dry tropics partnership for healthy waters

Dry Tropics Partnership for Healthy Waters
Waterways Report Card 2023

TECHNICAL REPORT

PART 4: Estuarine Results

Reporting on data collected 2021 - 2022

JULY 2023 | Dry Tropics Partnership for Healthy Waters (DTPHW)

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11 Estuarine Environment

The Estuarine Environment in the Dry Tropics region is comprised of two basins: the Ross Estuarine Basin and the Black Estuarine Basin. In each basin the water quality, and habitat and hydrology indices are reported. The extent of each basin is shown in Figure 10, and results are presented below.

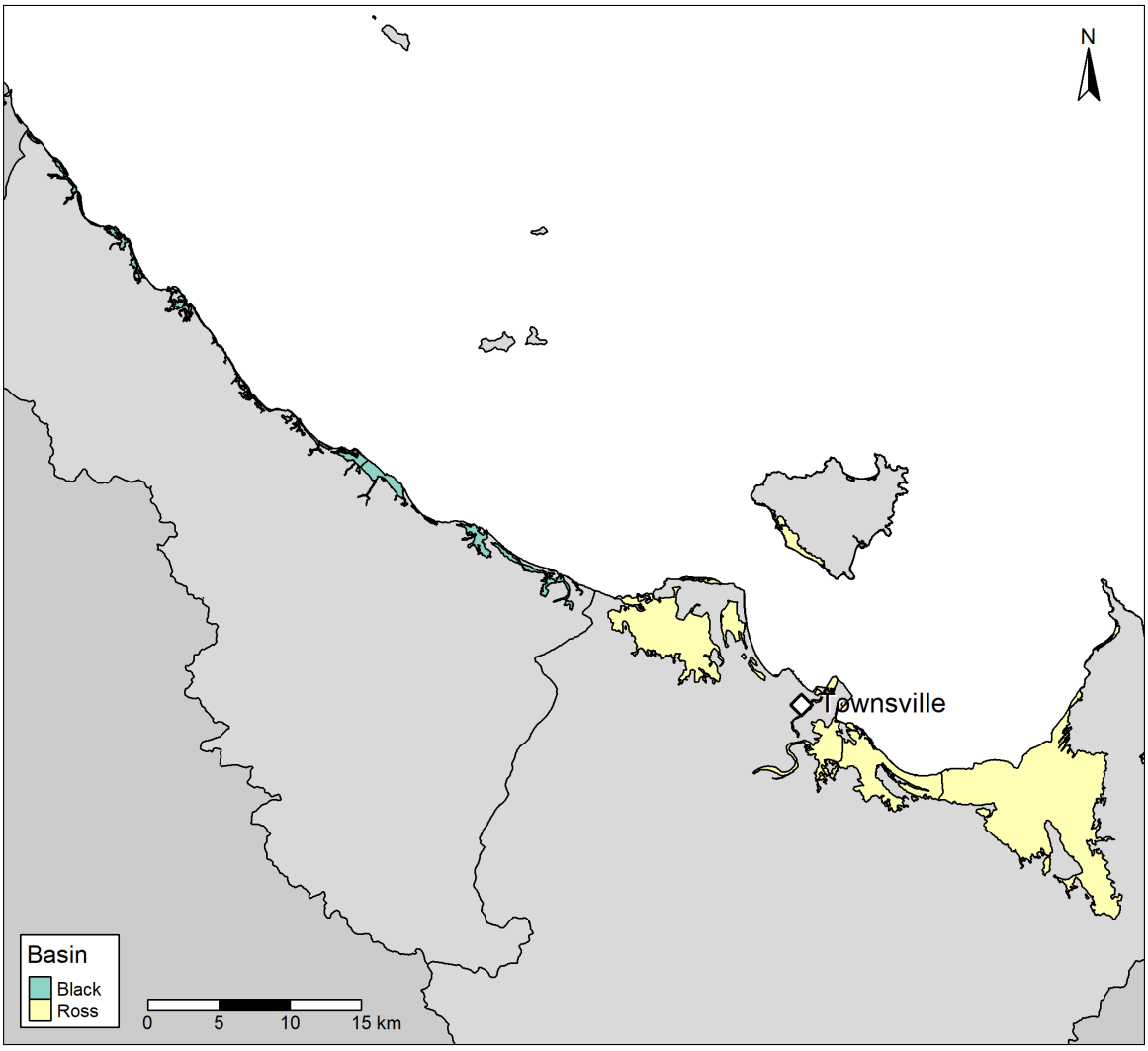

Figure 10. Dry Tropics Estuarine Basins.

