MEMORANDUM

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PROJECT TITLE	Winu Copper Gold Project		
SUBJECT	Peer review of the mine site and access road SWMPs and TUFLOW models		
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1 INTRODUCTION

Rio Tinto Winu Pty Limited proposes to develop the Winu Project (the Project). The Project is a new copper-gold mine located approximately 300 km south of Broome and 320 km east of Port Hedland in the northern Pilbara region of Western Australia.

The Project involves but is not limited to an open pit, ore processing facilities, ore and topsoil stockpiles, Waste Rock Landforms, Tailings Storage Facility, bore field(s) and associated infrastructure. Concentrate will be transported by truck via the Access Road and Great Northern Highway to port by a third party for export.

In December 2023 the Environmental Protection Authority (EPA) decided that a '*detailed assessment is required to determine the extent of the Project's direct and indirect impacts, and whether the EPA environmental factor objectives can be met'.* As part of the assessment process, Worley was commissioned to develop the Surface Water Management Plan (SWMP) of the proposed mine site and access road. Hydraulic modelling was completed in TUFLOW software to inform the SWMPs.

Rio Tinto has requested ATCW to provide a peer review of the SWMPs and TUFLOW models to support the assessment process and give confidence to the regulator and stakeholders that the SWMPs and TUFLOW modelling are fit for purpose at this stage of the Project.

ATCW's review of the mine site and access road SWMPs and TUFLOW models indicates that surface water impacts and mitigation measures have been adequately assessed at this stage of the Project.

2 OPERATIONAL SURFACE WATER MANAGEMENT PLAN

2.1 SWMP Review

The mine site SWMP aims to segregate and manage different water sources based on their level of contamination (such as clean, sediment-laden and potentially contaminated water sources) to protect the environment while maximizing water reuse potential. A series of drains (lined and unlined) and flood protection bunds have been proposed to segregate the water sources.

The SWMP proposes to relocate the Ammonium Nitrate/Fuel Oil and Solar Farm facilities to nearby areas where there is less ponding to improve the overall water quality to the receiving environment. ATCW agrees with this approach. Note the management of runoff from potentially contaminated areas is not documented in the SWMP.

2.2 Review of the proposed mine site TUFLOW model

A hydraulic model of the proposed mine site was developed in TUFLOW software as a direct rainfall (rain on grid) model. This approach applies rainfall depth and losses directly to the model domain. The outcomes of the hydraulic modelling informed the SWMP.

2.2.1 Design rainfall

Design rainfall depths and temporal patterns were adopted from the Bureau of Meteorology (BoM) 2016. Storm durations between 1 to 72 hours were simulated, which sufficiently captured the critical duration for the range of events modelled.

The 12 hour storm duration was adopted as the critical duration however, the resulting source file from TUFLOW was not provided as part of this review. The inter-dune closed catchments around the mine site have broadly similar catchment area and it is reasonable that a uniform storm duration would be critical for the model domain. However, this should be demonstrated with additional justification in the SWMP.

2.2.2 Rainfall losses

Rainfall losses (80 mm initial loss and 10 mm/hours continuing loss) were directly adopted from the Australian Rainfall and Runoff Data Hub (2019). This approach is consistent with guidance from Australian Rainfall and Runoff 2019 (ARR 2019), which indicates Data Hub losses should be adopted when there is insufficient recorded data to produce a calibrated model. Note that defining rainfall losses in the arid zone is a key constraint for all flood studies in the Pilbara region.

Worley attempted to validate the Data Hub values by reviewing water level data recorded at three loggers at the proposed site. The loggers indicate high infiltration rates (up to 80 mm/hour), and based on the information provided for this review, it is unclear if evaporation was considered in the drawdown rates. However, it is noted that the adopted continuing loss rates are conservatively low.

ATCW recommend comparing the water level logger data with site rainfall data, if available, to correlate events and increase confidence in the adopted rainfall losses.

2.2.3 Model domain

The model domain covers the entire proposed footprint. Direct rainfall was turned off over potential contaminate-producing landforms to simulate the landform toe-drain capture and storage system. This approach is appropriate, however the SWMP should clearly state that the rainfall volume of the contaminate-producing landforms have been considered in the Water Balance Report. Additionally, the SWMP should state that the TSF volume and freeboard allowance has been assessed separately in the Water Balance Report.

