NRM North

TECHNICAL REPORT
03 6333 7777
nrmnorth.org.au

2020 Tamar Estuary Report Card

SUMMARY AND KEY MESSAGES

The 2020 Tamar Estuary Report Card shows an overall improvement in grades across all zones of the kanamaluka/Tamar estuary, compared to the 2018 Report Card. The smallest improvement was seen in Zone 3 (Swan Point to Rowella), which changed from a B- to a B, both years associated with 'good ecosystem health'. Zone 1 (Launceston to Legana) is in 'poor ecosystem health', an improvement from the 'fail' grade in the 2018 Report Card.

Impacts from the extreme weather events shown in the 2018 Report Card, such as low dissolved oxygen concentrations caused by the 2016 flood, are no longer observed in the data used for the 2020 Report Card. Improvements in wastewater treatment plant operations have resulted in reduced effluent nitrogen at the Norwood and Longford plants by 75%, which may have reduced nitrogen concentrations in Zone 1 of the estuary.

Sediment raking activities occurred in the upper estuary until June 2019, with two days of sediment raking and 17 days of prop washing occurring in the Report Card period, down from 39 days of raking in the previous reporting period. A review of the sediment raking program published in 2019 showed raking activity re-suspended sediment and other pollutants in the water column. Most total pollutants resettled in the upper estuary close to Launceston, while many dissolved pollutants were elevated in the lower estuary for several weeks after raking ceased. The reduced sediment raking program in the 2020 Report Card year has resulted in improved water quality as seen by the improved concentrations in nutrients and metals, particularly aluminium, arsenic and cadmium.

WHAT IS BEING DONE TO IMPROVE WATER QUALITY IN THE ESTUARY?

SEWAGE TREATMENT PLANTS

There are 11 sewage treatment plants (STPs) located in close proximity to the kanamaluka/Tamar estuary which treat domestic sewage and trade waste from surrounding townships. Once treated, this wastewater is discharged directly to the Tamar, or to other connected waterways in close proximity. Treated wastewater discharged from these STPs contributes contaminants including organic compounds, nutrients and suspended solids to the Tamar. Ti-Tree Bend is the largest of these STPs and designed to treat a proportion of combined stormwater and sewage from the Launceston area. Five of the 11 STPs have reuse schemes for disposal of treated wastewater.

Sewage system optimisation projects undertaken by TasWater in 2018 have resulted in various improvements in discharge quality to the estuary. Process improvements in Longford and Norwood STPs have resulted in 75% less nitrogen in effluent discharge from these STPs, while dry weather bypass discharges from Ti-Tree Bend have been almost eliminated.

CATCHMENT WORKS

The Tamar Estuary River Health Action Plan (RHAP) was prepared by the Tamar Estuary Management Taskforce (the Taskforce) in 2017 under the Launceston City Deal with an aim of identifying investments to improve the health of the kanamaluka/Tamar estuary. It focuses on investing in a select group of recommended actions from the Water Quality Improvement Plan which lead to the greatest decrease in pathogens in the upper estuary from Launceston to Legana (Zone 1).

The catchment actions funded in the River Health Action Plan to the value of $11.5 million are being implemented across dairy and grazing areas, prioritised based on cost benefit and capacity to deliver, as well as urban areas over a 5-year period. This program is being managed by NRM North with the assistance of City of Launceston, West Tamar Council, Dairy Tasmania and the Tasmanian Farmers and Graziers Association (TFGA). Funded actions seek to exclude stock from streams, rehabilitate riparian vegetation buffers on grazing properties, ensure better effluent management on dairy farms and remove sewage intrusion into the separated stormwater system in urban Launceston. These actions are expected to reduce pathogen concentrations in the Launceston to Legana zone of the estuary by more than 4 percent, with the added benefit of reducing streamside erosion and sediment and nutrients loads from the catchment entering the estuary. For more information see the River Health Action Plan.

STORMWATER

Urban stormwater is primarily rainfall that runs off impervious areas such as roofs, roads, footpaths and car parks and enters drainage networks before being transported to waterways. In some areas, sewage intrudes into urban stormwater through cross-connections or damaged infrastructure. Urban sewage intrusion projects have been undertaken by City of Launceston in Trevallyn, Newstead and the majority of Riverside as part of the River Health Action Plan catchment works.

As of June 2020, these investigations have found nine confirmed sewage intrusions, two broken sewage mains and a collapsed stormwater main within these catchments; all of which are being rectified or are already fixed. Further investigations are happening in Mowbray, Norwood and Punchbowl and will continue until 2021. These improvements to stormwater management will result in decreased pathogens and other pollutants entering the kanamaluka/Tamar estuary.

SEDIMENT MANAGEMENT

A Sediment Raking Program was undertaken in the upper estuary form 2012 – 2019. Sediment raking involved the agitation of sediments on the bed and banks of the upper kanamaluka/Tamar estuary using a converted scallop dredge. The aim of the activity was to mobilise sediments from the upper estuary to reduce flood risk by removing built-up sediment, and improve recreational amenity, aesthetics and navigational access. During this Report Card period, sediment raking occurred from December 2018 to June 2019. A decision was made by the Launceston Flood Authority to cease sediment raking during this Report Card period following a review of the bathymetric and water quality impacts of the activity. The sediment raking review found that sediment raking did not effectively remove sediment from the upper estuary with the majority of raked sediments settling in the channel. It was also found that re-suspension of sediment particles and associated nutrients and metals, led to substantial impacts on water quality. Elevated pollutant levels were found throughout the length of the estuary for several weeks after sediment raking occurred. Larger and heavier pollutants resettled within Zone 1, however smaller dissolved pollutants were moved all the way down the estuary and were detected up to three weeks after raking activities stopped. The end of the sediment raking program has resulted in improved water quality and reduced concentrations of metals and other pollutants in the water column seen in improved Report Card grades in all zones of the estuary. Further information is available from the Tamar Estuary Management Taskforce.