11.1 Water Quality

The water quality index for the Estuarine Environment of the Dry Tropics region consists of two indicator categories: Nutrients, and Physical-Chemical Properties. Both indicator categories use data provided by multiple partners of the DTPHW team. The water quality index is updated annually, with the most recent updated including data from the 2021–2022 financial year.

11.1.1 Monitoring Sites

In the 2021–2022 technical report, all water quality data was collected from 22 sites. Sites were grouped into 13 watercourses, seven sub basins and two basins as detailed in Table 42, with locations presented in Appendix AA.

Table 42. Dry Tropics estuarine water quality site summary.

Basin	Sub Basin	Watercourse	Site
Ross Estuarine	Bohle	Bohle River	BOH3.9
		Louisa Creek	LOU0.9, LOU6.0, TC4A
	Lower Ross	Ross Creek	RC04, RC07
		Ross River	RR05
	Stuart	Sandfly Creek	CB3, CB9
	Alligator	Alligator Creek	CB8
Black Estuarine	Bluewater	Althaus Creek	AltC1.7
		Bluewater Creek	BWC2.4
		Sleeper Log Creek	SLC0.0, SLC2.0
	Rollingstone	Camp Oven Creek	CO1, CO2, CO3
		Saltwater Creek	SWC0.6, SC1, SC2
		Rollingstone Creek	RolC0.8
	Crystal	Crystal Creek	CryC1.0

11.1.2 Overall Summary: Estuarine Water Quality

The water quality index has improved since the 2018–2019 Dry Tropics Report for both estuarine basins. In the Ross Estuarine Basin, the index improved from a score of 39 (poor) in 2018–2019, to a score of 88 (very good) in 2019–2020 with the low scores in 2018–2019 attributed to the 2019 flood. The scores for the water quality index have remained relatively consistent over the last three reporting periods and the index decreased from 88 to 83, although has kept a "very good" grade.

In the Black Estuarine Basin, the index improved from 52 (moderate) in 2018–2019 to 64 (good) in 2021–2022. The index score also improved between the 2019–2020 and 2020–2021 reports from 47 to 66 but decreased from 66 to 64 between the 2020–2021 and 2021–2022 reporting periods (Table 43).

Table 43. Current and previous water quality scores and grades for the Dry Tropics Estuarine Basins.

Basin	Nutrients	Phys-Chem Properties	Water Quality			
			2021–2022	2020–2021	2019–2020	2018–2019
Ross Estuarine	88	78	83	88	88	39
Black Estuarine	74	55	64	66	47	52

Standardised scoring range: ■ = Very Poor: 0 to <21 | ■ = Poor: 21 to <41 | ■ = Moderate: 41 to <61 | ■ = Good: 61 to <81 | ■ = Very Good: 81 to 100.

11.1.3 Key Messages

- There was no change to the water quality index grade (although the Ross Estuarine score decreased from 88 to 83 and Black Estuarine score decreased from 66 to 64).
- 9 of 13 watercourses received a grade of "good" or "very good" for both the nutrients and physical-chemical properties indicator categories.
- The Camp Oven Creek and Crystal Creek watercourses exhibited unusually low Turbidity scores and should be closely monitored moving forward.

- Althaus Creek shows ongoing issues with the Turbidity indicator, and further investigation is required to isolate specific drivers.

Louisa Creek shows ongoing issues with the Low DO and TP indicators and further investigation is required to isolate specific drivers.

