



Broadscale microplastic assessment of NSW estuaries

Report card 2021–24

Department of Climate Change,
Energy, the Environment and Water



Assessing microplastic contamination in NSW

The *NSW broadscale microplastic assessment* is the first large-scale study of its kind in Australia, evaluating microplastic contamination across 120 coastal waterways in New South Wales.

Commissioned by the NSW Environment Protection Authority (NSW EPA) under the NSW Government's Waste and Sustainable Materials Strategy, this initiative was designed in response to the NSW Marine debris threat and risk assessment (MDTARA).

The MDTARA identified microplastics (plastic particles smaller than 5 mm) as a priority threat to the NSW marine estate, with significant knowledge gaps, including a lack of data on microplastic distribution and its abundance. This has led to an inability to spatially assess microplastic contamination and associated threat.

Acknowledging knowledge gaps and the growing threat that microplastics pose to aquatic environments, particularly critical ecosystems like estuaries, the *NSW Broadscale microplastic assessment* was initiated and undertaken by the Department of Climate Change, Energy the Environment and Water.

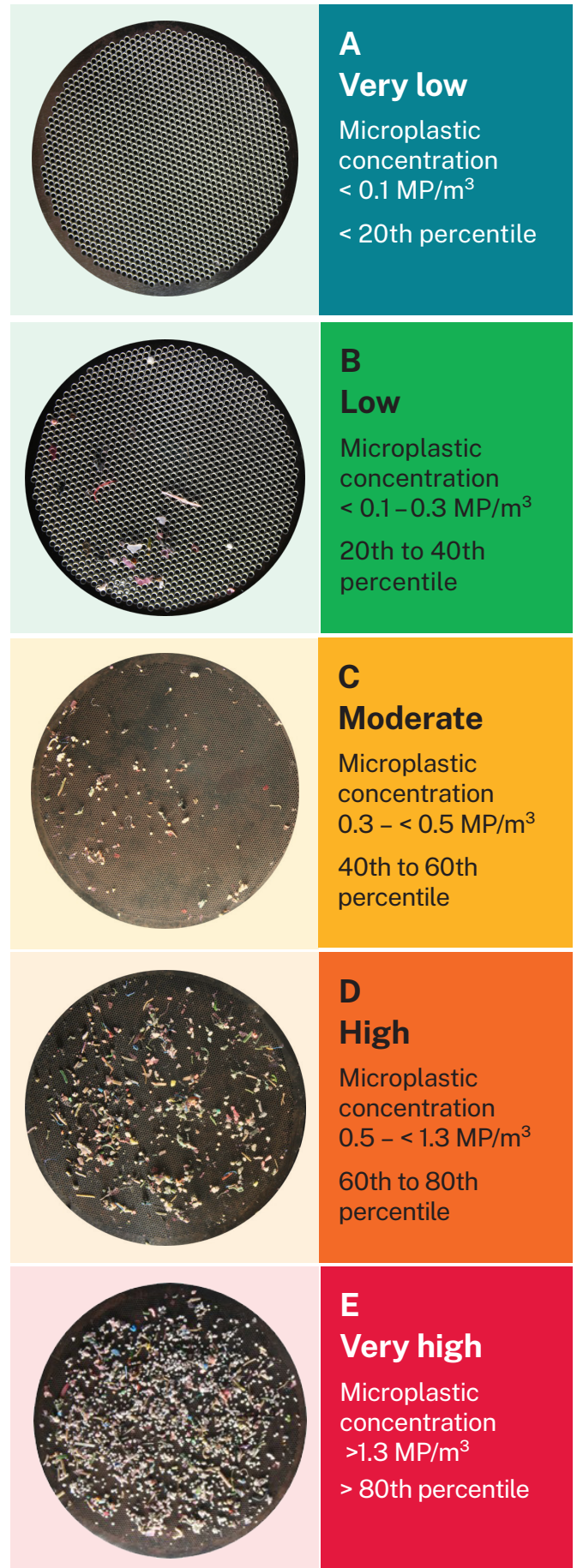
Conducted in the summer months from 2021 to 2024, surface water sampling revealed microplastics were present in all waterways surveyed.

A percentile-based grading system (A–E) was developed to classify contamination, identifying 23 waterways, mostly in urbanised regions such as the Hawkesbury–Sydney area, as having very high contamination levels ($>1.3 \text{ MP/m}^3$). 1.3 MP/m^3 is equivalent to an Olympic swimming pool ($\sim 2,500 \text{ m}^3$) containing 3,250 microplastics.

To learn more about how we sample for microplastics, watch our video '[Monitoring for Microplastics](#)'.

To find out more about the methodology used, check out our [microplastic methods paper](#).

Microplastic contamination grades



Sampling for microplastics

A manta net, with a mesh size of 300 μm , surveyed the top 15 cm of the water column in 120 NSW coastal waterways. To allow the sampling of shallower systems, a net was designed to be towed behind a canoe.

Collected samples were sieved, digested, density-separated, and vacuum-filtered to isolate microplastics from organic matter. Particles were then stained with Nile Red and photographed. These photographs were used to automate the identification of fluorescent particles and estimate microplastic concentration.

All samples were graded based on their microplastic concentration.



Manta net being towed by 4-metre canoe rigged with a motor on Parramatta River. Photo: NSW EPA

Overall results

Between 2021 and 2024, 594 surface water samples were collected across 120 NSW coastal waterways to assess microplastic contamination (Figure 1).

Of the waterways tested, only 4 had very low levels of microplastic contamination (Grade A), while 23 had very high levels (Grade E).

The overall median concentration was 0.38 MP/m^3 , but values ranged widely, with urban catchments such as Cooks River, Dee Why Lagoon, and Duck River recording the highest contamination levels. All waterways were situated within highly urbanised catchments. In contrast, minimally disturbed systems like Myall Lake and Nadgee Lake had the lowest concentrations (Figure 2).

Across all samples, an estimated 31,966 microplastic particles were counted, with small particles (0.25–1 mm) dominating at 68% (Figure 3).

Among larger particles (>2 mm), fragments and foam were most common, followed by film, artificial turf, and pellets (Figure 4). Foam, artificial turf and pellets accounted for 44% of all items categorised and are considered priority items.

Microplastic concentrations in NSW estuaries ($\sim 2 \text{ MP}/\text{m}^3$) sit towards the middle range of globally reported surface-water values (Figure 5). Levels exceed those documented in several European and offshore Australian waters and are comparable to urbanised systems in China, although they remain below the most extreme contamination hotspots reported worldwide. While methodological differences complicate direct comparisons, these data indicate that highly urbanised catchments are contributing microplastic loads at a scale consistent with some of the more impacted coastal systems globally.



Microplastics. Photo: NSW EPA

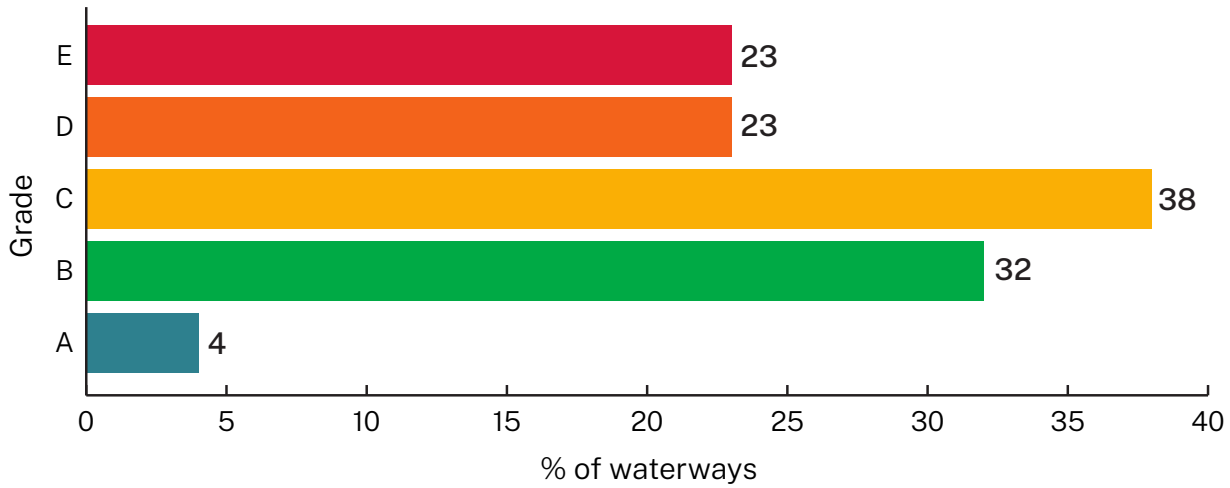


Figure 1 Distribution of NSW coastal waterways across microplastic contamination grades (A-E)