LONG TERM TRENDS - HOW DO GRADES COMPARE WITH PREVIOUS YEARS?

Letter grades are calculated from an Ecological Health Index (EHI), a value between 0 and 1, which is a composite measure of the extent to which water quality meets or exceeds water quality guideline values. Scores closer to 0 reflect poor water quality, and scores closer to 1 reflect good water quality.

Grades for each zone and the corresponding EHI are shown in Figure 1 and Figure 2 respectively. These are given for each monitoring period corresponding to a previous Report Card (for example, 2017 data was used for the 2018 Report Card). Note that no grade or EHI is provided in Zone 2 for 2010 or 2011, or in Zone 5 for 2011. This is because there is no dissolved metal data in these zones in these years so a like for like comparison using the current method is not possible. Differences in grades within zones over time are not consistent, due to the variability in factors driving grades in each zone.

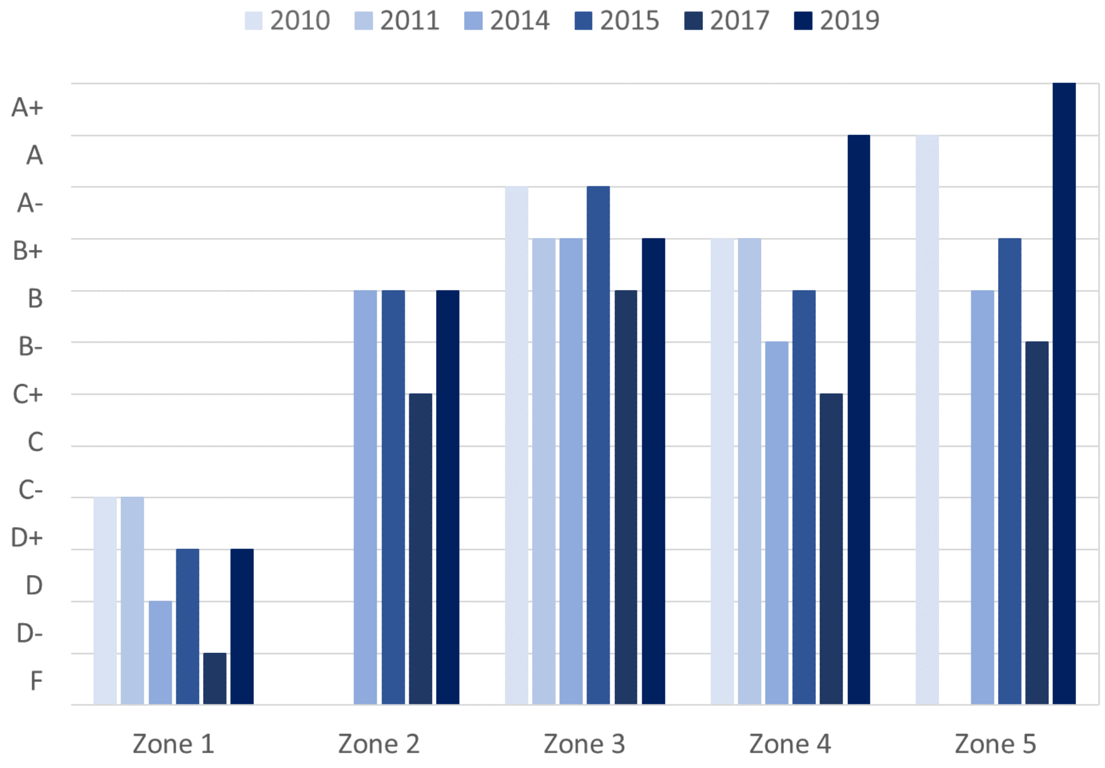

Figure 1. Trends in grades over time.