11.1.4 Nutrients

For the 2021–2022 technical report the nutrients indicator category is comprised of two indicators, Dissolved Inorganic Nitrogen (DIN), and Total Phosphorus (TP). Full results can be found in Appendix CC.

11.1.4.1 *Results: Estuarine Nutrients*

Median values for each indicator are compared against the relevant water quality objectives. Values are standardised before the comparison and aggregation of indicators. Median values, sample frequency, water quality objectives, and scaling factors are presented in Appendix BB, standardised scores are shown in Table 44.

11.1.4.1.1 Ross Estuarine Basin

The Ross Estuarine Basin received a nutrient indicator category score of 88 (very good). Within the basin, five of six watercourses received nutrient indicator category grades of “very good”, with scores of 83 or greater. The Louisa Creek watercourse was the only location to receive a grade of “moderate” (score of 50), which was driven by the TP indicator at two of three sites. Other than the TP indicator in the Louisa Creek watercourse, all watercourses received grades of “very good” or “good” for both the TP and DIN indicators (Table 44).

The low scores for the TP indicator at two of three sites in the Louisa Creek watercourse may be the results of a variety of factors including water quality objectives, number of samples, sample timing, and sample location. However, the WQOs for Louisa Creek are identical to other watercourses in the Ross Estuarine Basin, and the median value is notably higher than the other locations. These both indicate the scores are driven by concentration rather than differences in objectives (Appendix BB).

Although the number of samples taken in the Louisa Creek watercourse is more than 3x that of any other watercourse in the Ross Estuarine Basin (Appendix BB), it appears unlikely that these additional samples picked up broad trends/events missed by samples in other watercourses. Samples were collected on the same days as the other locations and were consistently higher throughout the reporting period (Appendix FF, Figure 46, Appendix HH). Furthermore, historical analysis of the watercourses and sites show a consistent trend of high TP concentrations (Appendix GG, Figure 52) and low scores (Appendix AA). Finally, the distribution of the sites within the Louisa watercourse suggests an upstream point source and diluting effect, with scores generally increasing further downstream (Figure 44). These spatial and temporal trends suggest an ongoing source of increased TP upstream of the sampling location that is unique to the Louisa Creek watercourse, such as its proximity to the outflow of the Mount St Johns Wastewater Treatment Plant, industrial areas, and residential developments.

Table 44. Unweighted standardised scores and grades for the nutrient indicator category and indicators in the Dry Tropics Estuarine Environment.

Basin	Sub Basin	Watercourse	Unweighted Score and Grade			Weighting (%)	Area (km2)	Weighted Score and Grade	
			DIN	TP	Nutrients			Sub Basin	Basin
Ross Estuarine	Bohle	Bohle River	90	90	90				88
		Louisa Creek	79	22	50				
			82	39	60	0.28	348	16.97	
	Lower Ross	Ross Creek	90	90	90				
		Ross River	90	90	90				
			90	90	90	0.69	864	62.47	
	Stuart	Sandfly Creek	76	90	83	0.002	28	1.86	
	Alligator	Alligator	90	90	90	0	5	0.35	
Black Estuarine	Bluewater Creek	Althaus Ck	90	90	90				74
		Bluewater Ck	63	90	76				
		SleeperLog Ck	90	90	90				
			83	90	86	0.48	278	41.39	
	Rollingstone Creek	Camp Oven Creek	80	90	85				
		Saltwater Ck	70	90	80				
		Rollingstone Ck	61	90	75				
			73	90	81	0.23	135	19.02	
	Crystal Creek	Crystal Ck	65	90	77	0.2	119	15.85	

Standardised scoring range: ■ = Very Poor: 0 to <21 | ■ = Poor: 21 to <41 | ■ = Moderate: 41 to <61 | ■ = Good: 61 to <81 | ■ = Very Good: 81 to 90. (Scores are capped at 90).