2.2.4 Terrain data

Rio Tinto provided LiDAR for the mine footprint and adjacent dune areas. The TUFLOW model cell size was 5 m with sub-grid scaling (SGS). SGS allows simulating the water surface elevation versus volume relationship for each grid cell rather than using a single elevation value for the grid cell elevation. Further, SGS uses the full topography across the cell face to generate water surface elevation versus width (or wetted perimeter) relationships to represent fluxes between adjacent cells. This approach is appropriate for a direct rainfall model.

2.2.5 Roughness

A uniform hydraulic roughness of 0.04 was adopted in the flood model. Based on Chow (1959), this roughness reflects cleared land with tree stumps, no sprouts. The fraction impervious was adopted as 0.0%. This approach is considered appropriate due to the lack of recorded data to calibrate the model.

Depth varying roughness is recommended for rain-on-grid hydraulic models to simulate the slow movement of runoff until sufficient depth is achieved. This has not been adopted in the Operational TUFLOW model. However, in the inter-dune areas, enclosed catchments create a unique flooding dynamic where flood depths are determined by the balance between total rainfall minus losses, rather than conveyance which depends on flow area and velocity.

It is unlikely that rerunning the model with an updated roughness definition would significantly change the outcomes.

2.3 Recommendations

The following are recommended for this stage of the Project:

1. Include additional justification in the SWMP to demonstrate the selection of a single storm duration for each design flood event.
2. When available, compare on-site rainfall measurements with water level logger data to identify corresponding events. This comparison will help validate the assumed rainfall losses and enhance confidence in the model's accuracy.
3. Specify management of runoff from contaminate-producing landforms. If this has been documented elsewhere (such as the Water Baland Report) then a reference should be added in the SWMP.

3 ACCESS ROAD SURFACE WATER MANAGEMENT PLAN

3.1 SWMP Review

Rio Tinto plans to construct a new Mine Access Road alongside the existing access route. This proposed road will be raised above the surrounding terrain and span approximately 200 km, connecting the Great Northern Highway to the airstrip located east of the Mine site.

The purpose of the Winu Access Road SWMP is to analyse flood patterns in areas near the planned route. By understanding the local hydrology and potential flood scenarios, the SWMP seeks to inform practical strategies and design decisions that will enhance the road's resilience during operation and reduce its environmental impact.

One of the recommendations in the SWMP is to conduct infiltration testing at pilot pit locations if ponding times pose an ecological risk. ATCW agrees this would be highly valuable for the project.

3.2 Review of the access road TUFLOW model

TUFLOW was used to create a hydraulic model simulating surface water runoff flows to generate design flood levels for the 1%, 5%, and 10% Annual Exceedance Probability (AEP) events. The model's topography includes existing access roads, the proposed Access Road, and borrow pits intended for road construction.

3.2.1 Design rainfall

Design rainfall depths and temporal patterns were adopted from the Bureau of Meteorology (BoM) 2016. The design rainfall depths were extracted at the centre of the TUFLOW model domain and applied over the entire model, which is appropriate given the minimal change in rainfall depth over the model extent.

The SWMP indicates storm durations between 1 to 72 hours were simulated, which sufficiently captured the critical duration for the range of events. However, the resulting critical duration source file from TUFLOW was not provided as part of this review. Table 5-1 of the SWMP presents the resulting critical durations and temporal patterns for the site which states the 9 hour storm has been adopted for the 1% AEP event over the entire model domain which covers almost 5,000 km^2.

It seems unlikely that a single storm duration would be critical for all catchments draining to the access road. Please include additional justification in the SWMP.

