

Oyu Tolgoi Phase 2: Plans, Issues and Risks: Executive Summary

An Overview of Oyu Tolgoi Phase 2 Mining Plans and some of the issues and risks associated with block cave underground mining, international metal price uncertainty, project power supply, and impacts on water resources used by herders



(Satellite image of Oyu Tolgoi Mine, November 2015, <http://landsatlook.usgs.gov>)

Prepared for
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January 10, 2016

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Introduction

This report summarizes the mining activity proposed by OT in its Phase 2 development plan, describes the block caving underground mining technology planned for the large deep ore body to be mined in Phase 2 and environmental impacts and reclamation potential of block cave mines, issues and risks associated with a future OT power supply, international metal market price uncertainties, and OT Phase 1 and 2 impacts on water resources and herders and their livelihood in the region surrounding the OT mine license area.

The Oyu Tolgoi (OT) Mine is located in Southern Mongolia and owned by Oyu Tolgoi LLC (OT LLC) which is a partnership that is owned 34% by the Government of Mongolia and 66% by Turquoise Hill Resources, 51% - a controlling interest - is owned by Rio Tinto.

Overview of OT Phase 2 Mining Plans

The Oyu Tolgoi Technical Report dated October 27, 2014 - OTTR 2014 at http://www.turquoisehill.com/i/pdf/2014-10-27_OyuTolgoiTechReport.pdf - is the most complete description of OT Phase currently available to the public.

OT proposes a Phase 2 development plan that includes a new, large underground mine for extraction of deep ore along with continued mining at the currently operating open pit. Most of the ore in OT Phase 2 would be extracted from the Hugo North underground mine located north of the current OT open pit and 1000 - 1300 meters below ground, too deep for open pit mining. OT Phase 2 plans call for mining the first, upper, portion of the Hugo North ore, called "Lift 1", using the block caving underground mining method.

Other mineral resources identified at OT but not proposed for the "Reserve Case" mine - "Phase 2" - are described as part of the long-term "Life of Mine Case". "Life of Mine Case" deposits include: Hugo North "Lift 2" - an ore deposit beneath "Lift 1", the Hugo South, and the Heruga deposits. OTTR 2014 identifies a series of decision options related to the mining of the "Life of Mine Case" deposits during the next 10 years, and beyond, that could lead to development of these additional deposits, including extraction during the mining of the "Reserve Case" ore before 2055.

OT Phase 2 ore production is projected to average about 115,000 tons per day (tpd), equal to about 40 million tons per year, during the 2020 - 2039 period when the underground Hugo North Lift 1 block cave mine is proposed to operate. OT open pit ore production would fall from the current 100,000 tons per day to 20,000 tons per day during 2019 - 2039 period, when the Hugo North Lift 1 mine is projected to produce 95,000 tons ore per day. This mix of open pit and underground ore will keep the combined tonnage of OT ore processed to about 115,000 tons per day between 2019 when North Hugo "Lift 1" underground ore would begin to be extracted, and 2039 when ore extraction from the Hugo North "Lift 1" will end.

What actions are required before final approval of PT Phase 2?

On December 14, 2015, Turquoise Hill Resources (TRQ) announced that the signing of a, “USD4.4 billion project financing facility”. (TRQ 12-2015 - http://www.turquoisehill.com/i/pdf/news/2015-12-14_NR_TRQ_YFb2vv.pdf). The facility provides loans through a group of international financial institutions and export credit agencies representing the governments of Canada, the United States and Australia, along with 15 commercial banks. The \$4.4 billion project finance facility OT’s owners signed provides a set of four loans with pay back terms of 12 – 15 years. The loans have a capacity of \$6.0 billion, providing the option for another \$1.6 billion.

Future steps to complete the loan process include OT completing a 2015 feasibility study, updating capital cost estimates and securing all necessary permits for the development of the underground mine. After these steps are complete and formal “notices to proceed” are issued by unanimous vote of the Boards of Turquoise Hill, Rio Tinto and Oyu Tolgoi, “the full \$4.4 billion facility will be drawn down by Oyu Tolgoi subject to satisfaction of certain conditions precedent typical for a financing of this nature.”

The Capital Cost of OT Phase 2 in the OT Underground Mine Development and Financing Plan (OTUMDFP) is listed as \$6.7 billion USD, including \$4.7 billion in underground development capital, \$1.5 billion in sustaining and \$0.6 billion USD in Value Added Tax (VAT) and Duties on Capital, exceeding the \$6 billion maximum value of the multi-bank loans being offered.

OTTR 2014 do not include plans for either a supplemental or a new Environmental and Social Impact Assessment (ESIA) for OT Phase 2.

