



Gulungul Creek monitoring data 2020-2021

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 levels of contaminants to be present in the creek, and also during routine monthly quality assurance sampling. No event-based samples were collected during January and February due to the 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 up to the end of February for the **2020-2021** wet season, to the [Water Quality Objectives \(WQOs\)](#) for Gulungul 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 Gulungul 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 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 charts below.

Guideline Value - The company shall treat values that exceed the Guideline value the same as a Limit exceedance except:

- When there is a corresponding increase at the upstream (background) site; and
- For the Mn limit when the flow is less than one cumec.

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 commenced in Gulungul Creek 17th December 2020. Cease to flow was declared on 2nd June 2021. Rainfall at Jabiru Airport for the 2020/2021 wet season, was 1634 mm for the period of Sept 2020-April 2021, above the mean annual rainfall for this site (1548 mm). March and April rainfall (265 mm and 40 mm respectively) was slightly below the averages for these months (305 mm and 89.4 mm). There was no recorded rainfall for May or June.

Water quality monitoring data collected by SSB shows all Water Quality Objectives were met in Gulungul Creek for the entire 2020-2021 wet season, and the aquatic environment downstream of Ranger mine remains protected.

Chemical Indicators

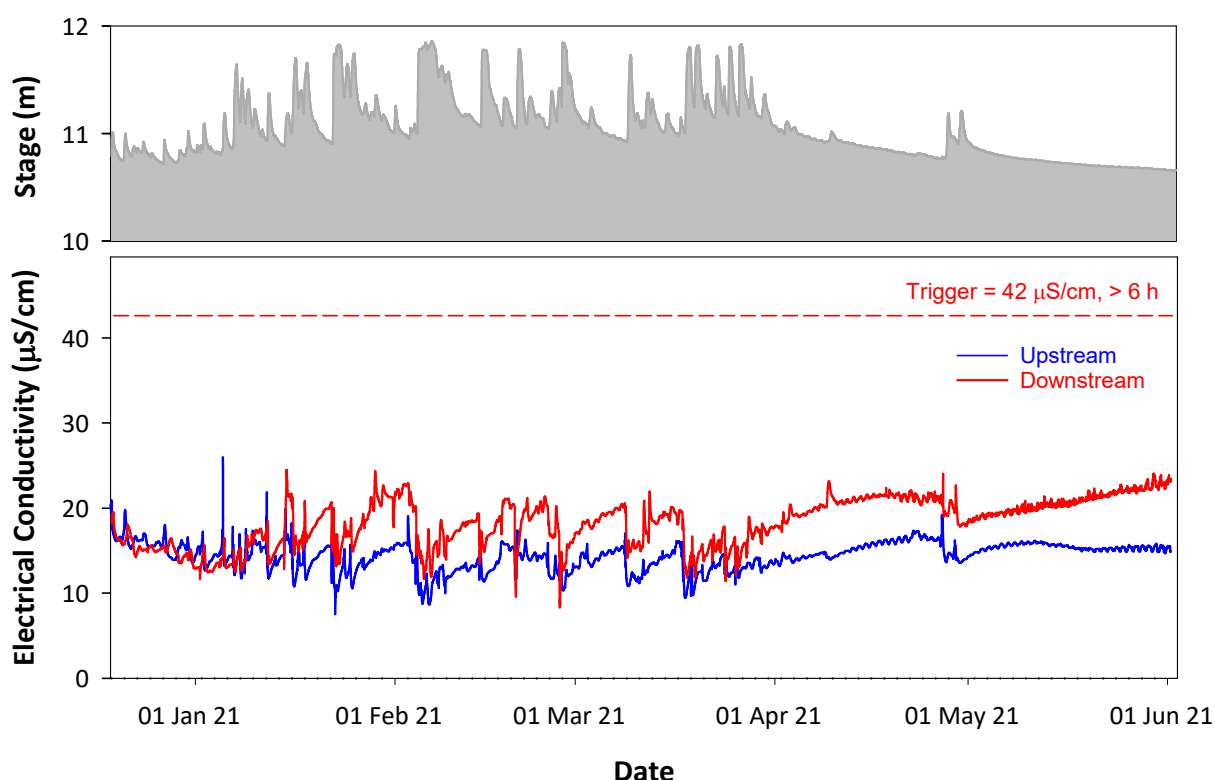
- Conductivity in Gulungul Creek
- Magnesium in Gulungul Creek
- Uranium in Gulungul Creek
- Manganese in Gulungul Creek
- Turbidity in Gulungul Creek
- Total Ammonia Nitrogen (TAN) in Gulungul Creek
- Radium-226 in Gulungul Creek



Conductivity in Gulungul 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 have been derived 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.