3.2.2 Rainfall losses

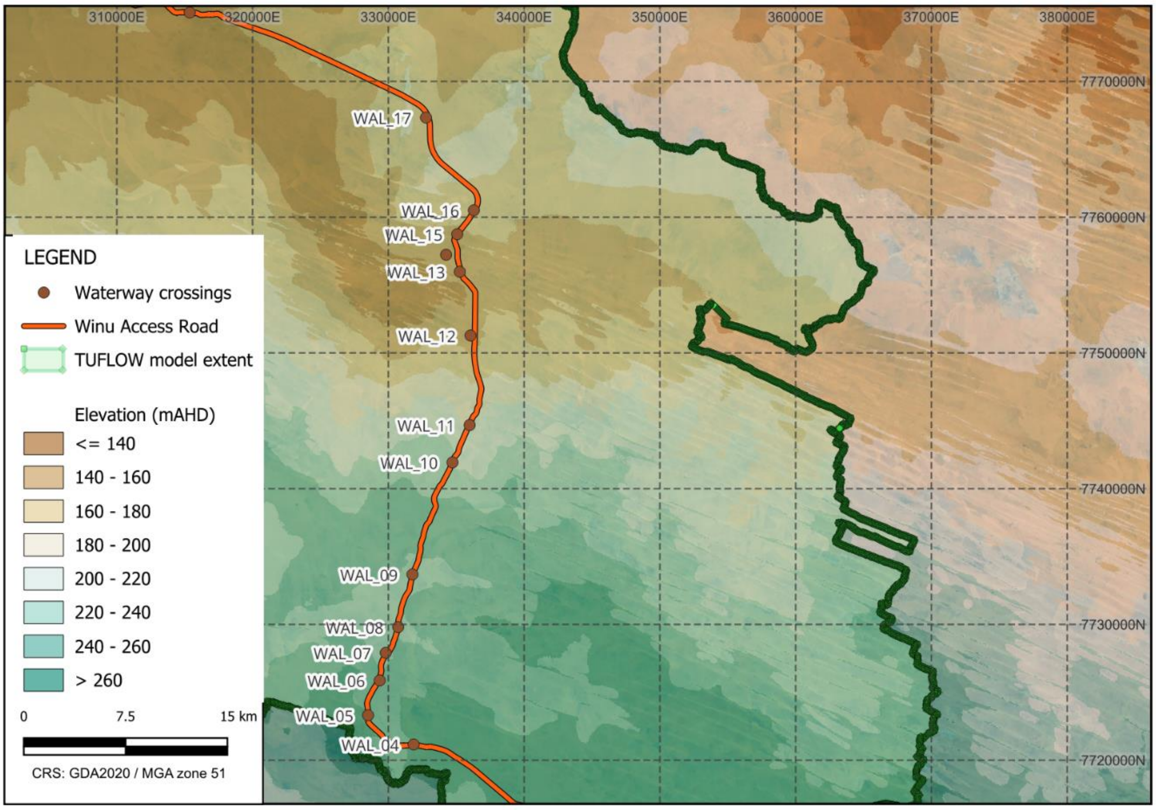
Data from the mine site model was adopted with rainfall losses of 80 mm initial loss and 10 mm/hours continuing loss.

3.2.3 Model domain

The model domain encompasses the entirety of the proposed access road alignment and includes all upstream catchment areas. This comprehensive spatial coverage enables the identification and analysis of all potential contributing watersheds that may impact the access road and facilitates the assessment of peak discharge rates at all watercourse crossing locations along the proposed route.

However, there appears to be an upstream catchment that has not been fully captured in the model domain (shown in **DIAGRAM 1**). This catchment is located to the east of the current model extent and may contribute to flow accumulation at the WAL_15 and WAL_13 access road crossing locations. This should be considered further.

DIAGRAM 1. POTENTIAL UPSTREAM CATCHMENT NOT BEEN INCLUDED IN TUFLOW



3.2.4 Terrain data and modifications

The TUFLOW model incorporates terrain data from three sources that have been prioritised by their accuracy. LiDAR data, provided by Rio Tinto, covers the Mine Access Road corridor and the Winu mine site, serving as the primary and most reliable elevation source. For areas beyond LiDAR coverage, LandGate terrain data with a 5-meter resolution was adopted. To ensure continuous integration with the LiDAR data, bulk vertical adjustments were implemented at flow path interfaces. The remaining model areas derive elevation from the hydrologically enforced Shuttle Radar Topography Mission (SRTM) dataset.

There are additional terrain modifications applied in the developed case to include the conceptual vertical alignment of the proposed access road and for the proposed borrow pit locations.

3.2.5 Roughness

The adopted Manning's 'n' roughness value was depth varied as a value of 0.10 for depths under 0.1 m, and 0.04 for depths above 0.1 m. Based on Chow (1959), this roughness reflects cleared land with tree stumps, no sprouts. This approach is considered appropriate for the floodplain and access road given the scale of the model. The fraction impervious was increased from 0% to 90% for the access road and 75% for the burrow pits, which is appropriate.

