



Magela Creek monitoring data 2017-2018

The Supervising Scientist water chemistry monitoring program has been developed using continuous monitoring of physico-chemical parameters coupled with automatic event-based collection of water samples. Chemistry samples are collected when an electrical conductivity (EC) trigger is reached, indicating the potential for high contaminants to be present in the creek, and during routine monthly quality assurance sampling.. No event-based samples were collected this season due to the continuing low electrical conductivity.

Details regarding the development and operation of the monitoring program can be found in the [Surface water chemistry monitoring protocol to assess impacts from Ranger Mine](#).

The charts below compare measurements of key chemical indicators, collected during the **2017-18** wet season, to the [Water Quality Objectives \(WQOs\)](#) for Magela Creek. The WQOs present a hierarchical set of trigger values for each indicator, enabling a tiered approach to the oversight and management of water quality in Magela Creek.

Focus Trigger Value - Values that are higher than the Focus level but lower than the Action level will result in a watching brief. A watching brief involves precautionary ongoing data assessment to verify whether or not a trend away from background is occurring, possibly including further sampling if required.

Action Trigger Value - Values that are higher than the Action level but lower than the Guideline/Limit will result in a data assessment. Where assessment of the data shows the value represents a trend away from background the company must undertake:

- An investigation into the cause of the exceedance; and
- Correction of the cause if it is deemed to be mining related.

The Focus and Action Trigger Values are used by the company to manage surface water quality during mine activities. These are not displayed on the plots below.

Guideline Trigger Value - The company shall treat values in excess of the Guideline the same as a Limit exceedance except:

- When there is a corresponding increase at the upstream site; and
- For the Mn limit when the flow is less than five cumecs.

When one or more of the above exceptions occurs, a Guideline exceedance will be treated the same as an Action exceedance.



Limit Trigger Value - Values that are higher than the Limit will result in a full investigation, including:

- Determining the cause(s) of the exceedance;
- Collecting further samples and data; and
- Undertaking immediate correction of the cause if it is deemed to be mining related.

The Guideline and/or Limit Values are used to monitor compliance and ensure the protection of the downstream environment.

Flow was recorded in Magela Creek for 240 days over the 2017-18 wet season. Flow commenced on 15 November 2017 and ceased on 12 July 2018. Rainfall for the start of the 2017-2018 wet season, as recorded at Jabiru Airport, was above average. Falls in January were nearly double the average for that month. The last rainfall recorded for the season at Jabiru Airport (BOM station 014198) was on 20 April 2018. Water quality monitoring data collected by the SSB to date shows that all Water Quality Objectives were met in Magela Creek for the 2017-18 wet season, indicating that operations at Ranger mine have not resulted in harm to downstream environments.