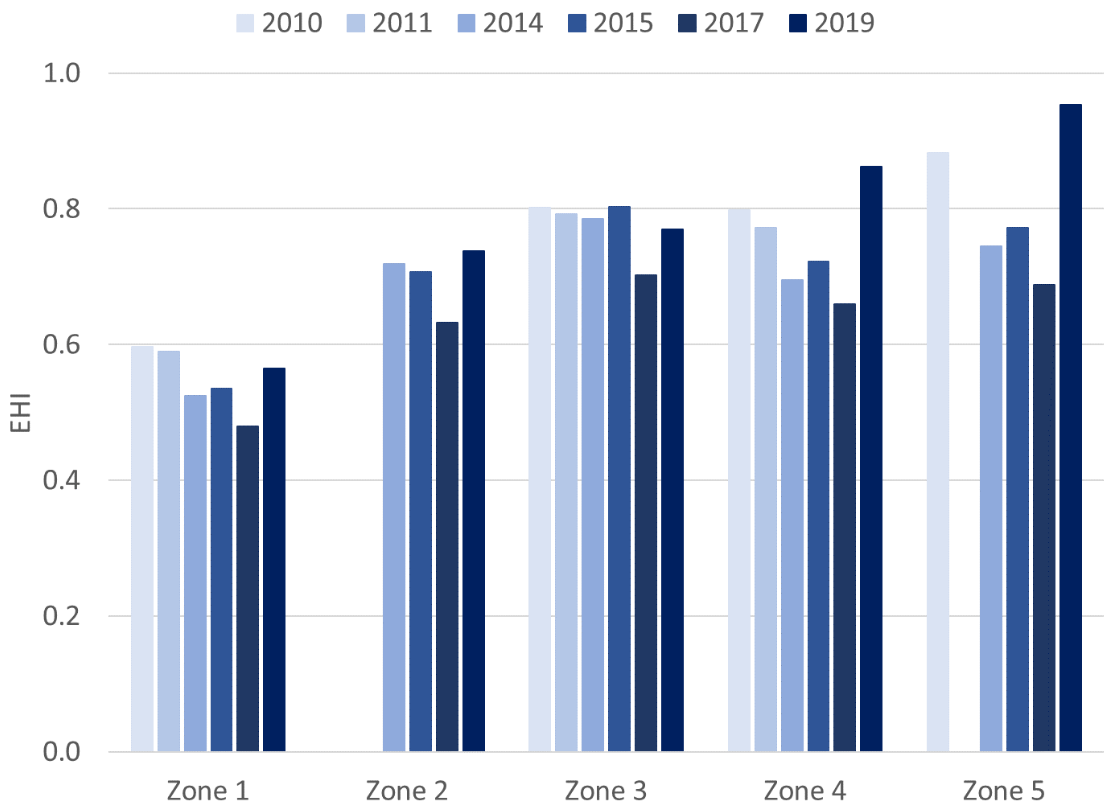

Figure 2. Trends in overall EHI producing grade by zone

Zone 1 experiences a drop in grades in 2014 to 2019, with the poorest grade in 2017. Grades in 2019 in this zone recovered but not quite all the way to pre-2011 levels. Inspection of overall EHI for this zone shows a substantial threshold effect when comparing 2010, 2011 and 2019, with EHI values varying by less than 0.02 leading to a difference in grade of D+ in 2010 and 2011 versus D in 2019.

No grade or EHI is available for Zone 2 in 2010 or 2011 with the revised methodology. Grades in 2014 and 2015 are the same as 2019 with small differences in EHI while the grade in 2017 drops from a B to a C+.

Grades and EHI in Zone 3 have mostly declined over time. Grades and EHI in 2015 recovered to 2010 levels but fell again in 2017 with an improvement in both EHI and grade from 2017 to 2019.

Changes over time in Zones 4 and 5 show a very similar pattern to Zone 1, although this is at higher EHI and grades in all years. Grades and EHI dropped from 2014 to 2017, then recovered in 2019. In these zones, the grades in 2019 are higher than 2010 and 2011.

These patterns in grades and EHI are due to a mix of changes in the components of EHI – nutrients, dissolved metals and other parameters. These can be seen responding to different pressures in the estuary and are discussed in more detail below.

Nutrients

Changes in pressures on nutrients over the period include:

- The commencement of iron salt dosing at Ti Tree Bend in April 2015 (half-way through the 2014 data series) led to a median decrease of total phosphorus (TP) discharged from Ti Tree Bend in the order of 60%. Total nitrogen did not experience a similar change.
- Improvements in wastewater treatment at Norwood and Longford plants reduced nutrients delivered to the upper estuary in 2019.
- Sediment raking released TP into the water column from Zone 1 and led to elevated dissolved reactive phosphorus (DRP) and nitrate + nitrite (NOx) down the length of the estuary.
- Differences in catchment inputs, with dry periods in some years and historically large floods in June 2016.

There is also a large increase in TP total phosphorus at site T10 in 2019, which is unexplained, that impacted substantially on the EHI in Zone 3 in this year This change is largely isolated to this site, with surrounding sites having TP values similar to previous years.

The Nutrient EHI shows changes over time in each zone (Figure 3).

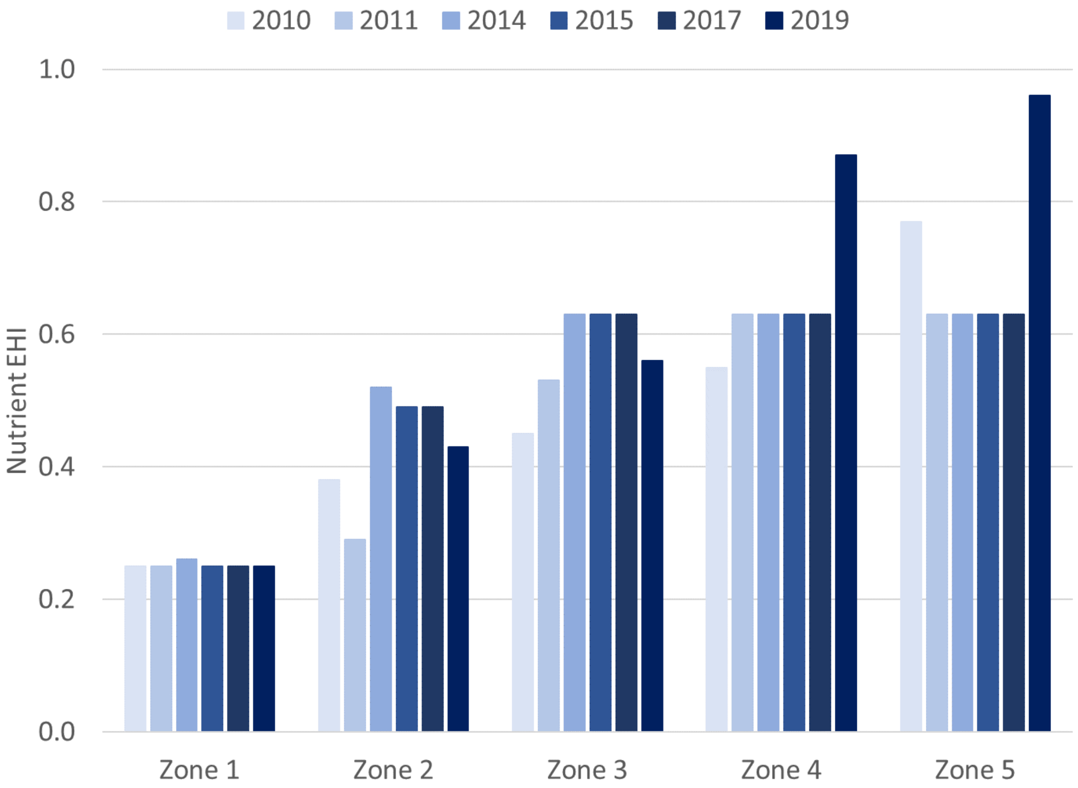

Figure 3. Trends in nutrient EHI by zone

While nutrients in Zone 1 are likely to have been impacted by all the factors above, this results in little to no change in nutrient EHI in this zone. This is because guideline values are low enough that nutrients generally exceed the highest guideline values regardless of changes in concentrations throughout in the time series.