The 2012 OT ESIA addresses a 27-year mine plan but OT Phase 2 is projected for a 40-year design life from completion of feasibility and financial studies in 2016 through 2055. OT also anticipates that the “Project will continue in operation well after that date [of 2055], possibly at higher production rates. Such plans are still at an early stage, so while they are referred to in the ESIA, they are not evaluated in the ESIA because of the limited amount of information available.” Also, “future developments of project-associated facilities are still under evaluation, and no clear decision has yet been made as to the preferred approach to be adopted by the Project,” including a railroad line and a power supply. (OTTR 2014 at 445-446).

What is Block Cave mining and what are some of its environmental impacts?

The Block caving mining method chosen for underground mining at OT Phase is expected to result in surface subsidence across an eight (8) square kilometer area.

The 2005 Oyu Tolgoi Integrated Development Plan (IDP) Executive Summary describes the block cave underground mining method as “[a] safe, proven, and highly productive method

for extracting bulk ore tonnages from underground mines. It involves undercutting part of the orebody across a plan area, causing the overlying rock to collapse. The collapse of the ore, or “cave,” is “by design” and is accomplished in a deliberate, controlled, and predictable manner.”

However, “**Block caving is expected to result in surface subsidence.** To preserve the integrity of the mine shafts and principal infrastructure, the shafts and infrastructure will be grouped together in a “farm” approximately 1,500 m due west of the centreline of the resource.” (OT IDP ES 2005 - P. 47 -

http://www.turquoisehill.com/i/pdf/IDP_ExecutiveSummary.pdf)(Emphasis added)

Large-scale permanent surface subsidence above the extraction zone is the primary long-term environmental damage resulting from block cave mines. The surface collapse, subsidence and fracturing of the land surface above the mine resulting from extraction of ore using the block cave mining methods leads to environmental damage that is not amenable topographic or biological reclamation to establish productive post-mining land uses because the damaged land surface affected by the block cave-induced subsidence is physically unstable.

OTTR 2014 plans for reclamation of Hugo North block caving mine subsidence are limited merely installing a fence 100 meters beyond the edge of the subsidence zone and monitoring the extent of subsidence.

Surface subsidence zone prediction maps for the Hugo North Lift 1 block cave mine have been included in the OT Integrated Development Plans from 2005, 2010 and 2012. The projected extent of the land area to be affected by the caved, fractured and subsidence zone at the Hugo North mine increased substantially in the IDOP 2012 from that projected in IDP 2010.

The OT Environmental and Social Impacts Assessment (ESIA 2012), identified an eight square kilometer – 8 km² – caved, fractured and subsidence zone is predicted to developed above OT Phase underground mine. “[T]he removal of ore through the block caving is likely to result in a subsidence zone later in the mine life as the caving propagates to the surface. Initial estimates are that this subsidence zone will cover an area of over 8 km² and be characterised by a depression surrounded by a circular cliff-like feature with an overall cliff height in excess of 20 m, which might be manifest as a single cliff or multiple smaller cliffs. Depending on the nature of the surface manifestation of this feature, the impact will be on topography and landscape; and also on hydrogeology and hydrology, and potentially present a potential community safety issue if cliffs are unstable once herders are allowed back into the area following mine closure and restoration.” (ESIA 2012 – C4 at P. 10 of 18, <http://ot.mn/environmental-social-impact-assessment/>)

The ESIA 2012 adds that, “the full extent of the subsidence zone is projected to more than three times the size of the open pit mine planned at the site, projected to be two square kilometers (2 km²)”, at ESIA 2012, C4 p. 10.

What are Some of the Major Impacts of OT Phase 1 and 2 on Water Resources Used by Herders?

Issues related to the impacts of OT operations on water resources used by the herder families surrounding the mine area has been identified in Executive Summary of the OT Independent Environmental Panel (IEP) reports investigating Khanbogd Soum herder complaints filed the International Finance Corporation (IFC) Compliance Advisor-Ombudsman (CAO) and Independent Audit Reports (IARs). CAO Complaint case files – Oyu Tolgoi-01 at <http://www.cao-ombudsman.org/cases/document-links/links-191.aspx> and Oyu Tolgoi-02 at <http://www.cao-ombudsman.org/cases/document-links/links-196.aspx>.

OTTR 2014 does not acknowledge or discuss the issues related to non-conformance with OT's commitments addressed in the IARs or the IFC CAO IEP Reports. The environmental impact assessment portion of the OTTR 2014 summarizes conceptual environmental and social impact issues. OTTR 2014 does not provide an assessment of the nature, extent or severity of the impacts of OT operations herders, water, wildlife or other issues, or identify any changes to previous ESIA's necessary to address impacts that have occurred.