Chemical Indicators

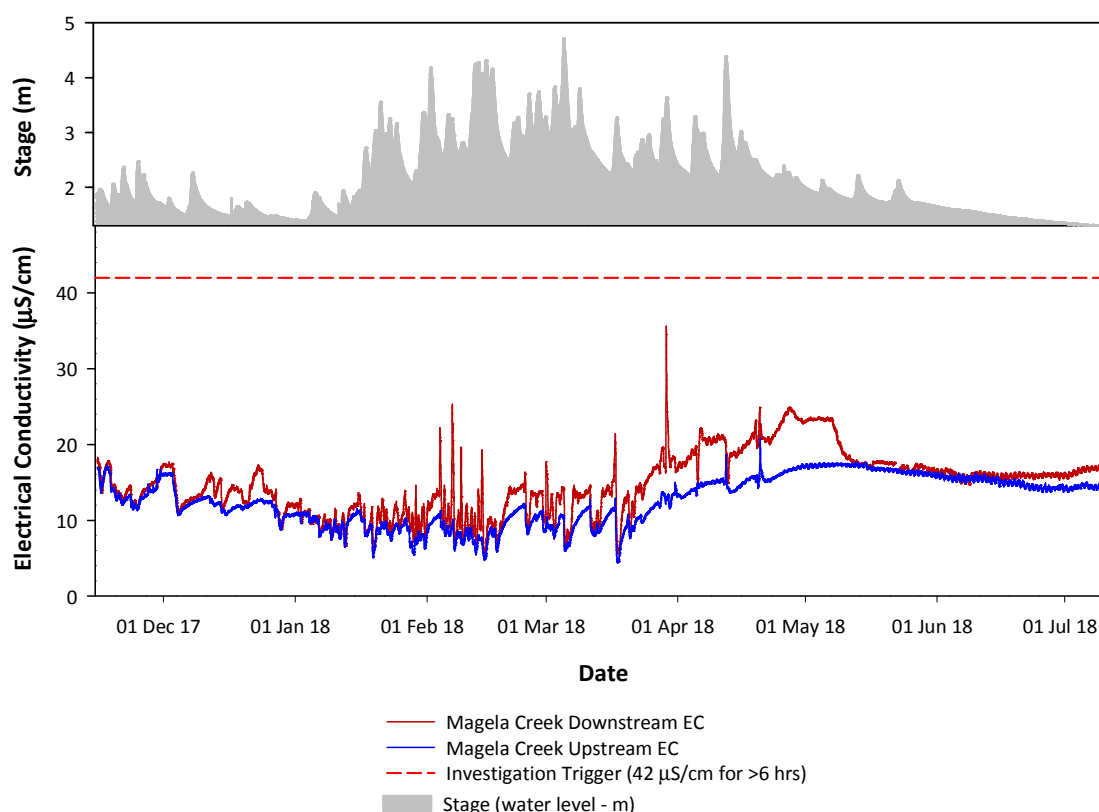
- Conductivity in Magela Creek
- Magnesium in Magela Creek
- Uranium in Magela Creek
- Manganese in Magela Creek
- Total Ammonia Nitrogen (TAN) in Magela Creek
- Turbidity in Magela Creek
- Radium-226 in Magela Creek



Conductivity in Magela Creek

A set of Electrical Conductivity (EC) Trigger Values have been derived to indicate when magnesium (Mg) concentrations might be approaching levels that exceed the Mg Trigger Values. The EC Trigger Values are essentially the same as the Mg Trigger Values, converted to EC using the long term EC-Mg relationship for Magela Creek. An additional *Investigation Trigger* was derived for EC which prompts an assessment of estimated Mg concentrations using the long-term Mg/EC relationship or an event specific relationship. The EC *Investigation Trigger* applies if conductivity exceeds 42 $\mu\text{S}/\text{cm}$ for more than 6 hours to prevent unnecessary action for short duration (< 6 hours) pulses that go above 42 $\mu\text{S}/\text{cm}$ but do not approach the Mg Guideline value.

Throughout the 2017-18 wet season, the conductivity in Magela Creek remained well below the Investigation Trigger value. An increase in conductivity was observed towards the end of March with the onset of recessional flows and increased groundwater contribution, which is known to have a higher EC than the rainfall driven surface water flow. The drop in EC observed at the downstream site during mid-May coincides with the cessation of discharge from Georgetown Billabong into Magela Creek.