3.2.6 Model configuration

There are not error messages for the model and the warnings that have been generated are not of concern. The simulation time for each storm duration has been adjusted to allow for the peak discharge and peak flood level to be reached at all locations in the model. However, the simulation time may be too short for some events.

Analysis of the 1% AEP 9-hour storm simulation reveals an anomaly in the time of maximum water level results (Tmax_H) along certain sections of the access road. These areas show peak flood levels occurring at 20 hours, which coincides with the simulation's end time. This timing suggests that the model may not have fully captured the complete flood progression.

While extending the simulation duration and rerunning the model might not yield significant changes to the results, it is advisable for this aspect to be reviewed by Worley to assess whether the current simulation adequately represents the full flood event, or if additional modelling time is necessary to capture the entire flood progression accurately.

3.2.7 Duration of inundation

Table 5-2 in the Access Road SWMP outlines the projected inundation periods (in days) for key waterway crossings. These estimates are derived from the peak flood depths for various events, coupled with a conservative drawdown time calculation. The current calculation assumes an infiltration rate of 10 mm per hour.

The high evaporation rates in the Operational SWMP (Section 5.3) for the duration of inundation analysis do not seem to have been included for the access road. Including evaporation in the drawdown calculations would likely reduce the estimated inundation times, providing a more accurate representation of actual conditions. A similar modification is recommended for the borrow pit drawdown calculations. Additionally, some of the borrow pit locations might benefit from a simple bund to divert local runoff entering the pit.

Table 5-3 presents a summary of the Access Road borrow pit locations and maximum flood depths. However, the depths provided in the table don't match the peak depths in the supplied 1% AEP depth raster (Winu_AR_06_01p+00540m+TP02_32M_d_Max). Please update the table to match the model results.

3.3 Recommendations

The following are recommended for this stage of the Project:

1. Extend the model domain to include the potential catchment to the east of the TUFLOW model domain presented in DIAGRAM 1.
2. Review the current simulation end time and determine if additional modelling time is necessary to capture the entire flood progression.
3. Update the peak depths in Table 5-3 to match the peak depths in the supplied TUFLOW result rasters.

4 SUMMARY

ATCW's review of the mine site and access road SWMPs and TUFLOW models indicates that surface water impacts and mitigation measures have been adequately assessed at this stage of the Project. The review identified recommendations to be considered to improve confidence in the TUFLOW model outputs and the SWMPs which are summarised in **Table 1**.

Worley responded to the recommended improvements by providing justification of the adopted approach and adjusting the Operational and Access Road SWMPs. The updates provided by Worley have been reviewed by ATCW and found to be satisfactory.

Table 1: SWMP Recommendations

ATCW comment	Worley Response
Operational SWMP	
Include additional justification in the SWMP to demonstrate the selection of a single storm duration for each design flood event.	Added text to 5.1 Ensemble Analysis: Ensemble analysis results per ARR2019 guidance showed that the same critical design storm was evident across the study area, likely due to the internally draining nature of the landforms and similar catchment sizes.
When available, compare on-site rainfall measurements with water level logger data to identify corresponding events.	On-site rainfall was not available for the analysed events.
Specify management of runoff from contaminate-producing landforms. If this has been documented elsewhere (such as the Water Baland Report) then a reference should be added in the SWMP.	Added text to 7.3 Potentially Contaminated Water: The internal potentially contaminated drainage systems of the TSF and Processing Plant are being designed by others as part of separate scope items and hence are not detailed in this report.
Access Road SMWP	
Extend the model domain to include the potential catchment to the east of the TUFLOW model domain presented in DIAGRAM 1.	The catchment area east of this area was assessed early on in this project and is internally draining, not reaching the road in the 1% AEP storm so it was clipped from the model to improve runtimes. The top catchments were included to cover the existing road.
Review the current simulation end time and determine if additional modelling time is necessary to capture the entire flood progression.	There was one crossing (WC17) with a maximum depth at 20 hours at the end of the 1% AEP simulation. The model was re-run for 30 hours and there was no increase in ponding depth. The other events were also re-run with longer simulation times and found to have no increase in maximum depths.
Update the peak depths in Table 5-3 to match the peak depths in the supplied TUFLOW result rasters.	The depth calculations have been revised over the whole region which increased some of the maximum depths marginally. Evaporation (9 mm/day as per the Telfer Aero loggers) has also been included in the inundation calculations for consistency with the Mine SWMP, which made a minor reduction in inundation times.

5 REFERENCES

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