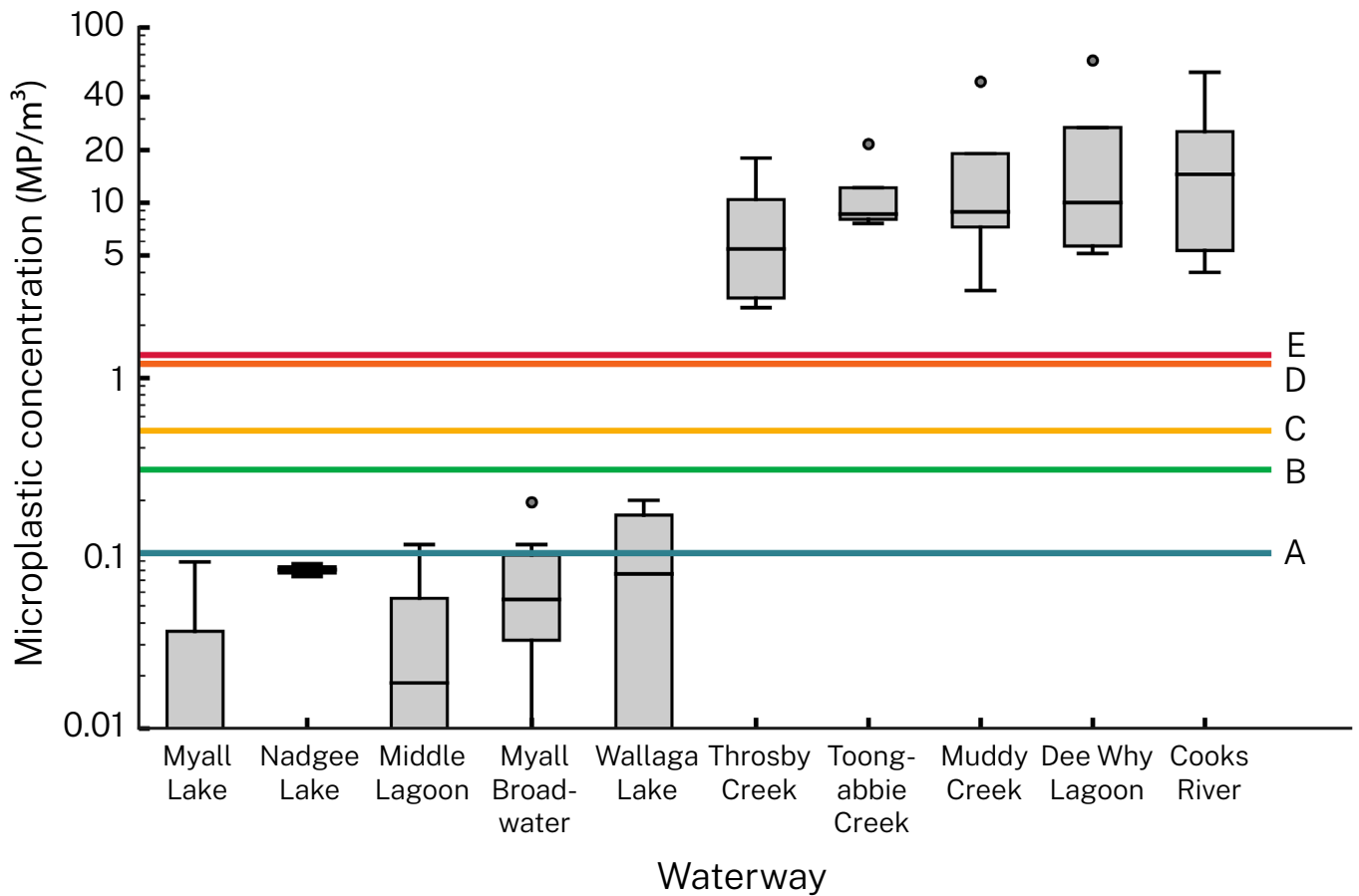


Figure 2 The 5 waterways with the least microplastic contamination (MP/m³) and the 5 waterways with the highest microplastic contamination

