

**Resolution Copper Project and Land Exchange
Environmental Impact Statement**

USDA Forest Service
Tonto National Forest
Arizona

July 1, 2020

Process Memorandum to File

Oyu Tolgoi Mine Research

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Revision History

Date	Personnel	Revisions Made
07/01/2020	Emily Newell	Process memorandum created
07/15/2020	Emily Newell	Text added to “Applicability to Resolution Copper” Section

Purpose of Process Memorandum

The Oyu Tolgoi mine is a combined open pit and underground mining project in Mongolia. It is a joint venture between the Government of Mongolia and Turquoise Hill Resources, a majority owned subsidiary of Rio Tinto. At the public hearings held during the comment period for the DEIS, commenters expressed concern over potential schedule delays and technical complications with the block cave mining technique proposed for use in the underground operation at the Oyu Tolgoi mine. In order to understand the potential for similar issues in the proposed Resolution Copper project, which is a joint venture between Rio Tinto and BHP Billiton, we reviewed available information to determine the validity of such claims relating to schedule delays and issues with block cave mining.

Findings from Research

Development of the underground operation began in mid-2016 with first production originally expected in 2020 or 2021. However, issues with the operation began in October 2018 when Rio Tinto released third-quarter results stating that shaft-sinking challenges were “ultimately expected to result in a revised ramp up schedule.” Sustainable production at the new section of the mine was not expected to be achieved earlier than third quarter 2021, a nine-month holdup from the initial scheduled date of early 2021. The holdup was the result of challenging ground conditions resulting in the delay of the completion of Shaft 2. Additional underground geotechnical data became available that led to improved understanding of the rock mass around and under the ore body. The data revealed some areas of the mine footprint was more variable than anticipated, requiring potentially significant changes to some elements of development design and the development schedule. Rio Tinto is studying relocating the ore passes on the footprint and this may modify the initiation sequence within Panel 0, and the results will be incorporated into the Definitive Estimate. At the time, both Rio Tinto and Turquoise Hill stated that project costs were expected to remain within the \$5.3 billion budget.

In response to the conclusions made by Rio Tinto about potential schedule challenges, Turquoise Hill performed an independent review in 2018 and identified some key risks which were developing:

- Shaft 2 equipping delays were due to lower than expected productivity in steel and electrical installation as well as increased quality assurance measures. It was likely the completion date would move beyond Q1'19 and impact overall underground development rate increases.
- There have been delays to development progress and productivities in key areas. Even though lateral development has experienced consistent overall progress, development of some critical areas, such as the footprint, Primary Crusher 1 (PC1) system, Shaft 2 and Shaft 5, have been impacted by delays and, with the exception of Shaft 5, are critical path items for the project schedule. Small delays in lateral development on the footprint have had a direct impact on the project schedule critical path, even though total lateral development or equivalent development meters have been on budget. Development in the PC1 system (which includes the PC1 chamber and transfers 3, 4 and 5) has, since the time of the Rio Tinto Review data cut-off, fallen significantly behind target rates.
- The Company review indicated that in some areas there was a delay to the critical path from scope growth in mass excavation and additional ground support due to unexpectedly adverse geotechnical conditions. Although the ground support quantities and installation times are less, but not materially less than planned in the 2016 Oyu Tolgoi Feasibility Study and ground support quantities are reported as lower than planned, some types of ground support have had reduced installation times.

After completion of the independent review, Rio Tinto advised Turquoise Hill that further delays on Shaft 2 were expected to contribute to an overall schedule delay to sustainable first production beyond the end of Q3'21. This was reaffirmed on July 15, 2019, when it was announced that sustainable first production could be delayed further by 16 to 30 months and costs to the project may increase by \$1.2 billion to \$1.9 billion over the \$5.3 billion previously disclosed. Sustainable first production is now expected between May 2022 and June 2023. Per the "Management's Discussion and Analysis of Financial Condition and Results of Operations" in the Turquoise Hill 2019 Annual Report, recent work indicated the schedule delay is within the 16 to 30 months range but is trending away from the lower end.

Shaft 2 was completed in October 2019 and an updated feasibility study was completed in early July 2020. The Definitive Estimate, which will include the estimate of cost and schedule for the underground project based on the updated design, is expected to be delivered in the second half of 2020.