Changes in Zone 2 are more mixed, improvements in 2014 and 2015 at this site may be due to reduced TP from Ti Tree Bend dominating the impacts in this zone. Subsequent declines in EHI are potentially due to the upstream tidal movement of nutrients from unexplained increases at T10 in 2019, combining with reduced pressures from sediment raking and Ti Tree Bend.

Nutrient EHI in Zone 3 increases from the 2010 to 2015, with a drop in 2019, but not to pre-2011 levels. As discussed, a large unexplained increase in TP at T10 impacts substantially on the nutrient EHI in 2019.

Patterns in nutrient EHI are similar in Zones 4 and 5. Generally consistent from 2011 to 2017, nutrient EHI improves above all previous years in 2019.

Dissolved metals

There was a general decrease in dissolved metal EHI in all zones in 2014 to 2017, with a recovery in 2019. Zone 3 and 4 both increase but not to the level of 2010 and 2011 EHI (Figure 4).

Decreases in dissolved metals EHI coincide with the peak period of sediment raking, which is known to have increased metals for the extent of the estuary. A statistically significant relationship exists between the number of days raked during the period of data collection and the preceding 6 months; and the dissolved metal EHI in Zones 1 and 3. This relationship is 94% significant in Zone 4 (ie falls just outside the 95% confidence level). No regression was undertaken for Zones 2 and 5 given the smaller number of data points available, but visual inspection shows similar trends. It is expected that changes in dissolved metal EHI can be largely attributed to the effects of sediment raking on the estuary, with improvements in dissolved metal EHI in 2019 a sign of recovery in water quality from cessation of this pressure.

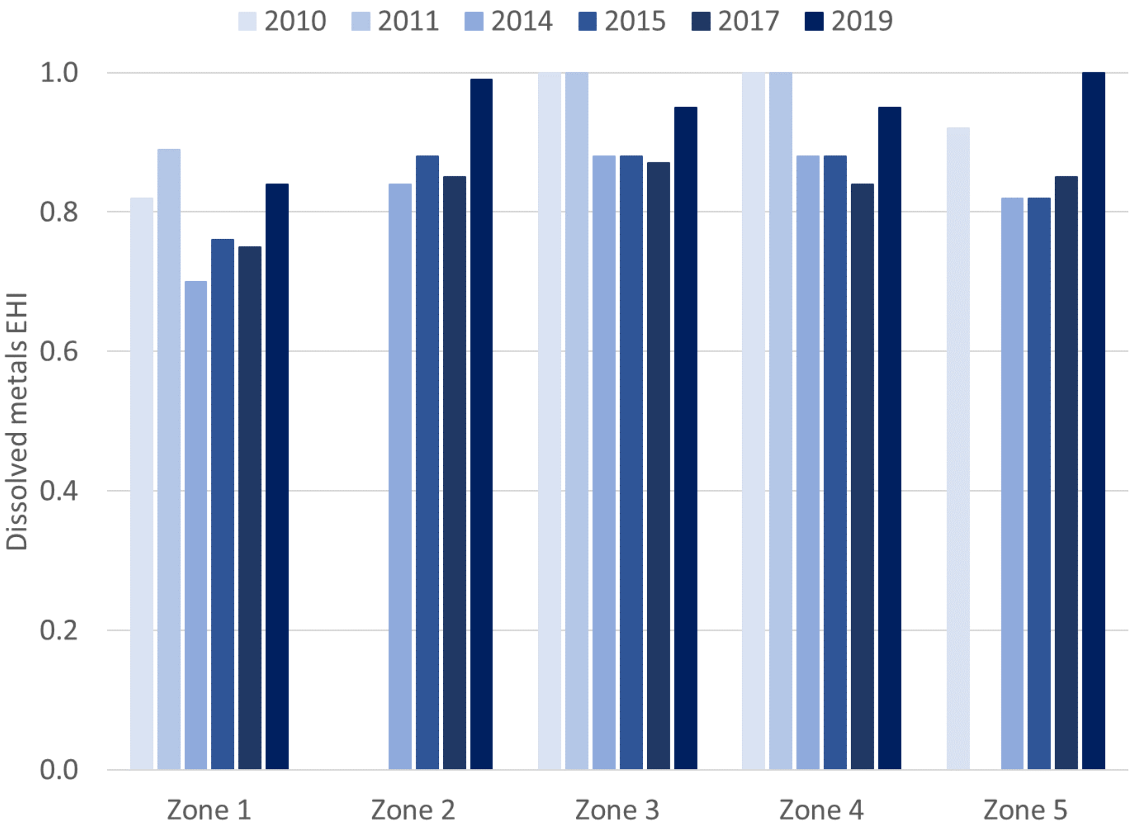

Figure 4. Trends in dissolved metal EHI by zone– note not all metals were collected in all zones in every year

Other parameters

The EHI equivalent measure for ‘other’ water quality parameters includes pH, dissolved oxygen saturation (DO%), chlorophyll-a (chl-a) and turbidity. This figure shows a general decrease from 2010 to 2017 with some recovery in 2019 (Figure 5). A large drop in EHI occurred in 2017 due to the combined effects of poorer pH, chl-a, turbidity and DO%, though major drops in DO% in this year are likely the key driver.