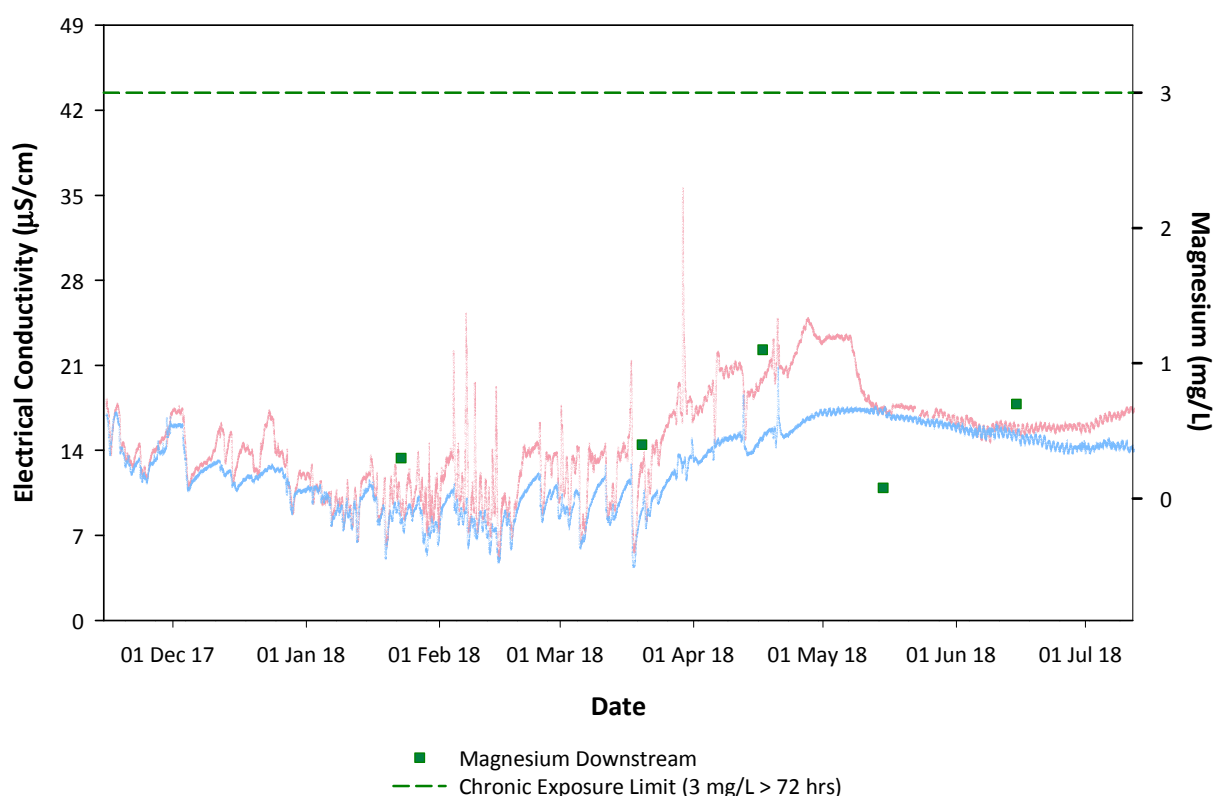
Magela Creek continuous conductivity monitoring data for the 2017-18 wet season.



Magnesium in Magela Creek

The magnesium *Chronic Exposure Limit* of 3 mg/L has been derived using local ecotoxicological data and applies to exposures greater than 72 hours in duration. The Supervising Scientist has also developed an interpretative framework for Mg exposures of less than 72 hours, which integrates the magnitude and the duration of any given pulse exposure. Details can be found on the [Ecotoxicology Electrical Conductivity-Magnesium Pulse Framework](#) page.

The EC trace indicates that magnesium has been below the Chronic Exposure Limit throughout the season. Discrete samples collected from downstream Magela confirmed this interpretation with magnesium concentrations well below the limit.



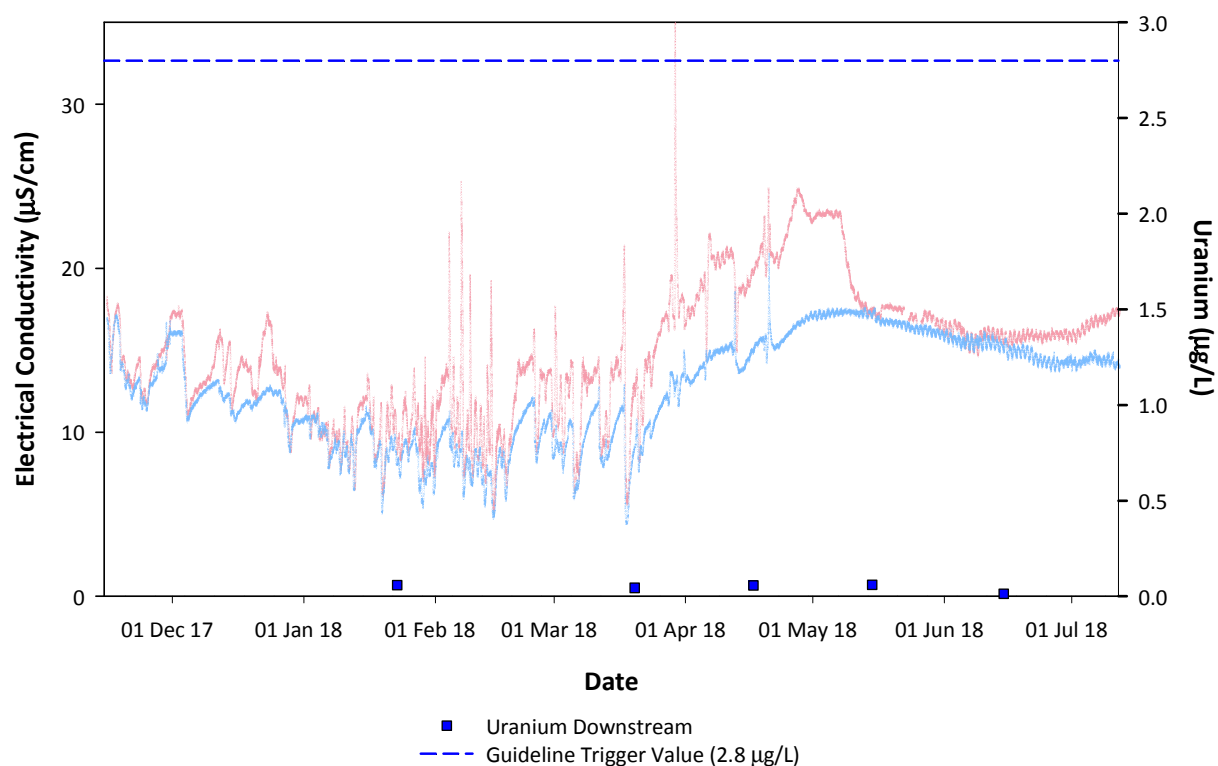
Magela Creek magnesium data for the 2017-18 wet season (continuous EC data shown in background for reference, blue = upstream, red = downstream).