As of March 2020, work on the underground project continues, but has been slowed by complications resulting from the COVID-19 pandemic. The full impact of the slowdown on the Underground Project is unknown.

Applicability to Resolution Copper

There are no specific parallels between the Oyu Tolgoi experience and Resolution Copper. No evidence has been found through this research that the adverse geotechnical conditions that occurred at Oyu Tolgoi would repeat themselves at Resolution Copper. Nor is there any indication that such conditions if they occurred aren't already considered and incorporated into the Resolution Copper development and engineering plans. Geology and geotechnical conditions are site-specific. What was experienced geologically at Oyu Tolgoi has no bearing on what would be experienced geologically at Resolution Copper.

The applicability of Oyu Tolgoi to Resolution Copper is as an example of the challenges that can occur during mine development. There is no reason to anticipate that Resolution Copper would experience the exact same challenges, but it is indeed reasonable to anticipate that Resolution Copper could experience other unspecified challenges. These could be difficulties in material or equipment supply, unanticipated geologic conditions, difficulties with ventilation, difficulties with dewatering, or an unlimited number of other challenges.

Oyu Tolgoi is an example of how unanticipated real-world challenges can be met. Meeting these challenges may result in project delays, project overruns, or both. These represent business challenges and decisions for the mining company, but they have no bearing on the Forest Service decision. No part of the Forest Service decision takes Resolution Copper's profitability into account¹.

Reference Documents

The following documents and sources were utilized in the preparation of this memorandum.

Turquoise Hill Resources, Ltd. 2019. Extraordinary Oyu Tolgoi 2018 Annual Report. Available at: <https://www.turquoisehill.com/site/assets/files/5034/turquoise-hill-ar-2018-web.pdf>. Accessed June 30, 2020.

¹ Many public comments have been received on the DEIS regarding the Forest Service analysis of alternative mining techniques. One common denominator in many of these comments is the belief that the Forest Service considered profitability as an evaluation criteria. This is an incorrect belief. No part of the Forest Service analysis includes an evaluation of Resolution Copper's profitability; rather, mining costs are considered as part of evaluating the reasonableness of different mining techniques. See Project Record #0003300 for more detail.

Turquoise Hill Resources, Ltd. 2020. 2019 Annual Report. Available at: https://www.turquoisehill.com/site/assets/files/5110/turquoise_hill_2019_ar.pdf. Accessed June 30, 2020.

Jamasmie, Ceclia. *“Rio Tinto delays start of Oyu Tolgoi expansion due to technical issues.”* Mining.com. 16 October 2018. Available at: <https://www.mining.com/rio-tinto-delays-start-oyu-tolgoi-expansion-due-technical-issues/>. Accessed June 30, 2020.

Rio Tinto. *“Update on Oyu Tolgoi underground project.”* Riotinto.com. 16 July 2019. Available at: <https://www.riotinto.com/news/releases/Oyu-Tolgoi-underground-project-update>. Accessed June 30, 2020.

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Jamasmie, Cecilia. *“Turquoise Hill bears the brunt of further delays, added costs for Oyu Tolgoi mine.”* Mining.com. 19 August 2019. Available at: <https://www.mining.com/turquoise-hill-faces-trouble-at-mongolian-mine/>. Accessed June 30, 2020.

Rio Tinto. *“Rio Tinto provides update on Oyu Tolgoi project.”* Riotinto.com. 16 March 2020. Available at: <https://www.riotinto.com/news/releases/2020/Rio-Tinto-provides-update-on-Oyu-Tolgoi-project>. Accessed June 30, 2020.

Rio Tinto. *“Oyu Tolgoi mine design confirms project schedule and cost ranges and update to Ore Reserves and Mineral Resources.”* Riotinto.com. 3 July 2020. Available at: <https://cts.businesswire.com/ct/CT?id=smartlink&url=http%3A%2F%2Fwww.riotinto.com%2Finvest%2Ffinancial-news-performance%2Fresources-and-reserves&sheet=52245025&newsitemid=20200702005596&lan=en-US&anchor=riotinto.com%2Finvest%2Ffinancial-news-performance%2Fresources-and-reserves&index=1&md5=68ab216428e507d83af27ee11675a079>. Accessed July 13, 2020.