Electrical conductivity in Gulungul Creek has remained below the Investigation trigger value.

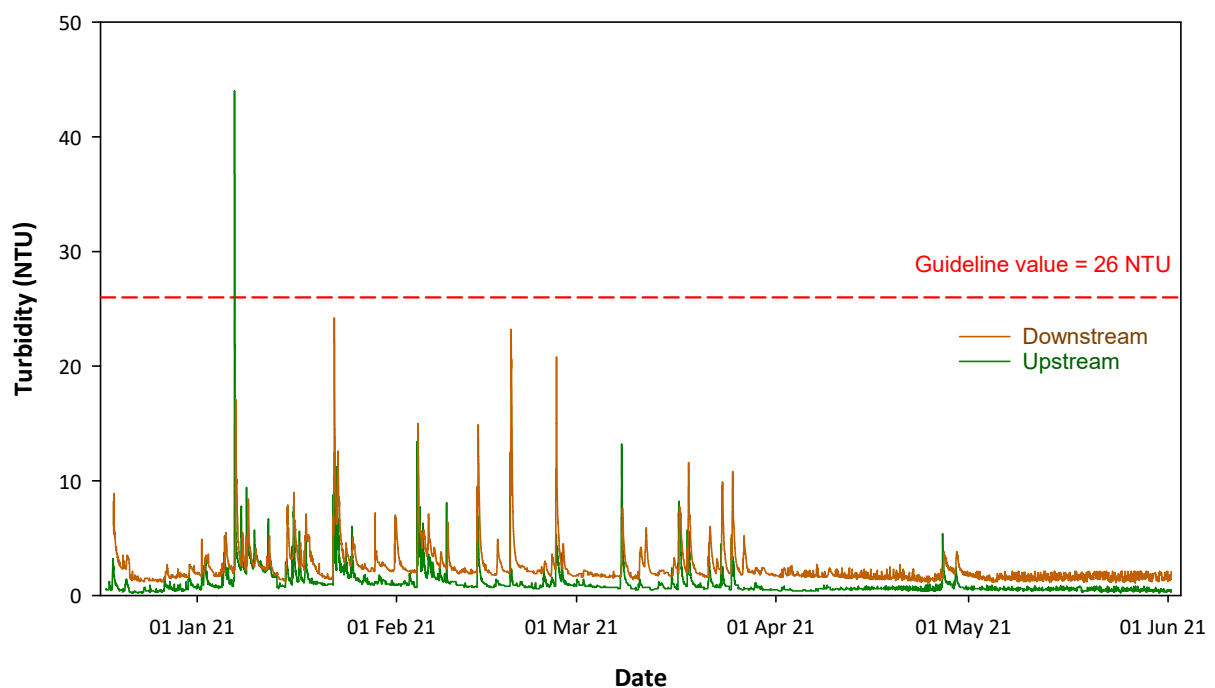




Turbidity in Gulungul Creek

The turbidity *Guideline Trigger Value* of 26 NTU has been derived statistically from historical weekly grab sampling data at reference sites. This guideline may be exceeded occasionally due to natural events but should not be exceeded due to mining activities.

Turbidity at the Gulungul Creek downstream site has remained below the guideline value for this wet season. On 6th January, 44 NTU was measured at the upstream monitoring site. The downstream site experienced a smaller spike of 17 NTU at the time. There were also smaller peaks at both upstream and downstream sites throughout Jan-April, that were associated with rainfall events and were not related to mine site activities. The data does not indicate a trend of increased turbidity above the trigger value at the downstream site, or a specific mining-related effect.