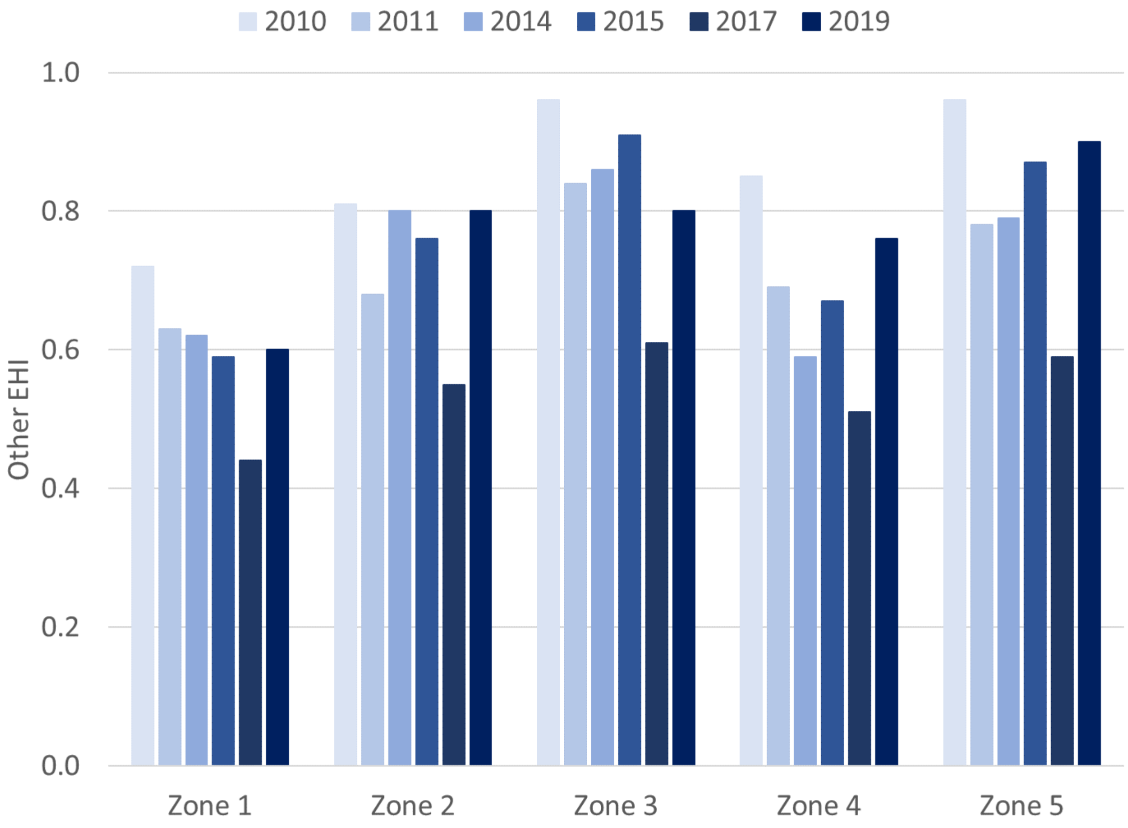

Figure 5. Trends in other (Chlorophyll-a, turbidity, pH and DO%) EHI by zone

Given the different drivers of change in the parameters that make up the ‘other’ component of the EHI, understanding changes across time in each zone requires consideration of changes in the EHI for each parameter.

Trends in the dissolved oxygen saturation EHI shows large decreases in the DO% EHI value in 2014 and 2017 in all zones except Zone 1 (Figure 6). A perfect, or almost perfect EHI of 1, was experienced in other years in these zones. In Zone 1 the same drop in 2017 occurred as in other years, but no drop occurred in 2014 and there was a small variation from the EHI of 1 in 2010 and 2015.