11.1.4.1.2 Black Estuarine Basin

The Black Estuarine Basin received a nutrient indicator category score of 74 (good). Within the basin, all seven watercourses received a nutrient indicator category grade of “good” or “very good”, with scores of 75 or greater. The DIN indicator at site SC1 in the Saltwater Creek watercourse was the only indicator to not receive a grade of “good” or “very good”, instead received a grade of moderate (56). However this lower score does not appear to be consistent across multiple reporting periods (Appendix AA, Appendix GG, Figure 51).

11.1.4.2 *Physical Chemical Properties*

For the 2021–2022 technical report the physical-chemical properties indicator category is comprised of three indicators, Turbidity (NTU), High DO, and Low DO.

11.1.4.3 *Results: Estuarine Physical-Chemical Properties*

Median values for each indicator are compared against the relevant water quality objectives. Values are standardised before the comparison and aggregation of indicators (Lonborg 2016). Median values, sample frequency, water quality objectives, and scaling factors are presented in Appendix DD, standardised scores are shown in Table 45.

11.1.4.3.1 Ross Estuarine Basin

The Ross Estuarine Basin received a physical-chemical properties score of 78 (good). Five of six watercourses received nutrient indicator category grades of “very good” or “good”, with scores of 78 or greater. The Louisa Creek watercourse was the only location to receive a grade of “moderate” (score of 45), which was driven by the Low DO indicator at two of three sites (Table 45).

In Louisa Creek, two of three sites have consistently scored “very poor” for the low DO indicator. These results are likely due to ongoing influences specific to the watercourse (Appendix DD, Appendix GG, Figure 55). These sites also received the “very poor” grade for TP. The relationship between DO and nutrients is well established, and the very poor low DO score is likely due to increased TP upstream of the sampling location. Sources of increased TP may include the outflow of the Mount St Johns Wastewater Treatment Plant, industrial areas, and residential developments (Figure 44).

11.1.4.3.2 Black Estuarine Basin

The Black Estuarine Basin received a nutrient indicator category score of 55 (moderate). Four of seven watercourses received a nutrient indicator category grade of “good” or “very good”, with scores of 76 or greater. The Camp Oven Creek and Crystal Creek watercourses received grades of “moderate” and the Althaus Creek watercourse was the only location to receive a grade of “very poor” (16), which was driven by the Turbidity and High DO indicators. Despite the “good” or “very good” grade for most watercourses, scores for all indicators ranged from “poor” or “very poor” to “very good”.

Table 45. Unweighted standardised scores and grades for the physical chemical indicator category and indicators in the Dry Tropics Estuarine Environment.

Basin	Sub Basin	Watercourse	Unweighted Score and Grade						Weighted Score and Grade	
			Turbidity	High DO	Low DO	Phys-Chem	Weighting (%)	Area (km2)	Sub Basin	Basin
Ross Estuarine	Bohle	Bohle River	66	90	90	78				78
		Louisa Creek	66	90	24	45				
			66	90	41	53	0.28	348	16.97	
	Lower Ross	Ross Creek	90	90	90	90				
		Ross River	90	90	70	80				
			90	90	83	86	0.69	864	62.47	
	Stuart	Sandfly Creek	76	90	90	83	0.002	28	1.86	
	Alligator	Alligator	90	90	90	90	0	5	0.35	
Black Estuarine	Bluewater Creek	Althaus Ck	0	33	90	16				55
		Bluewater Ck	90	76	90	83				
		SleeperLog Ck	62	90	90	76				
			53	72	90	63	0.48	278	41.39	
	Rollingstone Creek	Camp Oven Creek	42	90	54	48				
		Saltwater Ck	82	77	90	80				
		Rollingstone Ck	69	90	90	79				
			63	84	74	69	0.23	135	19.02	
	Crystal Creek	Crystal Ck	7	90	90	48	0.2	119	15.85	

Standardised scoring range: ■ = Very Poor: 0 to <21 | ■ = Poor: 21 to <41 | ■ = Moderate: 41 to <61 | ■ = Good: 61 to <81 | ■ = Very Good: 81 to 90. (Scores are capped at 90).