The Independent Expert Panel (IEP) found impacts on herder water resources that affect herder socio-economic and cultural conditions significantly and more severely than previously identified. IEP ES 2015 reports that:

“The direct effect of the relocation of the Bor Ovoo spring on the herders' access to water and water quality is the complete loss of the spring. The temporary replacement water source at the Southern fence line of the MLA delivers water, however it does not replicate the functions for livestock herding neither the ecological functions of wildlife habitat of Bor Ovoo spring. The loss of the original Bor Ovoo spring has caused longer distances for herders to access water at the current water outlet of the diversion pipe; with the establishment of the latest fence line along the MLA border, this has become even more pronounced.” and

“The loss of access to summer pasture and loss of water sources due to watershed wide impacts by the OT mine and infrastructure development (including coal road) has resulted in far reaching and irreversible disturbance to traditional nomadic livestock husbandry in Khanbogd Soum, especially in Javkhalant Bag effecting the whole herding community. The search for water and pasture and inability to let winter pastures rest, is degrading remaining pastures; with the effects of fragmentation, mechanical disturbance, dust and litter along infrastructure corridors, the cumulative impacts are severe and will continue to increase as mine development proceeds.” (IEP ES 2015 at http://www.cao-ombudsman.org/cases/document-links/documents/ExecutiveSummary_edit_Jan_30_2015-ENG.pdf)

OTTR 2014 asserts that OT has not, “seen ... any connection between the deep aquifer and the shallow herders' wells in near-surface streambed aquifers,” at P. 413, failing to acknowledge or ignoring the “interaquifer flow” between shallow herders' wells and the deep aquifer caused by poor borehole construction identified in the IARs.

OT recognizes, “It has a requirement to make its self-discovered water resources available to be used for household purposes, it is confirmed in the [OT Investment Agreement] IA that OT LLC holds the sole rights to use these water resources for the Project. OT LLC has the right under the IA for a water use right for the period of its mining licence” but no plans to address that requirement are detailed in OTTR 2014.

Neither the IARs or OTTR 2014 describe the “best efforts” that OT is reported to be making to address the interconnected aquifer problems affecting shallow wells used by herders resulting from OT well construction, or how the performance of those best efforts with be evaluated.

What are some of the potential impacts of the steep fall in International Metal Market Prices below those used for OT Phase 2 mine planning in OTTR 2014?

All projections of the future value and economic impacts of OT Phase 2 presented in the May 18, 2015 Oyu Tolgoi Underground Mine Development and Financing Plan (OTUMDFP 2015) are based on the international market prices for the copper, gold and silver that would be extracted.

December 2015 international market prices for copper, gold and silver are significantly: 20–30% lower than those used in OTTR 2014 resource evaluations and economic projects for OT Phase 2.

As long as lower metal prices last, the value of OT copper, gold and silver production will be reduced below the estimated OT Phase 2 income and value which were based on higher projected prices. Income derived from the mine and government payments associated with Current OT Phase 1 operations will also that reflect the value of mine production will also be reduced due to lower metal prices than those projected in the OTTR 2014.

OT Phase 2 plans include mining of 1.5 billion tons of ore at copper grade (“content”) of 0.83%, gold grade of 0.32 grams per ton and silver grade of 1.94 grams per tons. OT Phase 2 ore is estimated to contain 24.9 billion pounds of copper, 11.9 million ounces of gold and 78.0 million ounces of silver. The value of recovered metal from OT Phase 2 used in OTTR 2014 are, “copper at \$3.01/lb, gold at \$1,250/oz and silver at \$20.37/oz and cost for the underground mine are based on \$15.32/t.” At those prices, the total value of the metal recovered from OT Phase 2 would be about \$88.4 billion dollars, of which more than 82% – \$74.7 billion – would come from copper sales.

If December 1, 2015 international market prices for copper - \$2.11/lb, gold - \$1,065/oz, and silver - \$14.21/oz, are used to calculate the value of the ore proposed for mining at OT Phase 2, the total value of the metal to be recovered would fall more than \$22 billion, from \$88.4 billion to \$66.1 billion, with the copper value falling from \$74.7 billion to \$52.4 billion, also a fall of more than \$20 billion.

Rio Tinto management's view on the effects of the recent fall in the copper price on OT are summarized in a November 26, 2015 article titled, "Copper prices may weigh on Rio Tinto's looming decision on Oyu Tolgoi expansion," that reports Rio Tinto's chief executive for copper and coal Jean-Sebastien Jacques's and Rio Tinto's belief that "the copper market is facing two or three years more of pain, it is the one commodity they expect to recover the fastest." (Mining 2015 <http://www.mining.com/web/mongolia-struggles-to-develop-tavan-tolgoi-coal-mine/>)

Similarly, Mr. Jacques said, "We are pretty bullish about the copper market in the long term and the reason is we expect a 6 to 8 million tonne shortfall [of copper] in the next 10 years," he said. "Oyu Tolgoi will be part of the solution to provide the copper that is required in China or any part of the world at that point in time." (INVEZZ 2016 at <http://invezz.com/news/equities/21694-Rio-Tinto-share-price-Miner-agrees-4-4bn-Mongolia-mine-financing>)

What are some of the issues related to developing a power supply for OT Phase 2?