Uranium in Magela Creek

The uranium *Limit Trigger Value* of 2.8 µg/L has been derived using local ecotoxicological data in accordance with the Australian Water Quality Guidelines to protect 99% of the species present.

The uranium concentration in samples collected during the 2017-18 wet season were low and well below the trigger value at the Magela Creek downstream site.



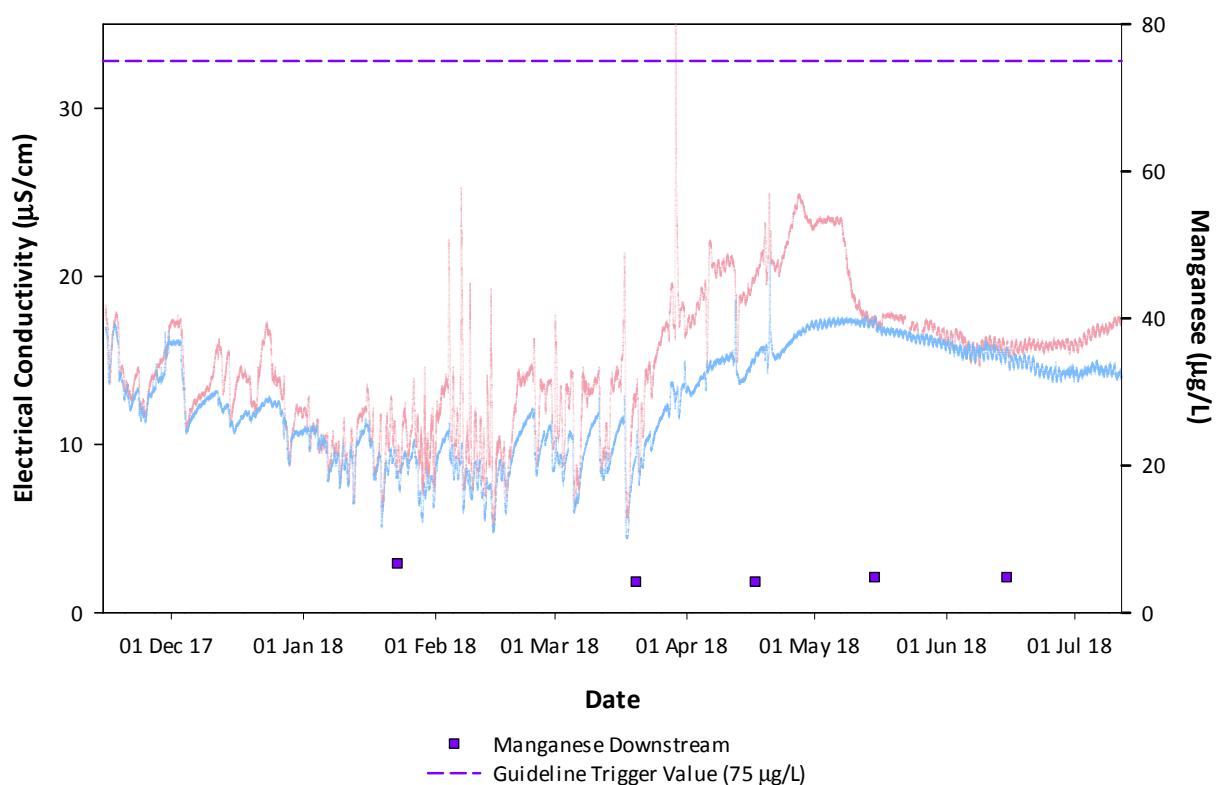
Magela Creek uranium data for the 2017-18 wet season (continuous EC data shown in background for reference, blue = upstream, red = downstream).