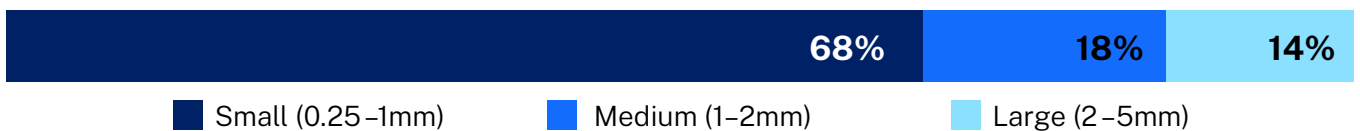


Figure 3 Proportion of microplastic particles by size class

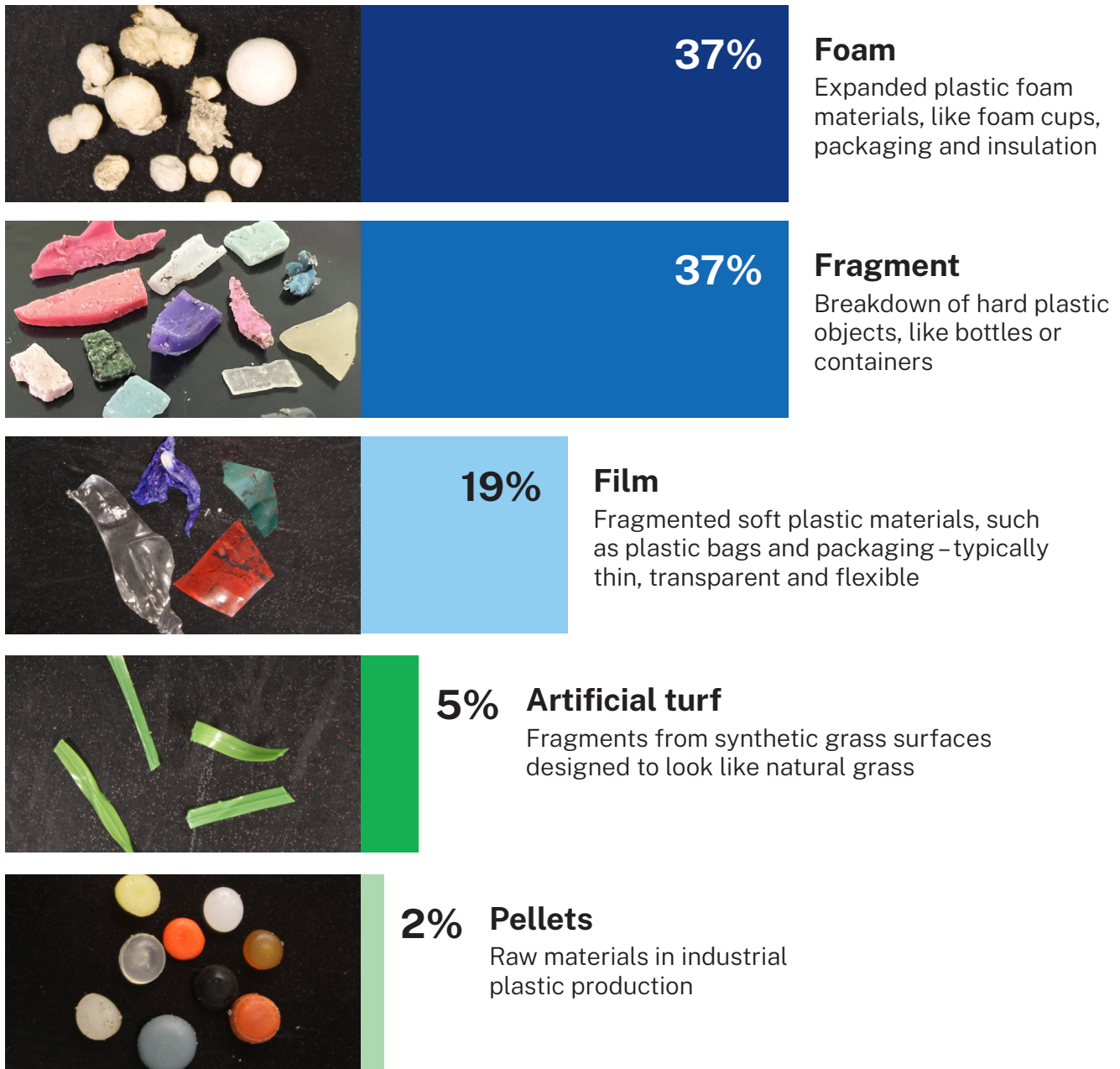


Figure 4 Proportion of microplastic particles by morphology

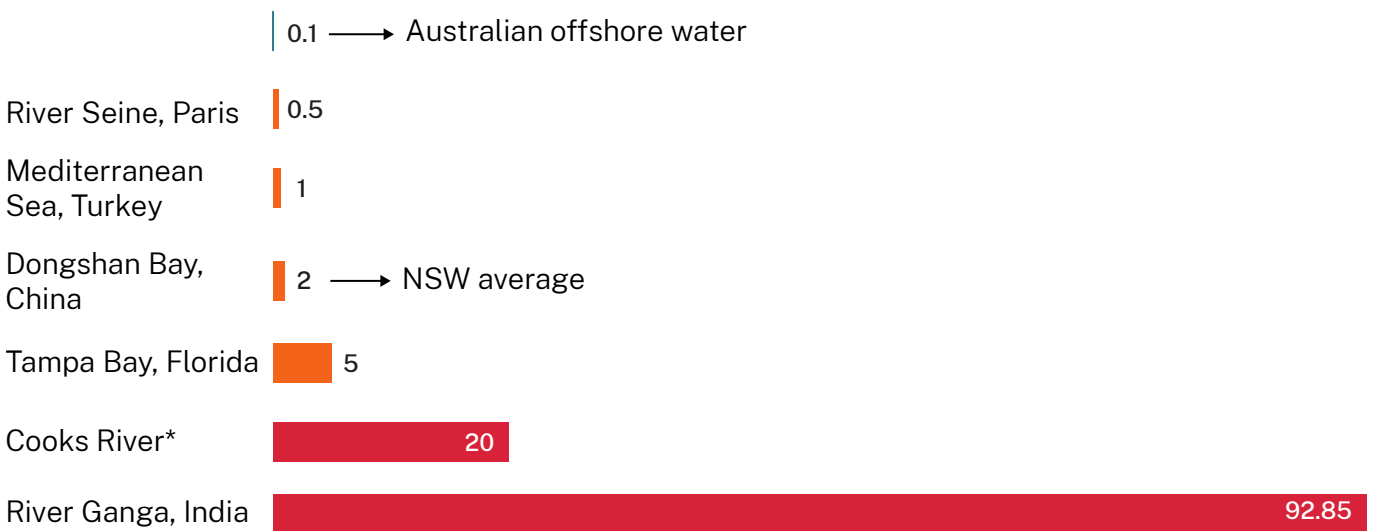


Figure 5 Comparison of NSW and global microplastic contamination in surface waters, MP/m³ (*median). Note that microplastic concentrations across studies measure different particle size ranges, making direct comparisons complex

Regional results

Due to the geographic scale of New South Wales and the large number of waterways surveyed (n=120), the state was subdivided into 8 regions (Figure 6).

This colour scheme was used to produce a spatial heatmap for each region, clearly identifying locations with the highest and lowest levels of microplastic contamination.

Grades were visualised using a traffic-light colour scheme, ranging from teal (very low contamination) to red (very high contamination).

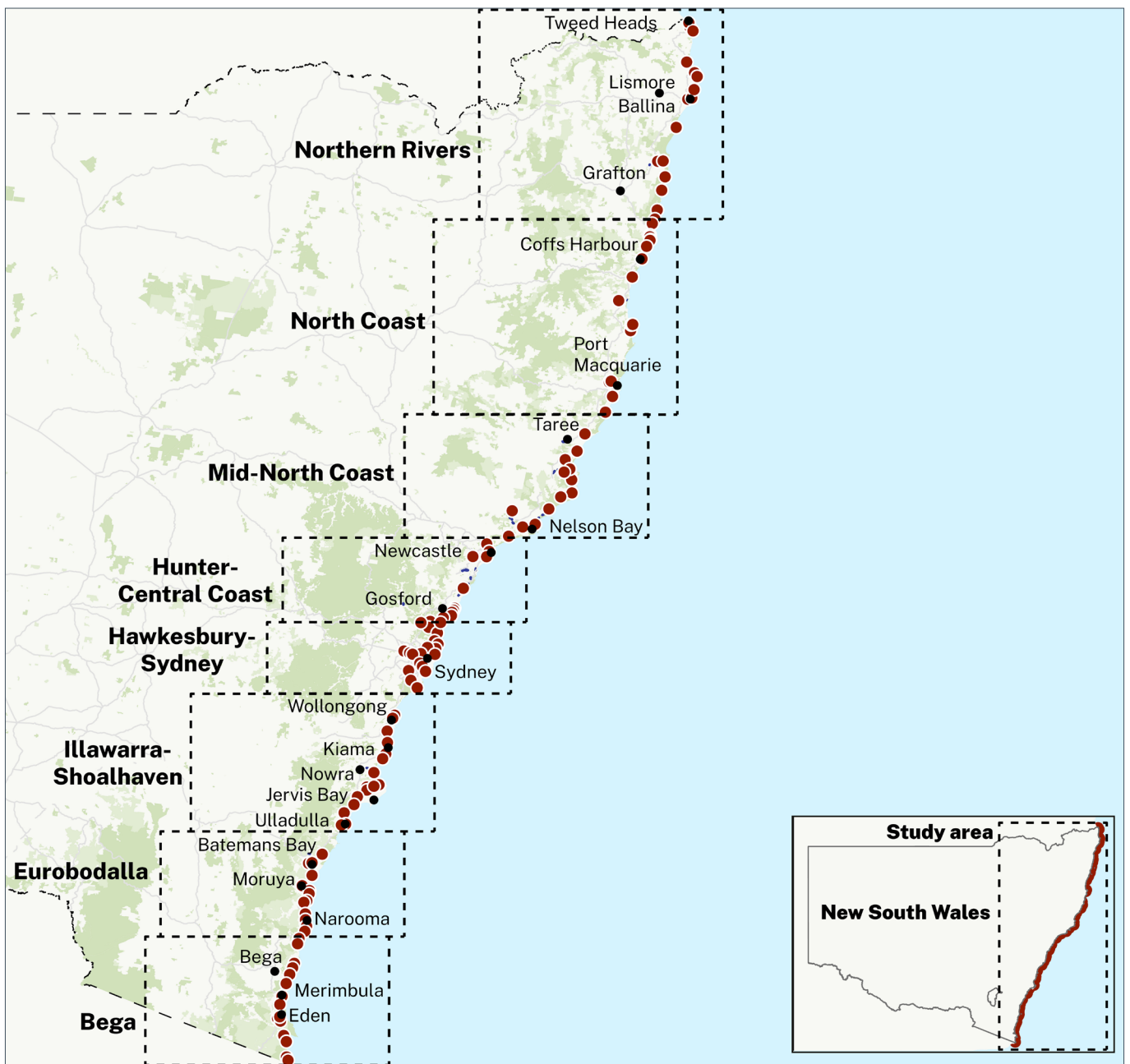


Figure 6 Microplastic reporting regions and waterways across New South Wales

Northern Rivers

The Northern Rivers region exhibited generally low-to-moderate microplastic contamination compared to other NSW coastal regions, ranking fifth statewide. Across 15 waterways and 58 samples, most systems fell within Grades B–C, with only 2 waterways graded E (>1.3 MP/m³) (Figure 7).