A power supply source to operate OT Phase 2 at full capacity has not yet been built. Power supply needs for OT are projected to grow from 145 Megawatts (MW) at start, to 246 MW when underground mine development is completed.

However development of a Tavan Tolgoi Independent Power Project (IPP) in time to meet OT Phase 2 demand by the 2020-2022 period faces many obstacles including funding challenges, mixed political support and operating issues. OTTR 2014 says that, "the Power Plant Project will implement the environmental protection provisions of the IA as described in the ESIA (July 2012). A Supplemental ESIA specifically for the Power Plant Project is forthcoming."

In August, 2015, an Erdenes Mongol senior economist said that, "Turquoise Hill has issued a financial guarantee worth one billion US dollars for the construction of Tavantolgoi Power Plant. The Government has given directions to associated officials to launch development of the plant from spring of 2016." However, As no feasibility study or environmental assessment have been prepared for the Tavan Tolgoi Power Plant, or any alternative power supply for OT Phase has been released, it is unclear if the USD one billion financial guarantee from Turquoise Hill is sufficient incentive to drive the construction of 246-megawatt power source OT says it needs from Tavan Tolgoi. In addition to Tavan Tolgoi Power Plant delays, Mongolia has failed to obtain loans needed to operate the Tavan Tolgoi coal mine thus far, casting a shadow over the likelihood of development of Tavan Tolgoi deposit on a large enough scale to power OT Phase 2 when that power is needed. At a cost of USD one billion, the 246-megawatt plant would cost about \$4.06/watt to construct.

Are alternative sources of power available for OT?

While OTTR 2014 at P. 438 says, “Copper demand will also benefit from a greater long-term focus on renewable sources of energy and energy-efficient technologies such as wind turbines and electric/hybrid vehicles, which are of copper-intensive fabrication,” OTTR 2014 offers no renewable energy options for the OT power supply.

China, the source of power current used by OT, is transitioning from coal to renewable energy sources rapidly as Forbes reports that, “Renewable energy is also key to China’s transition away from coal. China invested \$90 billion in clean-tech investments last year, according to Bloomberg New Energy Finance, far more than the U.S. Non-fossil fuel sources – solar, wind, hydro and nuclear – are expected to make up 20% of China’s energy mix in 15 years. China already has more wind-generating capacity than any country in the world and it is likely this year to overtake Germany as the world’s largest solar country, measured by installed capacity. By 2030, China’s non-fossil-fuel energy base alone will be almost equivalent to the total electrical capacity of the U.S. today.” (FORBES 9-2015b)

Options for wind power production in Mongolia at the industrial scale needed by OT are identified in the “Scaling Up Renewable Energy in Mongolia Investment Plan” summarized at the Mongolia National Renewable Energy Center’s webpage at:

<http://www.nrec.mn/web/data/main/main1441093417.pdf>.

NREC 2015 identifies five active wind power development projects, with potential to generate a total of 350 MW:

Oyu Tolgoi Wind Power Project by Qleantech LLC, 102 MW; Sainshand Wind Park, Sainshand Wind Park LLC, 52 MW; Choir Wind Farm, Aydiner Global LLC, 50.4 MW; Tsetsii Wind Farm, Clean Energy Asia LLC, 50 MW and AB Solar Wind, AB Solar Wind LLC, 100 MW

If the \$115 million cost for 54 megawatt Sainshand wind project is accurate, the cost per watt for the project will be \$2.12/watt. European Bank for Reconstruction and Development (EBRD) reports that cost design and construction of the 50 megawatt Salkhit Wind Project, the only operating industrial scale wind farm in Mongolia, was \$123 million, a cost of \$2.46/watt. (EBRD 2013 <http://www.ebrd.com/downloads/news/treasury-development-salkhit.pdf>)

The project cost of Sainshand wind project would be only 53% per watt of the projected cost of a 246-megawatt Tavan Tolgoi Power Plant if it would cost \$1 billion, a cost of \$4.06/watt. If the more conservative cost of the Salkhit Wind Farm were used for comparison, the cost of wind power for OT Phase 2 would be 40% less than the cost per watt for Tavan Tolgoi power at \$4.06/watt.

OT’s ownership should consider investment in renewable energy sources for the mine’s future power supply. The wind projects listed have potential to come on line before a Tavan Tolgoi coal-fired power plant fed by Tavan Tolgoi coal and at potentially lower cost.