In two of the three watercourses (Camp Oven Creek, Crystal Creek), “very poor” grades for the Turbidity indicator are unexpected and are not consistent across multiple reporting periods (Appendix EE). Further, other indicators in these watercourses received grades of “good” or “very good” both for this reporting period, and previous periods which may indicate the lack of ongoing issues (Table 45, Appendix DD). However, for the Althaus Creek watercourse, consistently “very poor” Turbidity suggests an ongoing source of increased turbidity, possibly due to its proximity to the more urbanized Townsville region compared to other locations in the Black Estuarine Basin and further investigation is required (Appendix DD, Appendix GG, Figure 53).

11.1.5 Confidence Scores

Overall, there was moderate confidence in the results due to limited ability to define the measured error, however, all other criterion received a score of 2 or greater (Table 46).

Table 46. Confidence scores for the nutrients, and physical-chemical properties indicator categories.

Indicator Category	Maturity (x0.36)	Validation (x0.71)	Representativeness (x2)	Directness (x0.71)	Measured error (x0.71)	Score (Rank)
Nutrients	2	3	2	3	1	9.6 (3)
Phys-Chem	2	3	2	3	1	9.6 (3)

Rank based on score: 1 (very low) = 4.5 to 6.3; | 2 (low) = >6.3 to 8.1; | 3 (moderate) = >8.1 to 9.9; | 4 (high) = >9.9 to 11.7; | 5 (very high) = >11.7 to 13.5.

11.2 Habitat

The habitat and hydrology index for the estuarine environment of the Dry Tropics region consists only of habitat specific indicator categories and is referred to throughout as the habitat index. The habitat index is comprised of two indicator categories: Mangrove and Saltmarsh Extent, and Estuarine Riparian Extent. Both indicator categories use data from the regional ecosystem vegetation spatial layers[17]. In the Dry Tropics region this data is updated approximately every four years with the most recent update occurring in 2022 (publication of 2019 regional ecosystem vegetation).

11.2.1 Overall Summary: Estuarine Habitat

The scores and grades for the estuary habitat indicator categories and habitat index for 2021–2022, and the indices for previous reporting years are presented in Table 47. Scores have remained consistent over reporting years with no changes in grades or scores. In the Ross Estuarine Basin, the habitat index received a score of 73 (good) and in the Black Estuarine Basin, the habitat index received a score of 71 (good) (Table 47).

[17] All regional ecosystem data was downloaded from QSpatial’s [Catalogue] (Queensland Government 2023).

Table 47. Standardised score for the estuarine habitat index.

Basin	Mangrove and Saltmarsh	Riparian Extent	Habitat Index		
			2021–2022	2020–2021	2019–2020
Ross Estuarine	67	80	73	73	73
Black Estuarine	63	80	71	71	71

Standardised scoring range: ■ = Very Poor: 0 to <21 | ■ = Poor: 21 to <41 | ■ = Moderate: 41 to <61 | ■ = Good: 61 to <81 | ■ = Very Good: 81 to 100.

11.2.1.1 *Key Messages*

- Across both habitat extent indicator categories vegetation loss was minimal, with a maximum loss of 0.09%. It should be noted that this amount of loss is within the margin of error of the method.
- The grade and score for the habitat index did not change in either the Ross or Black estuarine basins.

11.2.2 Mangrove and Saltmarsh Extent

The mangrove and saltmarsh extent indicator category provides a measure of the total area of mangrove and saltmarsh and the amount of change (loss or gain) of this vegetation. The specific regional ecosystem (RE) vegetation types that are selected to be included in this analysis are:

- RE 11.1.1 *Sporobolus virginius* grassland on marine clay plains
- RE 11.1.2 *Samphire forbland* on marine clay plains
- RE 11.1.3 Sedgelands on marine clay plains
- RE 11.1.4 Mangrove low open forest and/or woodland on marine clay plains

11.2.2.1 *Monitoring Sites*

The entire estuarine environment in both the Ross and Black estuarine basins was assessed for mangrove and saltmarsh extent. The vegetation was separated into “no vegetation”, “other vegetation” (vegetation but not the target RE type), and mangrove and saltmarsh (target RE type). A map of the assessed area and the composition of these vegetation groups is provided in Appendix II.