Large rivers such as the Tweed, Richmond, and Clarence consistently showed low contamination (Grade B). In contrast, smaller lagoon systems such as Lake Ainsworth and Belongil Creek recorded the highest regional concentrations, highlighting the influence of estuary type on microplastic loads.

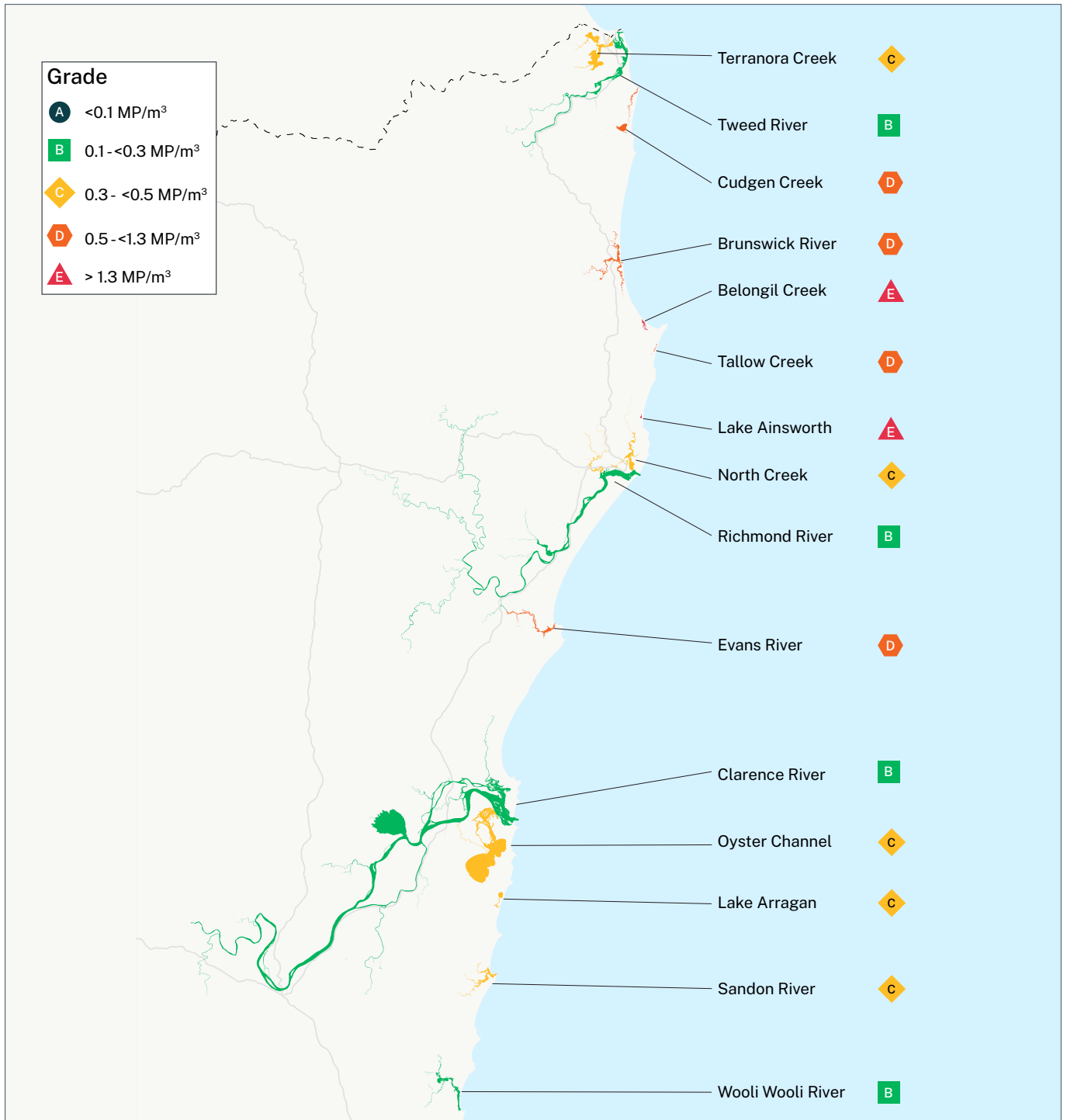


Figure 7 Coastal waterways within the Northern Rivers region colour-coded according to microplastic contamination grade

North Coast

The North Coast region exhibited moderate to high microplastic contamination, ranking seventh statewide. Across 17 waterways and 67 samples, most systems fell within Grade C, with no waterways graded A or B and 3 systems graded E ($>1.3 \text{ MP/m}^3$) (Figure 8).

Localised hotspots were found at Darkum Creek, Coffs Creek and South West Rocks Creek, all in highly disturbed catchments and among the most contaminated waterways in New South Wales.

While some systems showed high variability, overall patterns indicate that smaller, urbanised waterways drive elevated contamination in this region.

