ID	8606
Stream Name	Calliope River
Barrier Name	Duckholes Rd
Barrier Type	Pipes
Comments	Small pipe culvert crossing that should be replaced with baffled box culverts
Remediation Solution	Baffled culverts



Our country, Our future.

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