Manganese in Magela Creek

The manganese *Limit Trigger Value* of 75 µg/L has been derived using local ecotoxicological data and applies to creek flows greater than 5 cumecs. Flows less than 5 cumecs are indicative of groundwater-dominated inputs, which are likely to be higher in manganese. This guideline may be exceeded occasionally due to natural events but should not be exceeded due to mining activities.

The manganese concentration in samples collected during the 2017-18 wet season were low and well below the trigger value at the Magela Creek downstream site.



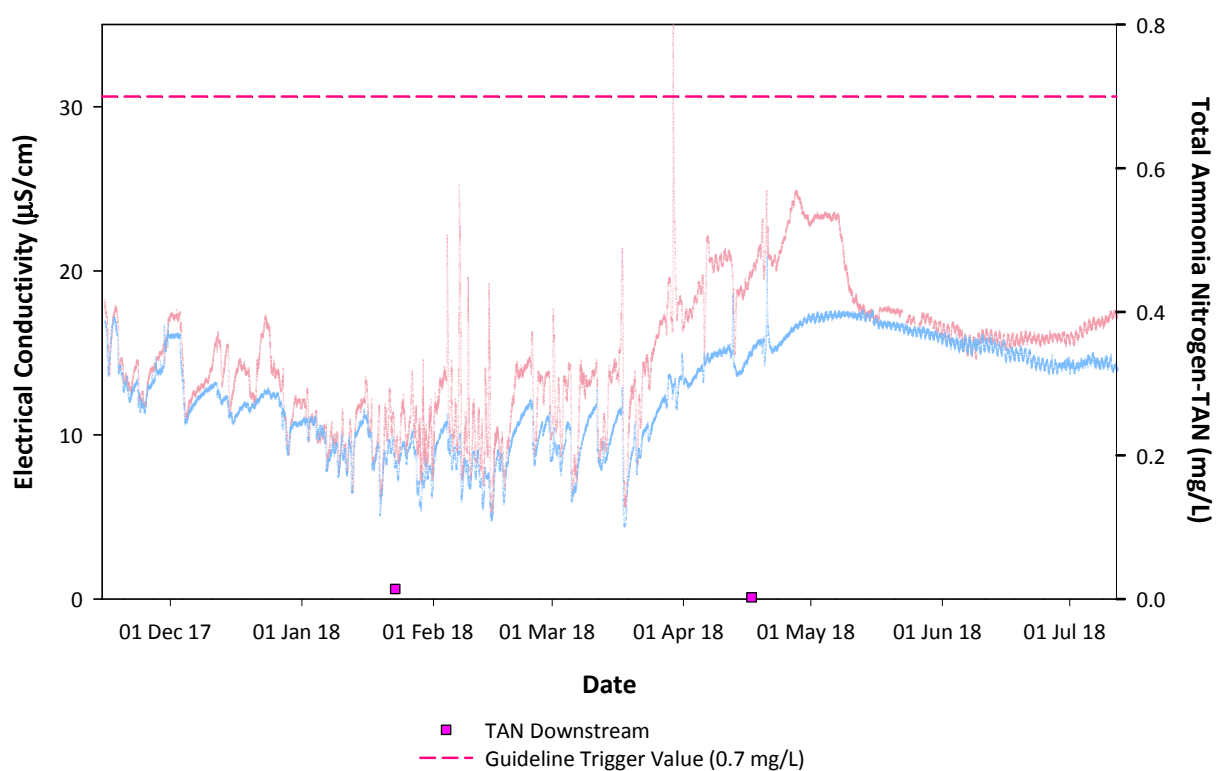
Magela Creek manganese data for the 2017-18 wet season (continuous EC data shown in background for reference, blue = upstream, red = downstream).