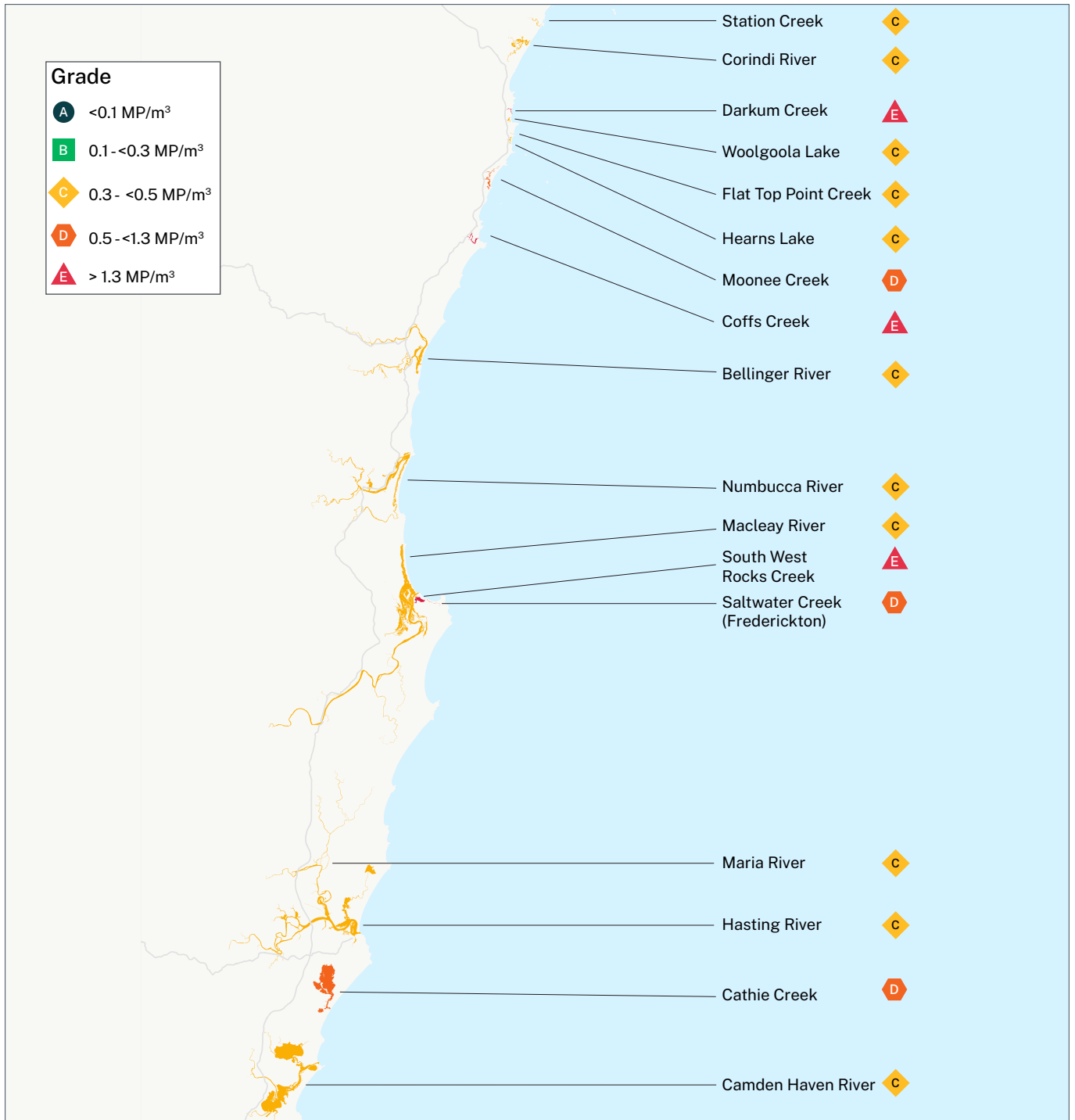


Figure 8 Coastal waterways within the North Coast region colour-coded according to microplastic contamination grade

Mid North Coast

The Mid North Coast region recorded the lowest microplastic contamination of all NSW coastal regions, ranking first statewide. Across 11 waterways and 96 samples, concentrations were predominantly low, with 2 waterways graded A (<0.1 MP/m³), 8 graded B (0.1–<0.3 MP/m³), and only one graded C (0.3–<0.5 MP/m³). No sites exceeded Grade D or E thresholds (Figure 9).

Myall Lake ranked first out of 120 monitored waterways statewide (median 0.01 MP/m³; Grade A), reflecting its minimally disturbed catchment.

Overall, the region demonstrates consistently low contamination, with only Wallamba Cove showing slightly elevated levels likely due to localised sources.

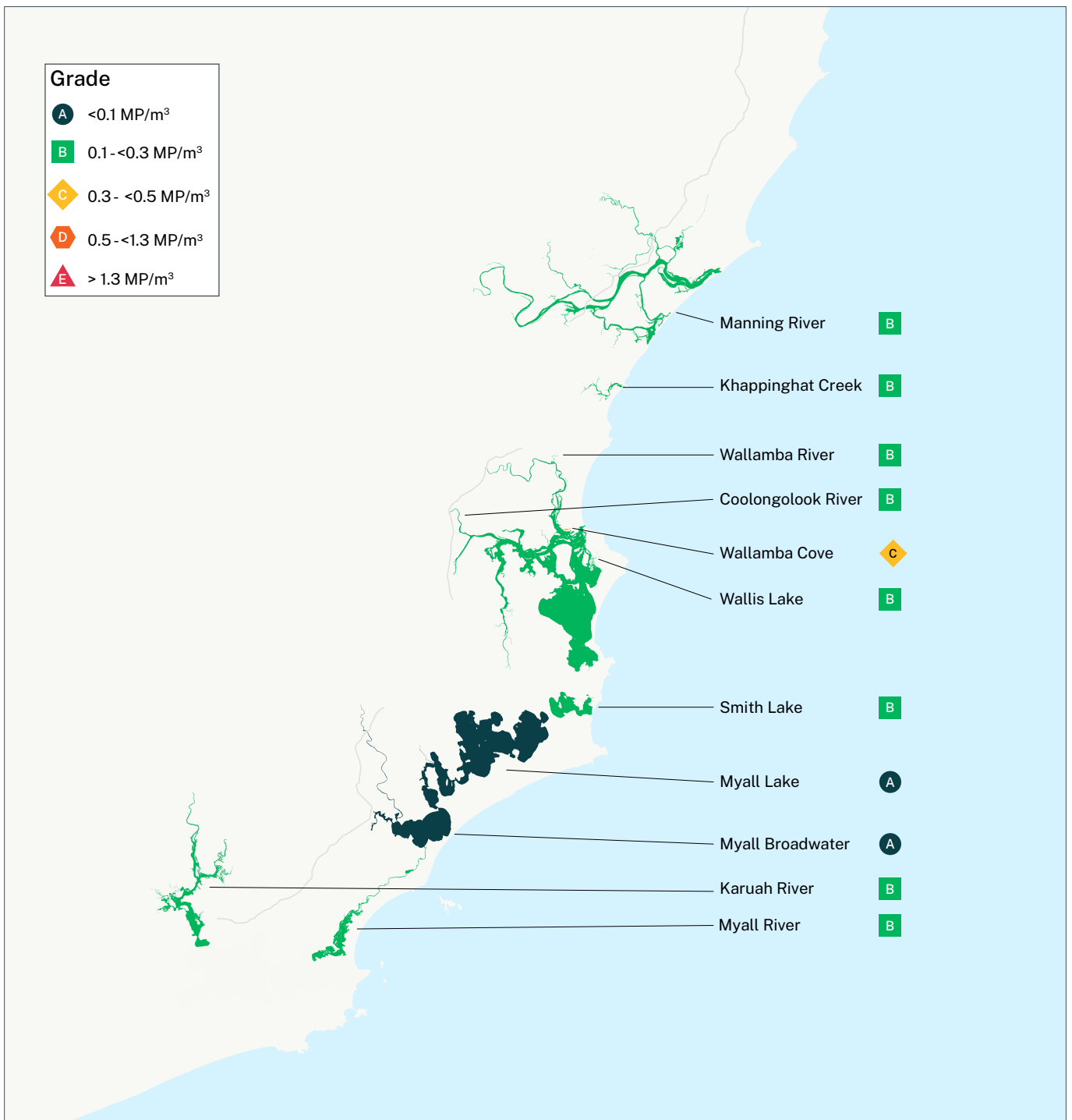


Figure 9 Coastal waterways within the Mid North Coast region colour-coded according to microplastic contamination grade

Hunter–Central Coast

The Hunter–Central Coast region exhibited low-to-moderate microplastic contamination, ranking fourth statewide. Across 12 waterways and 74 samples, most systems fell within Grades B–C, with 2 waterways graded D and 2 graded E (>1.3 MP/m³) (Figure 10).

Localised hotspots at Throsby Creek and Terrigal Lagoon recorded median concentrations well above Grade E thresholds (5.42 MP/m³ and 3.04 MP/m³, respectively), identifying them as priority sites for management. Larger systems such as Tilligerry Creek, Lake Macquarie, and Tuggerah Lakes generally recorded low contamination (Grade B).