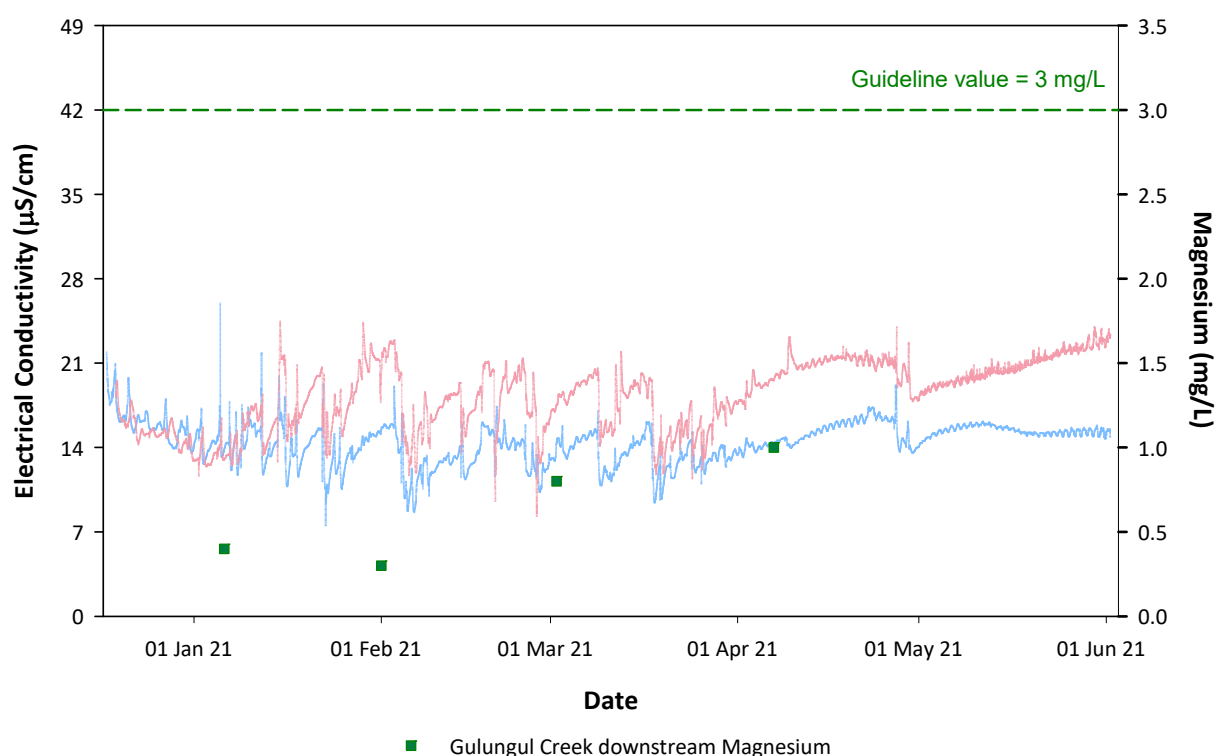




Magnesium in Gulungul Creek

The magnesium (Mg) guideline value (and *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 pulse exposures of less than 72 hours, which integrates the magnitude and the duration of any given pulse exposure. Details can be found in the [Revised Ranger Mine Water Quality Objectives for Magela Creek and Gulungul Creek](#).

The EC trace for the 2020-21 wet season (shown below) remains below the investigation trigger (42 $\mu\text{S}/\text{cm}$ for > 6 h). Discrete samples collected from the downstream site in Magela Creek also demonstrate no increase due to mining activity, with dissolved magnesium concentrations (< 0.45 μm filtered fraction) below the guideline value (green dashed line). Continuous EC data shown for reference.