Total Ammonia Nitrogen (TAN) in Magela Creek

The interim total ammonia nitrogen (TAN) *Guideline Trigger Value* of 0.7 mg/L was derived using international ecotoxicity data. In accordance with the Australian Water Quality Guidelines, the Supervising Scientist is currently developing site-specific trigger values, based on ecotoxicity data using local aquatic species.

The TAN concentrations in discrete samples were low and well below the trigger value at the Magela Creek downstream site.



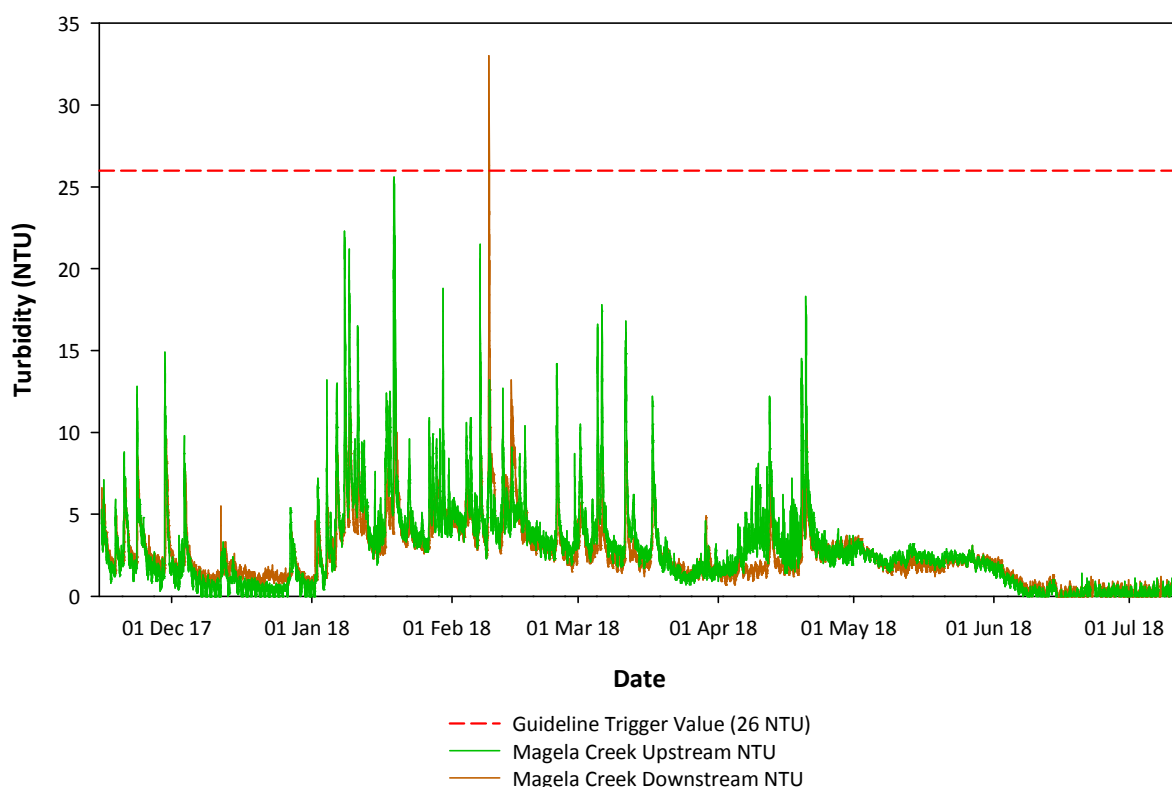
Magela Creek total ammonia nitrogen (TAN) data for the 2017-18 wet season (continuous EC data shown in background for reference, blue = upstream, red = downstream).



Turbidity in Magela Creek

The turbidity *Guideline Trigger Value* of 26 NTU was determined statistically from historical weekly grab sampling data, and applies to water quality measured in grab samples. This guideline may be exceeded occasionally due to natural events but should not be exceeded due to mining activities.