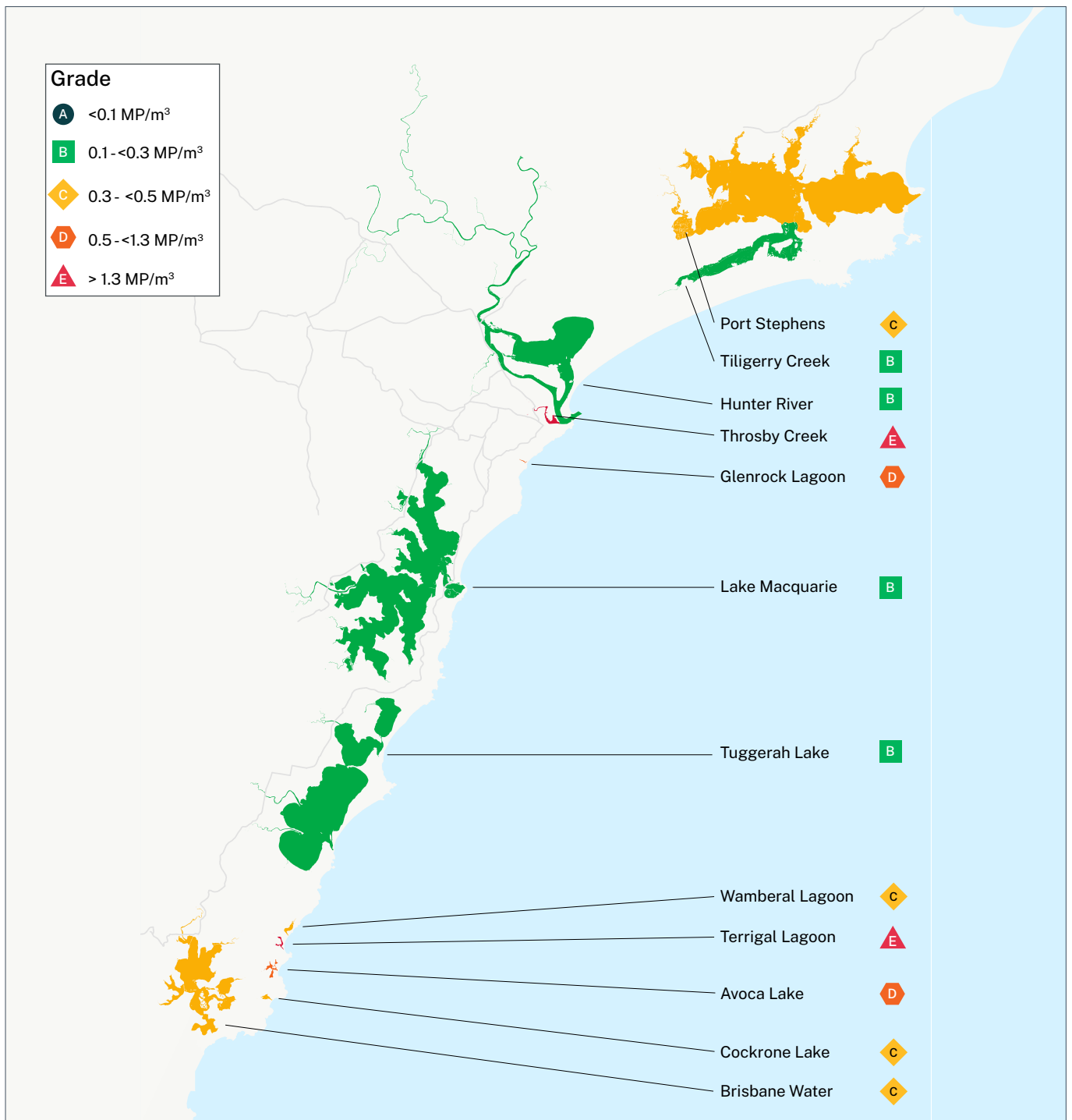


Figure 10 Hunter–Central Coast waterways spatial assessment of microplastic contamination

Hawkesbury–Sydney

The Hawkesbury–Sydney region ranked the highest for microplastic contamination among NSW coastal regions. Across 21 waterways and 111 samples, concentrations were predominantly within the high-to-very high range, with 10 waterways graded E (>1.3 MP/m³) and only one graded B (Figure 11).

Most sites exceeded Grade E thresholds, including major systems such as Cooks River, Dee Why Lagoon, and Parramatta River, highlighting the strong influence of urbanised catchments on microplastic loads.

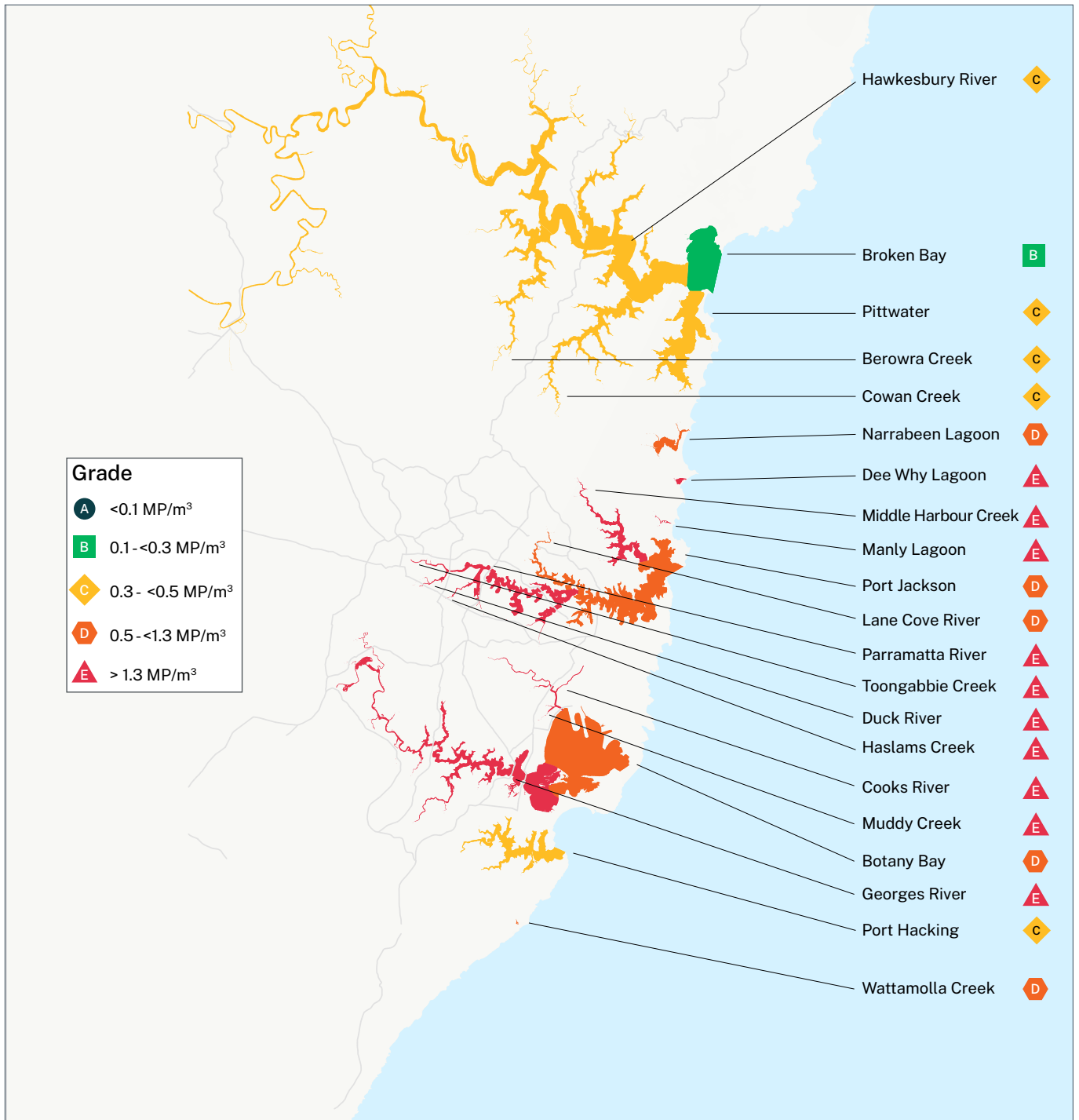


Figure 11 Spatial distribution of microplastic contamination grades (A–E) across waterways in the Hawkesbury–Sydney region

Illawarra–Shoalhaven

The Illawarra–Shoalhaven region exhibited moderate to high microplastic contamination, ranking sixth statewide. Across 16 waterways and 72 samples, most systems fell within Grades D–E, with 5 waterways graded B, one graded C, 4 graded D, and 6 graded E (>1.3 MP/m³) (Figure 12).

Localised hotspots included Moona Moona Creek and Fairy Creek, which recorded median concentrations of 3.24 MP/m³ and 6.30 MP/m³, respectively, ranking among the most contaminated waterways in New South Wales. In contrast, larger systems such as Lake Illawarra, Shoalhaven River, and St Georges Basin generally recorded low contamination (Grade B). These patterns highlight the influence of estuary type on microplastic loads.