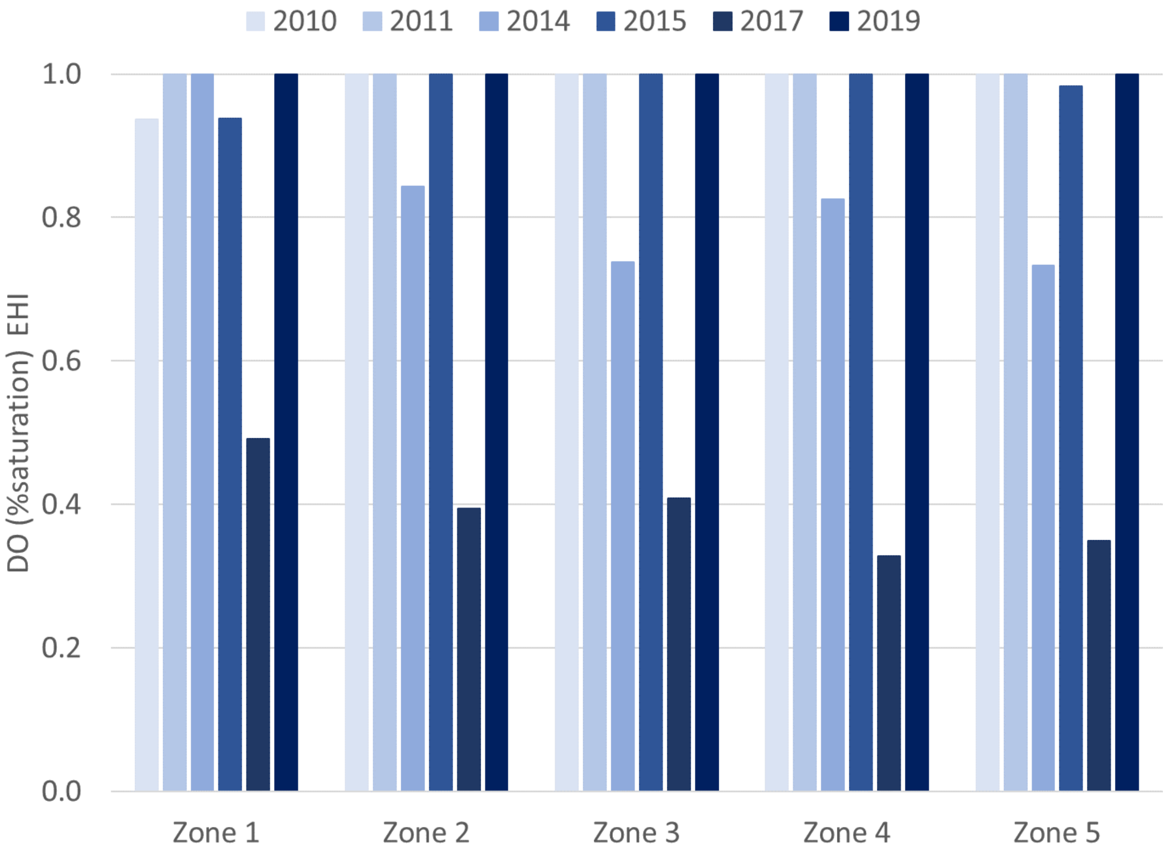

Figure 6. Trends in Dissolved oxygen saturation EHI by zone

Trends in the pH EHI show decreases in Zone 1 from 2014 onwards, with a larger decrease in 2017 and slight increase in 2019 (Figure 7). Zone 2 experienced a small decrease in EHI in 2014 with all other years stable at 1. Zone 3 experiences very small decreases from an EHI of 1 in years from 2014 onwards. The largest changes were experienced in Zones 4 and 5 with very large decreases in EHI after 2011. Time series data in these zones shows the pH began fluctuating over a larger range from 2014 onwards, with a generally decreasing trend, accounting for the drop in EHI. The cause of these changes is unknown. While climate change is known to decrease pH, with greater changes in the Southern Ocean than northern areas of Australia's waters, these changes are substantially larger than those described as a result of climate change in the literature.

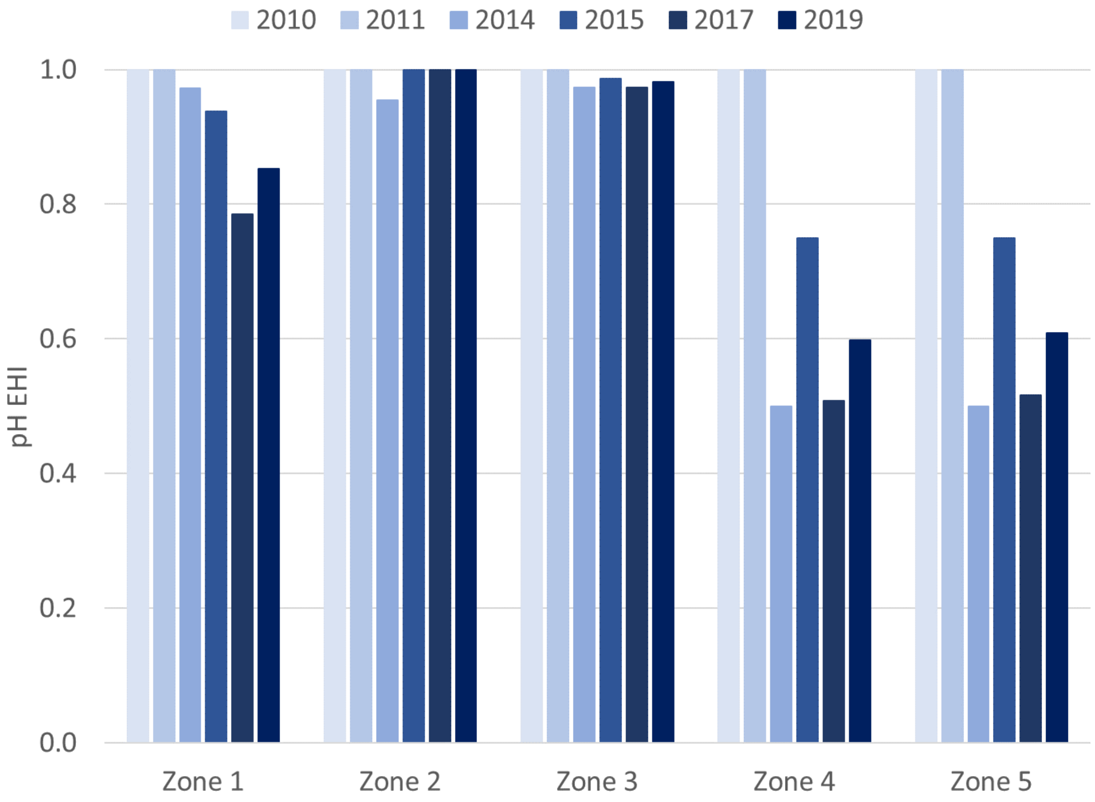

Figure 7. Trends in pH EHI by zone

The chlorophyll-a EHI shows a very large reduction in EHI in Zone 1 after 2010 (Figure 8). A reduction is also experienced in Zone 2, but a greater degree of variation is seen, with substantial increases in 2014 (which are also experienced in Zones 3 to 5) with a generally downward trend from that point onwards. Zone 3 experiences similar changes to Zone 2, though chl-a EHI in 2019 is less than 2017 in this zone. Zone 4 has peaks in 2010 and 2014 with chl-a EHI in other years being low. Zone 5 chl-a EHI also has peaks in these years but the highest chl-a EHI is in 2019. The high degree of variability in this parameter is likely due to a generally smaller range of values used to describe scores, particularly in the marine waters in Zones 4 and 5, resulting in threshold effects becoming more apparent.