11.2.2.2 *Results: Estuarine Mangrove and Saltmarsh*

The standardised score and grade for the mangrove and saltmarsh extent indicator category is calculated as a percentage lost/gained compared to the amount of vegetation present during the 2013 assessment. Other years of data are presented to provide a broader overview of general mangrove and saltmarsh trends.

For the 2021–2022 reporting period the total area of mangrove and saltmarsh extent was 11,620.9ha in the Ross Estuarine Basin, and 981.6ha in the Black Estuarine Basin (based on 2019 vegetation) which represents no loss in both basins since 2017. From 2013 to 2019, Ross Estuarine Basin has lost 7.9ha (0.07%) of mangrove and saltmarsh, and from preclearing estimates has lost 133.2ha (1.15%). In the Black Estuarine Basin, 0.9ha (0.09%) of mangrove and saltmarsh was lost from 2013 to 2019, and 9.3ha (0.95%) was lost from preclearing estimates (Table 48).

Table 48. Mangrove and saltmarsh extent in the estuarine environment of the Dry Tropics.

Basin	Mangrove and Saltmarsh Extent			
	2019 (ha)	2017 (ha)	2013 (ha)	Pre-clear (ha)
Ross Estuarine	11,620.9	11,620.9	11,628.8	11,754.1
Black Estuarine	981.6	981.6	982.5	990.9

Further, between 1997 and 2019, Ross Estuarine Basin lost 24ha (0.21%), which is less than one fifth of the loss from pre-clear to 2019. This suggests that most the vegetation loss in the Ross Estuarine Basin occurred before extensive record keeping began. In the Black Estuarine Basin, from 1997 to 2019 5ha (0.57%) of mangrove and saltmarsh was lost. This is roughly half of the total vegetation loss from pre-clearing to 2019, and suggests that only a moderate amount of land clearing occurred in the Black Estuarine Basin before record keeping began (Appendix KK, Appendix LL).

In the Ross Estuarine Basin, the final standardised score was 67 (B) with a total percent loss of only 0.07%, and in the Black Estuarine Basin the final standardised score was 63 (B) with a total percent loss of only 0.09% (Table 49).

Table 49. Mangrove and saltmarsh loss and standardised score in the estuarine environment of the Dry Tropics.

Basin	Mangrove and Saltmarsh Extent		
	Extent loss 2013–2019		Standardised Score (Grade)
	ha	%	
Ross Estuarine	-0.79	-0.07	67
Black Estuarine	-0.09	-0.09	63

Standardised scoring range: ■ = Very Poor: >3% loss | ■ = Poor: 0.51 – 3% loss | ■ = Moderate: 0.11 – 0.5% loss | ■ = Good: 0 – 0.1% loss | ■ = Very Good: increase in mangrove of saltmarsh area.

11.2.3 Estuarine Riparian Extent

The estuarine riparian extent indicator category provides a similar measure of estuarine vegetation, however, targets the riparian buffer zone of estuarine waters. The riparian buffer zone is defined as areas within a 50-metre buffer of each waterway, and the indicator category includes any vegetation that is present within the zone (Scarth, et al. 2006). Although not targeting specific vegetation groups, this measure provides insight into any vegetation loss in the critical buffer zone which plays an important role in water quality and water flow (Hoffmann 2009).

11.2.3.1 *Monitoring Sites*

The estuarine riparian buffer zone in both the Ross and Black estuarine basins was assessed for total vegetation extent. The vegetation was separated into no vegetation, and vegetation. A map of the assessed area and the composition of these vegetation groups is provided in Appendix JJ.

11.2.3.2 *Results: Estuarine Riparian Extent*

The standardised score and grade for the estuarine riparian extent indicator category is calculated as a percentage lost/gained compared to the amount of vegetation present during the 2013 assessment. Other years of data are presented to provide a broader overview of general riparian trends.