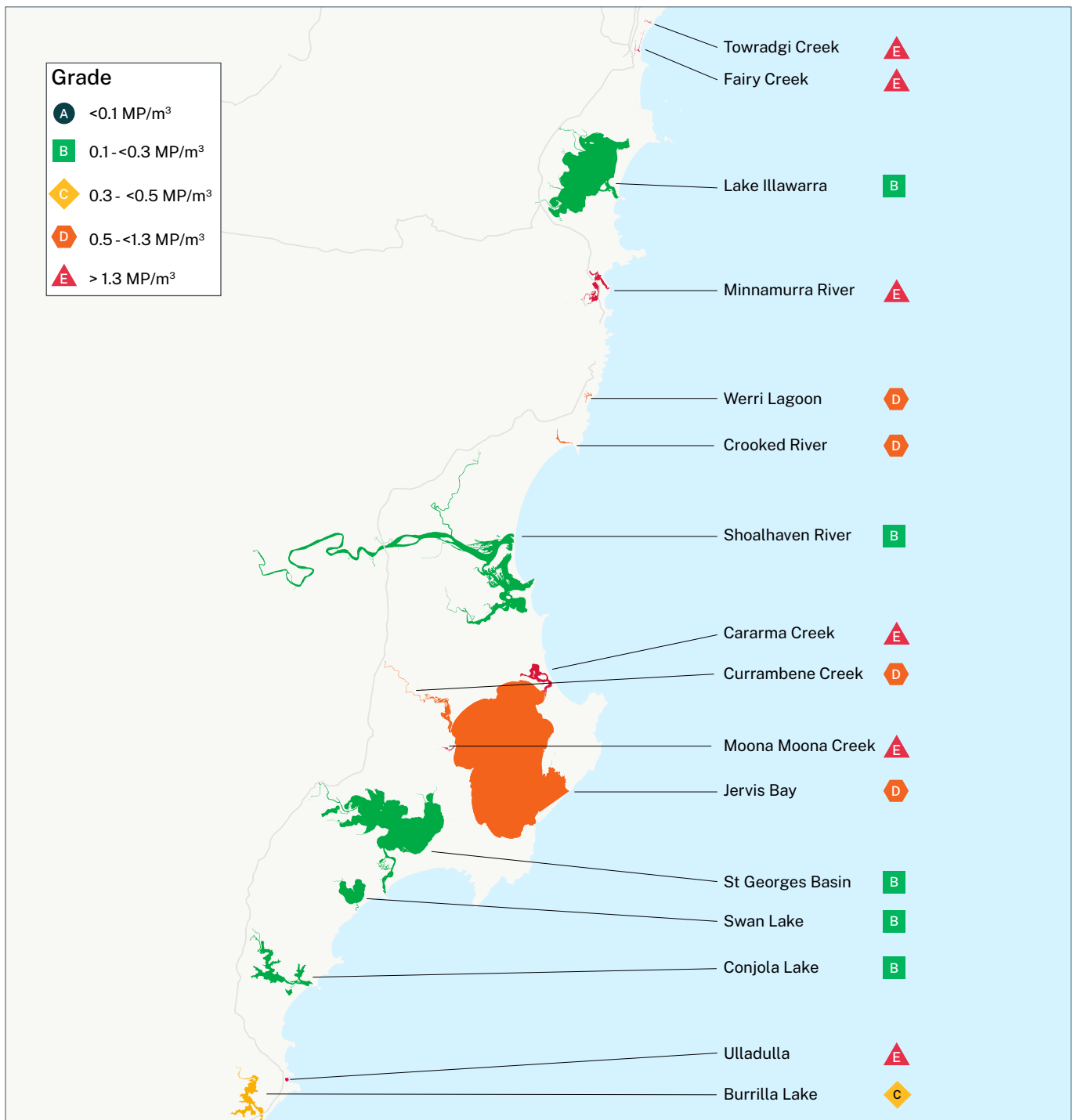


Figure 12 Spatial distribution of microplastic contamination grades (A–E) across coastal waterways in Illawarra–Shoalhaven region

Eurobodalla

The Eurobodalla region exhibited low-to-moderate microplastic contamination, ranking second statewide as one of the least impacted regions. Across 13 waterways and 58 samples, most systems fell within Grades B–C, with 5 waterways graded B, 6 graded C, and 2 graded D; no sites were graded A or E (Figure 13).

Overall, this region had low levels of microplastic contamination, except for isolated hot spots where higher levels were found. These seem to be caused by site-specific sources that can be managed.

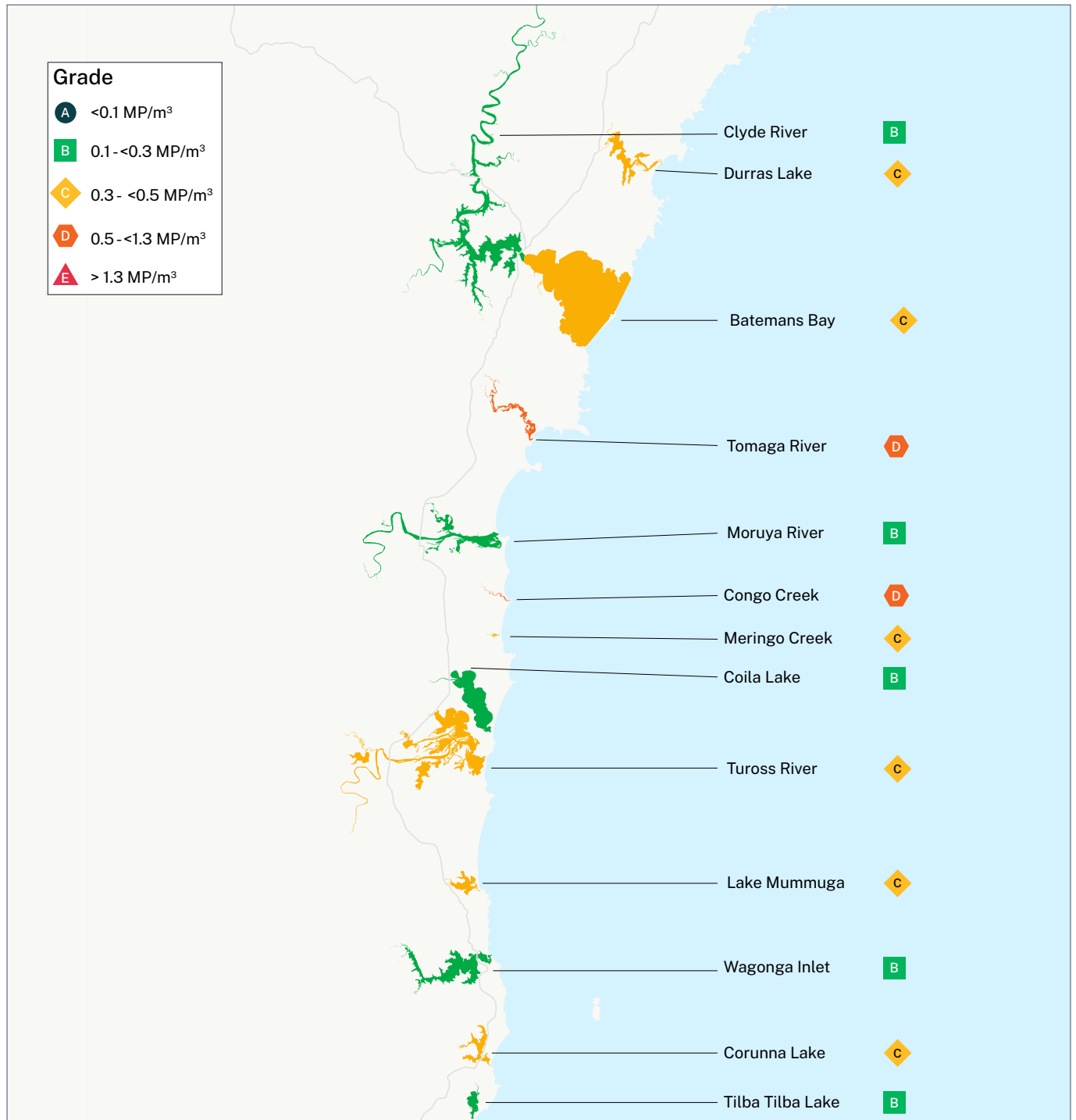


Figure 13 Spatial distribution of microplastic contamination grades (A–E) across coastal waterways in Eurobodalla region

Bega

The Bega region exhibited low-to-moderate microplastic contamination, ranking third statewide as one of the least impacted regions. Across 15 waterways and 58 samples, most systems fell within Grades A–C, with 2 waterways graded A (<0.1 MP/m³), 5 graded B, 5 graded C, and 3 graded D; no sites were graded E (>1.3 MP/m³) (Figure 14).