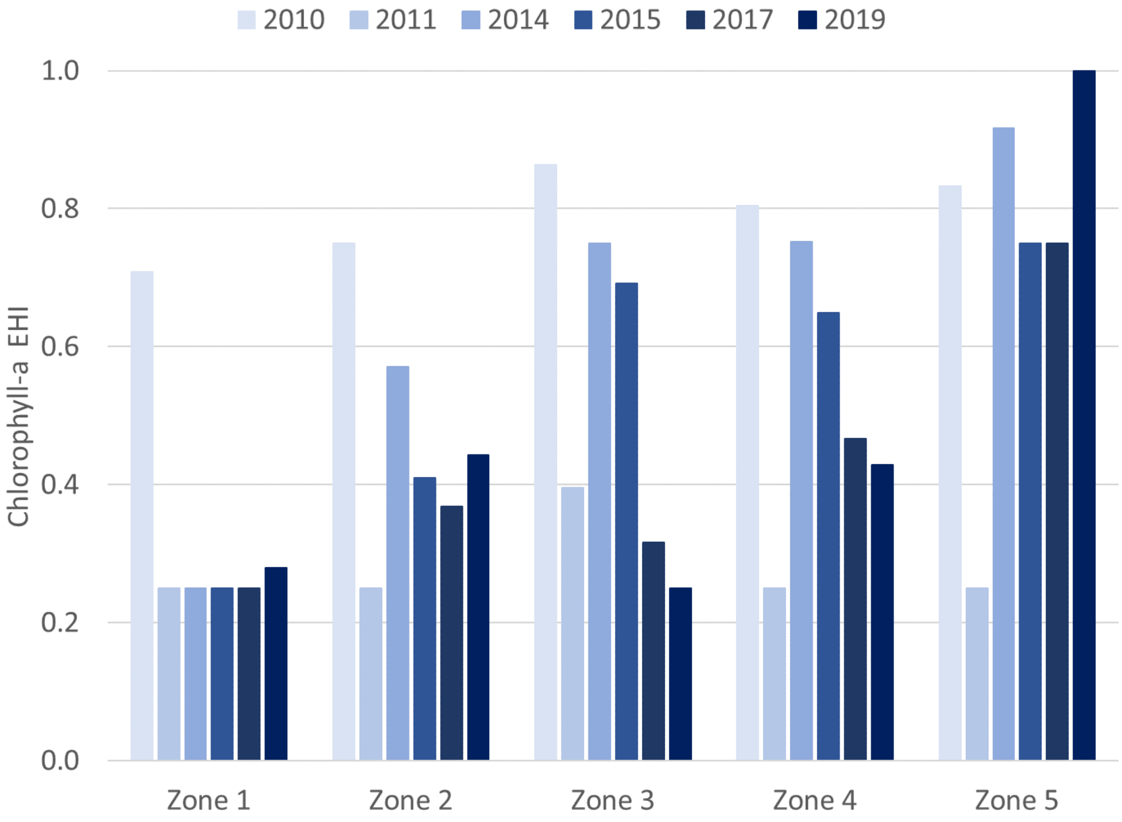

Figure 8. Trends in chlorophyll-a EHI by zone

Trends in the turbidity EHI for each zone show similar patterns in Zones 1 to 3, with consistent turbidity EHI in 2010 to 2015 and a drop in the latter two years (Figure 9). 2019 values are higher than 2017 values in Zones 2 and 3, but the same in Zone 1. Turbidity EHI values in Zone 4 are more consistent across the years, with drops in 2011 and 2017. In Zone 5 years 2010 and 2019 both have high EHI, with a large decrease in 2017 and step wise decrease from 2011 to 2014 and 2015 (which have the same value).