The turbidity values recorded in Magela Creek mostly remained below the guideline value to the end of May 2018. Peaks in turbidity were associated with rainfall events and do not reflect a trend of increased turbidity at the downstream site, or a specific mining-related effect. The spike recorded at the downstream site in mid-February was attributed to an intense localised rain event and was not related to mine activities. Variability in turbidity has reduced with the cessation of rainfall events.



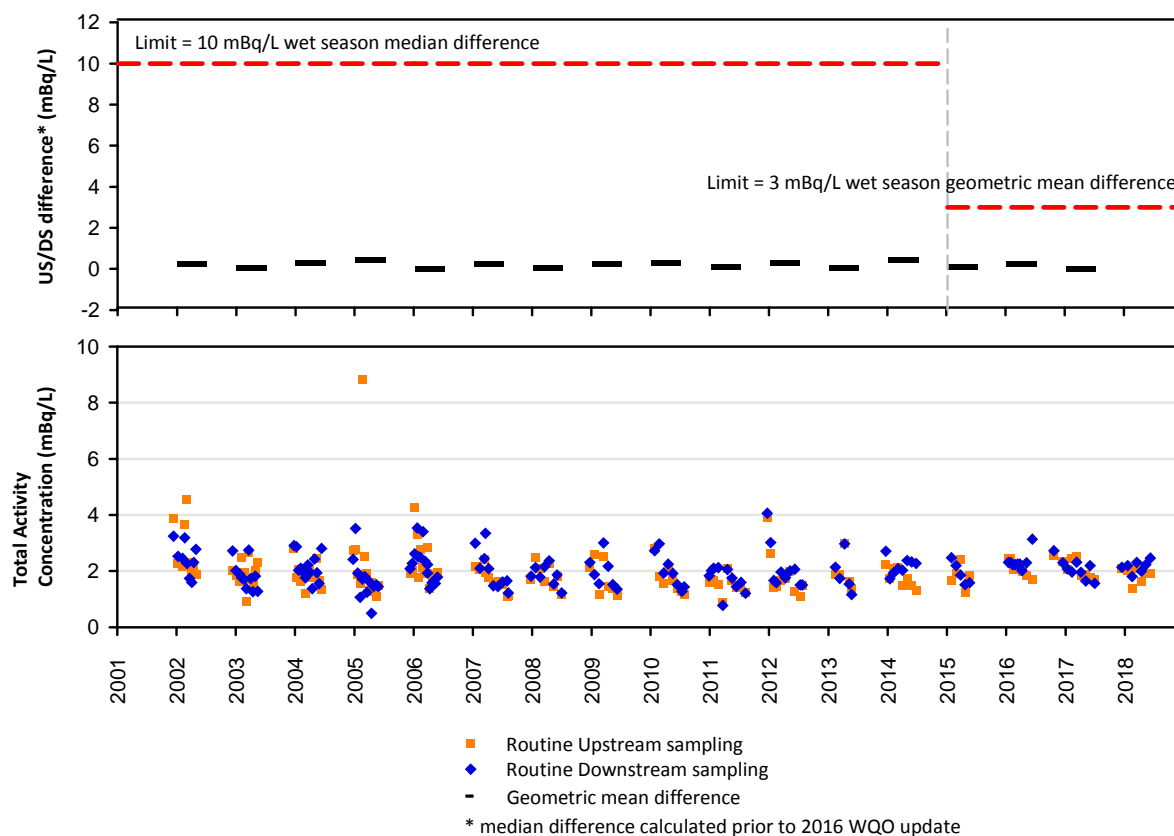
Magela Creek continuous turbidity monitoring data for the 2017-18 wet season.



Radium-226 in Magela Creek

The activity concentration limit for radium-226 was developed to ensure the radiation dose received by people who consume mussels from downstream waterways remains safe. The radium-226 *Trigger Value* of less than 3mBq/L is calculated as the geometric mean difference between the upstream and downstream values for the entire wet season.

Radium samples collected and reported during the wet season to date are similar to previous seasons at both the upstream and downstream sites. The final samples for the 2017-18 wet season are still undergoing analysis and the geometric mean will be reported as soon as these data are available.



Magela Creek Ra-226 monitoring data from the commencement of the 2001-02 wet season to the 2017-18 wet season (seasonal geometric mean not yet calculated).