Nadgee Lake and Middle Lagoon recorded consistently very low concentrations (Grade A), ranking second and third statewide for lowest contamination, reflecting their minimally disturbed catchments.

While overall contamination was low, Bermagui River, Merimbula Lake, and Twofold Bay showed higher concentrations (Grade D), suggesting localised anthropogenic pressures.

These findings highlight the influence of catchment disturbance on microplastic loads and the role of pristine lagoons as reference sites.

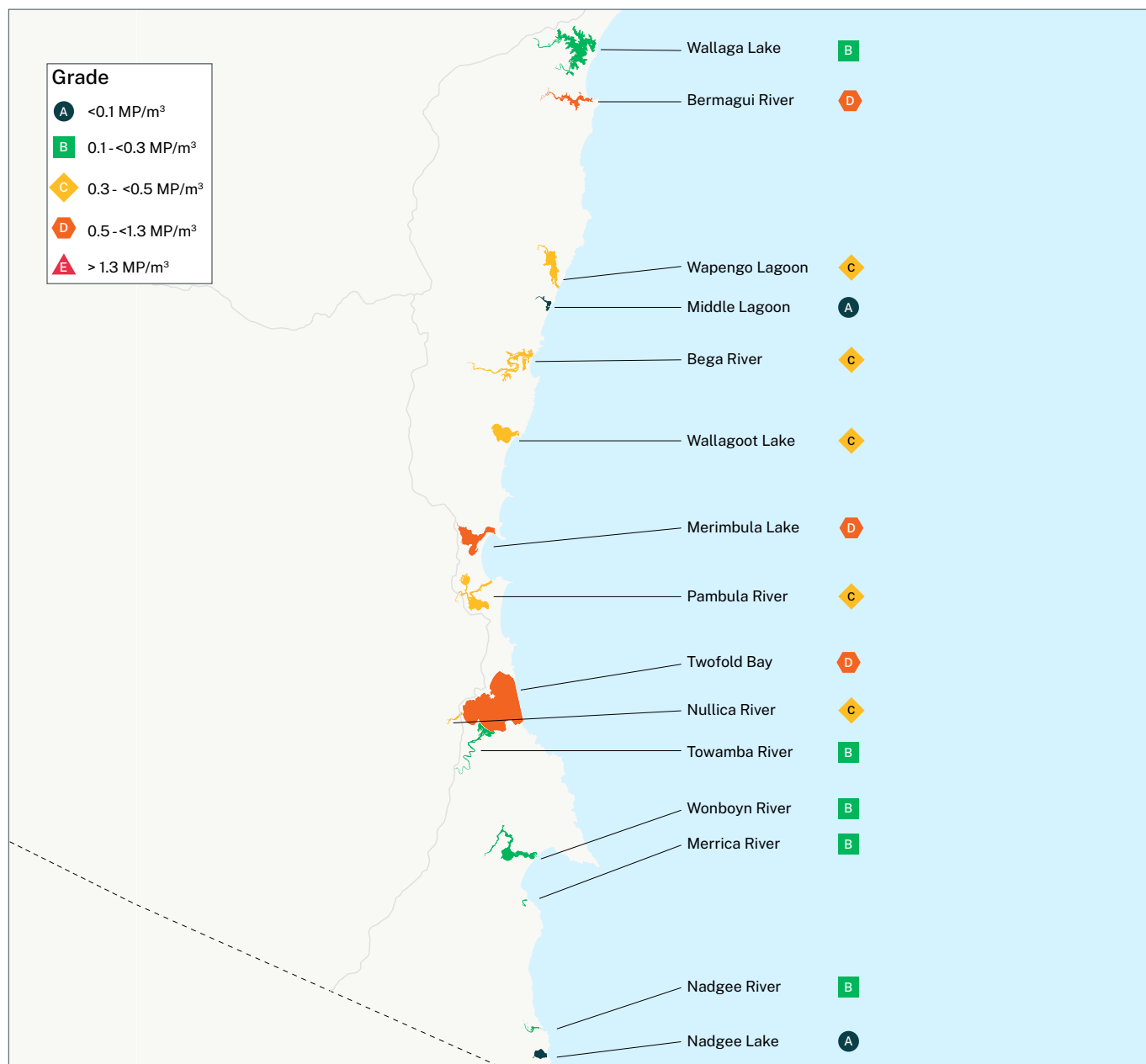


Figure 14 Spatial distribution of microplastic contamination grades (A–E) across coastal waterways in the Bega region

Key findings

- Microplastics were present in all NSW waterways surveyed (mean = 2.15 MP/m³, median of 0.38 MP/m³).
- NSW microplastic concentrations on average are moderate-high relative to international surface-water studies.
- Smaller sized particles (>0.25 to <1 mm) were the most abundant, accounting for 68% of all particles.
- Most waterways fell within low to moderate contamination.
- 19% of waterways were graded E (very high contamination).
- The Hawkesbury–Sydney region is the primary hot-spot. Cooks River, Dee Why Lagoon, Manly Lagoon and Duck River (Upper Parramatta River) were the most contaminated and considered priority waterways for management.
- There is a strong link between urbanisation and contamination (increase of +1 MP/m³ per 10% increase in urbanisation).
- Estuary hydrodynamics influence microplastic retention.
- Foam, artificial turf fragments and pellets (priority items) accounted for 44% of all items categorised.
- Fragments and film (secondary microplastics) accounted for 56% of all items categorised.

Recommendations

- **Long-term monitoring.** Establish a statewide program with sentinel sites, seasonal sampling, and trend tracking.
- **Expand scope.** Include smaller particles (<0.25 mm), sediment and biota sampling, and flood/baseflow events.
- **Standardised methods.** Develop national protocols in collaboration with EPA, CSIRO, and AIMS (Australian Institute of Marine Science).
- **Ecosystem impact studies.** Assess bioavailability, bioaccumulation, and toxicological effects on estuarine species.
- **Target priority sources**
 - Foam packaging – regulate or phase out.
 - Artificial turf fragments – containment and phase out.
 - Pellets (nurdles) – enforce handling and containment.
- **Polymer risk assessment.** Identify dominant polymers and evaluate toxicity for risk-based regulation.
- **Focus on urban catchments.** Prioritise the Hawkesbury–Sydney region for interventions (stormwater treatment, litter flow analysis (*Streets to Sea*), land-use controls).

Project funding

This study was undertaken by the Department of Climate Change, Energy, the Environment and Water, and this project is an initiative of the NSW Environment Protection Authority under the NSW Government’s Waste and Sustainable Materials Strategy.

This project was part funded by the Marine Estate Management Strategy under Initiative 1a.

More information

- [Microplastics monitoring](#)
- [Marine debris threat and risk assessment](#)
- [Stat on pixels – Microplastic automated count script](#)
- [Streets to Sea](#)
- [Waste and Sustainable Materials Strategy](#)
- [Microplastic sampling video on microplastics across NSW coastal waterways](#)