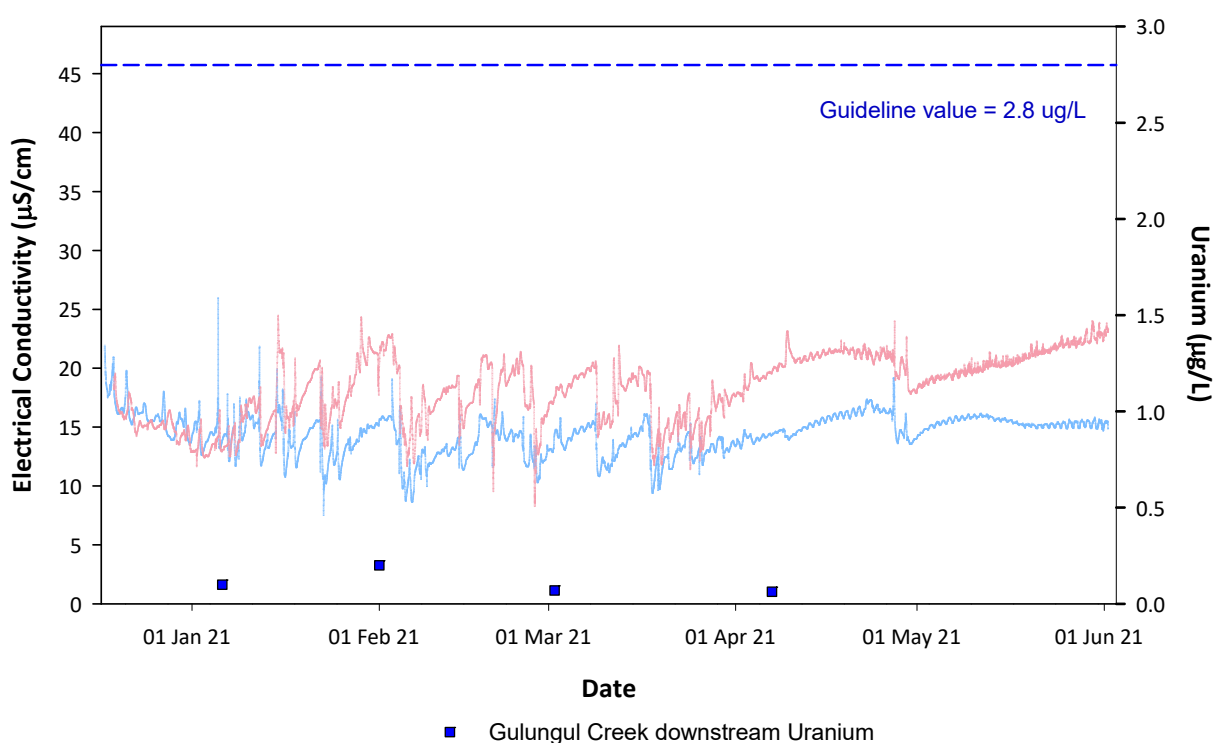




Uranium in Gulungul Creek

The site-specific uranium guideline 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.

Dissolved uranium concentrations (<0.45 µm filtered fraction) measured at the Gulungul Creek downstream site have remained below the guideline value. Continuous EC data shown for reference.

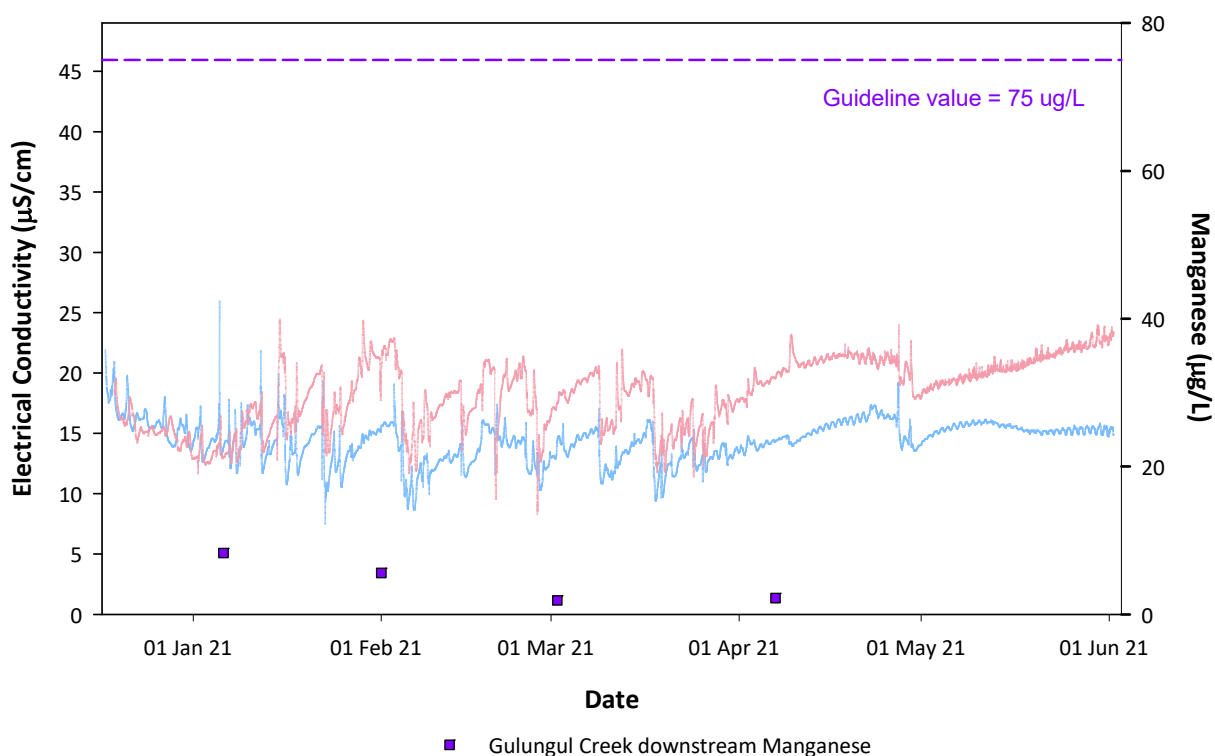




Manganese in Gulungul Creek

The site-specific manganese guideline value of 75 µg/L has been derived using local ecotoxicological data and applies only when creek flows are greater than 1 cumec. Flows less than 1 cumec 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.