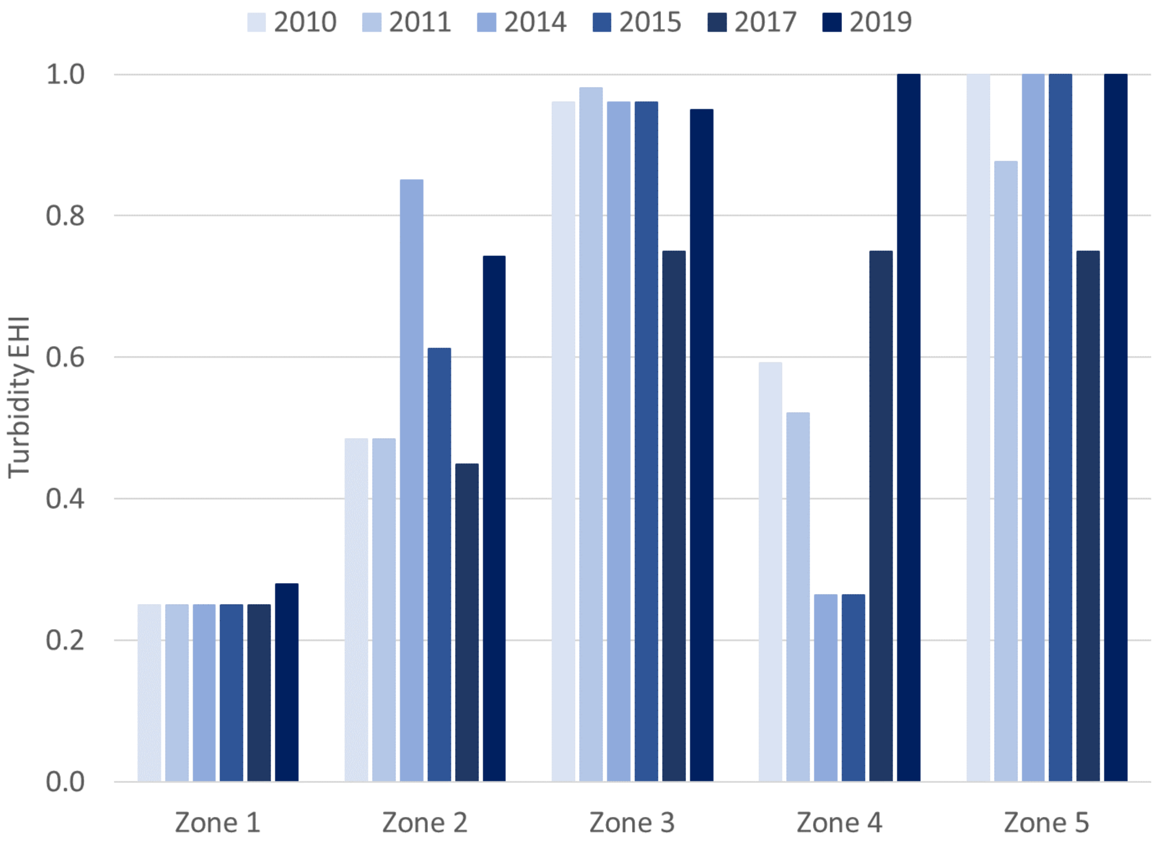

Figure 9. Trends in turbidity EHI by zone

These results show the difficulty of unpacking the drivers of the Other EHI component, with large fluctuations in some of these parameters having a substantial influence over final grades.

HOW ARE THE GRADES CALCULATED?

The 2020 Tamar Estuary Report Card has been produced using 12 months of kanamaluka/Tamar estuary ambient monitoring data, from December 2018 to November 2019, at 16 sites along the length of the estuary. In 2020, a new methodology was employed to calculate the grades. Key changes to the Report Card methodology include the adoption of biologically relevant trigger values, which are generally more stringent than previous methods. For toxicants such as metals, the worst value for the year is used as the score for the Ecosystem Health Index (EHI) reflecting the fact that one toxic event will have an impact on the ecosystem. Usually the 95th percentile of observed values is compared to the Toxicant Default Guideline Value (DGV) as insufficient number of samples were taken to determine a 95th percentile with a 95% confidence level (35 sample are required) to compare against the toxicant DGV. The EHI for nutrients is determined using the Tasmanian interim default guideline values, and the EHI for other parameters such as dissolved oxygen and pH, is determined using ANZECC guidelines where default trigger values are specific to ecological health. These methods provide a grade that best reflects the biological impact of changes in water quality.

All past grades have been re-calculated using the new methodology to allow for comparisons between years.

Scoring nutrients, Chlorophyll-a and turbidity

Interim Default Guideline Values for Tasmanian estuaries, developed by EPA Tasmania, are used to calculate scores for nutrients, Chlorophyll-a and turbidity. Observation scores use thresholds based on the median, 80th and 90th percentile values as shown. The final site score is the median of the observation scores for that site. Well flushed trigger values are used for the kanamaluka/Tamar estuary, with a salinity threshold of 25 parts per thousand used to separate thresholds for Chlorophyll-a and turbidity, and high conservation value (HCV) percentiles used in the lower estuary. For observations where salinity is less than 25ppt, and for TN and TP, the slight to moderately disturbed (SMD) percentiles are applied.

Scoring Toxicants

For toxicants, any exceedance of the trigger values is biologically significant, so comparison of medians is not appropriate and can miss significant environmental degradation. In a large data set, comparison of the 95th percentile to the trigger value would be the preferred approach. In the TEER Ecological Health Assessment Program (EHAP) metals data is generally not collected every month, so there is insufficient data to reliably calculate the 95th percentile. The lowest score (equivalent to the highest concentration of the toxicant) is used.

The 99%, 95% and 80% level of protection default guideline values for species protection are used to allocate scores. Observations greater than the 80% level of protection DGV are allocated the lowest score of 1, reflecting the likely toxic effect of this concentration of toxicant. Scores of 2 are provided to observations between the DGVs for 80% and 95% level of protection, 3 between 95% and 99% and 4 for concentrations below the DGV for 99% level of protection of species. The site score for the toxicant is the lowest score for the site over the period (equivalent to the highest concentration). For toxicants that are affected by salinity, different default guideline values are used depending on the salinity level (marine values are used at salinity>2ppt).). In theory, default guideline values at salinities below 2ppt should be corrected for water hardness, however the EHAP does not contain the information on $CaCO_3$ required to do this correction, so uncorrected default guideline values are used for freshwater.

Data below the limits of reporting is halved. Where thresholds are below the laboratory Limit of Reporting (LOR), the threshold is set at the LOR. A value of 4 is used where the water quality value is at or below the lowest threshold and 1 above the highest. If available thresholds create 3 bands, a value of 2 is allocated for the middle band.

pH and Dissolved oxygen saturation

Both pH and dissolved oxygen (DO) have a range within which values are associated with ecological health, where health declines outside this range with either decreasing or increasing values. These ranges vary for fresh and marine waters. ANZECC default guideline values for dissolved oxygen are between 85% and 110% saturation for lowland rivers, 80% and 110% for estuaries and 90% to 110% saturation for marine waters. 60% is considered to be a threshold below which DO should not fall, even in highly modified systems. DO saturation above 120% is also considered to be environmentally harmful. These values are used to determine the ranges of DO% associated with different scores for individual sites.

Likewise, ANZECC default guidelines for pH vary between 7 to 8.5 in estuaries and 8 to 8.4 in marine waters. Discussion of the effects of pH on ecological condition in the explanatory notes states that pH variation outside the range of 0.5 from the upper and lower end of the band for fresh and estuarine waters can be considered harmful, while marine waters should be kept within a range of 0.2. These values were used to derive ranges for scores on pH.