For the 2021–2022 reporting period the total area of mangrove and saltmarsh extent was 1,777.5ha in the Ross Estuarine Basin, and 125.5ha in the Black Estuarine Basin (based on 2019 vegetation) which represents no loss in both basins since 2017. From 2013 to 2019, both basins also had no loss of their riparian vegetation. In comparison to preclearing estimates Ross Estuarine Basin has lost 10.6ha (0.60%) of its estuarine riparian vegetation, and Black Estuarine Basin has lost 1.4ha (1.13%) (Table 50).

Table 50. Estuarine riparian extent in the estuarine environment of the Dry Tropics.

Basin	Estuarine Riparian Extent			
	2019 (ha)	2017 (ha)	2013 (ha)	Pre-clear (ha)
Ross Estuarine	1,777.5	1,777.5	1,777.5	1,788.1
Black Estuarine	125.5	125.5	125.5	127.0

In the Ross Estuarine Basin, from 1997 to 2019 1.3ha (0.07%) of estuarine riparian vegetation was lost. Although only a small amount, this indicates clearing of riparian vegetation is ongoing. However, from 1997 to 2019, Black Estuarine Basin there was no loss, which suggests all riparian vegetation loss occurred before extensive record keeping began, and that riparian land clearing has not occurred since (Appendix MM, Appendix NN).

In the Ross Estuarine Basin, the final standardised score was 80 (B) with no loss of riparian vegetation, and in the Black Estuarine Basin the final standardised score was 80 (B) with no loss of riparian vegetation (Table 51).

Table 51. Estuarine riparian extent loss and standardised scores in the estuarine environment of the Dry Tropics.

Basin	Estuarine Riparian Extent		
	Extent loss 2013–2019		Standardised Score (Grade)
	ha	%	
Ross Estuarine	0.0	0.0	80
Black Estuarine	0.0	0.0	80

Scoring range: ■ = Very Poor: >3% loss | ■ = Poor: 0.51 – 3% loss | ■ = Moderate: 0.11 – 0.5% loss | ■ = Good: 0 – 0.1% loss | ■ = Very Good: increase in mangrove of saltmarsh area.

11.2.3.3 *Back Calculated Scores*

As the spatial area assessed for the mangrove and saltmarsh indicator category was updated, results in previous technical reports have been superseded. Further, the additional of the riparian extent indicator category, has also impacted results. Previous results have been back calculated and updated in Table 47. Results before back calculation can be found Appendix OO.

The update increased the habit index score in the Ross Estuarine Basin from 71 to 73 and reduced the habitat index score in the Black Estuarine Basin from 77 to 71. The Mangrove and saltmarsh indicator category decreased from 71 to 67 in the Ross Estuarine Basin, and from 77 to 63 in the Black Estuarine Basin.

11.2.4 Confidence Scores

Confidence in the mangrove and saltmarsh extent and riparian extent indicator categories was moderate with a rank of 3 out of 5. For both indicator categories method maturity received a score of 2, as the methodology has been peer-reviewed, but not yet published. Validation received a 2 as the measures are based on remote sensing data with regular (but not comprehensive) ground truthing. Representativeness received a 2 as the remoting sensing data is at a scale of greater than 1:10,000 but less than 1:1,000,000. Directness scored a 1 as the loss of vegetation was not measured directly and was simply inferred by changes in cover in satellite imagery. And the measured error scored a 2 as some components of the underlying dataset do not have their error quantified.

Table 52. Confidence scores for the mangrove and saltmarsh extent and riparian extent indicator categories.

Indicator Category	Maturity (x0.36)	Validation (x0.71)	Representativeness (x2)	Directness (x0.71)	Measured error (x0.71)	Score (Rank)
M. & S. Extent	2	2	2	1	2	8.2 (3)
R. Extent	2	2	2	1	2	8.2 (3)

Rank based on score: 1 (very low) = 4.5 to 6.3; | 2 (low) = >6.3 to 8.1; | 3 (moderate) = >8.1 to 9.9; | 4 (high) = >9.9 to 11.7; | 5 (very high) = >11.7 to 13.5.