Dissolved manganese concentrations (<0.45 µm filtered fraction) at the Gulungul Creek downstream site have remained below the guideline value. Continuous EC data shown for reference.

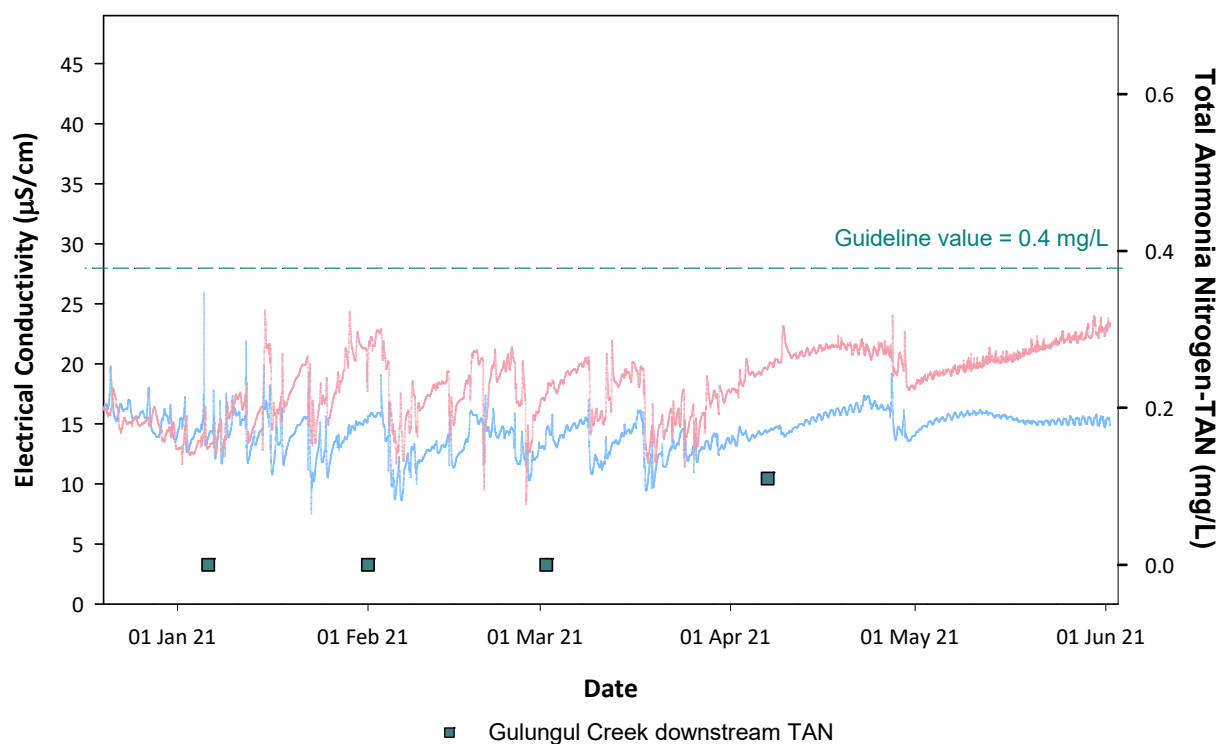




Total Ammonia Nitrogen (TAN) in Gulungul Creek

The site-specific guideline value for total ammonia nitrogen (TAN) of 0.4 mg/L has been derived using local ecotoxicological data in accordance with national guidance, to protect 99% of the species present.

Dissolved TAN concentrations (<0.45 μm filtered fraction) at the Gulungul Creek downstream site have remained below the guideline value. Continuous EC data shown for reference.





Radium-226 in Gulungul Creek

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

For radium-226 samples collected for the season, minimal difference was detected between the upstream and downstream sites, with the upstream sites having higher activity than the downstream. The total activity of the samples has been within the historical range for both the upstream and downstream sites; 4-23 mBq/L and 3-12 mBq/L, respectively.

