



## Orion Minerals

ASX/JSE RELEASE: 30 July 2019

# Orion's Flagship Prieska Copper-Zinc Project Moves to Post-Feasibility Study Field Trials and Enterprise Optimisations

- ▶ **Water treatment and mine dewatering field trials commenced with potential to materially reduce project capital costs.**
- ▶ **Enterprise optimisation process commissioned, targeting quantum improvements in project financial performance over and above an already robust Foundation Phase mining plan.**
- ▶ **Key supply contracts negotiations under way in preparation for project construction approval.**
- ▶ **Granting of Mining Right and Water Use Licences for the Repli portion of the Prieska Deposit imminent.**

### Orion's Managing Director and CEO Errol Smart, commented:

*"We identified numerous opportunities to improve on the Foundation Phase mining plan during the feasibility study process. In our opinion, these opportunities can result in quantum improvements in the already pleasing project financial returns and risk profile. We are thus making use of the time, whilst securing and formalising project funding, to ensure that the project execution incorporates as many of these improvements as possible, further de-risking the project and providing for the best commercial outcome.*

*The areas of focus that have been selected for priority optimisation work are chosen for their potential to make the largest positive impact on capital costs, reduce project development lead time and improve NPV. "*

Orion Minerals Limited (**ASX/JSE: ORN**) (**Orion** or the **Company**) is pleased to announce that following the release of the positive Bankable Feasibility Study (**BFS**) (refer ASX release 26 June 2019) for the development of the Prieska Copper-Zinc Project (**Prieska Project**) as a long-life, high margin, base metal mine, work is now underway to:

- complete pilot-scale field trials on various aspects of mine dewatering, viewed as a critical area for project success;
- follow-up on the optimisation opportunities identified during the BFS, including mine-to-market enterprise optimisation of the Foundation Phase mining plan;
- formalise key supply contracts to fast-track preconstruction activities and lock-in competitive pricing of critical plant and equipment identified during BFS inquiries; and
- expedite the granting of the various licences needed to undertake mining operations.

### Pilot-Scale Dewatering Field Trials

The BFS base case plan caters for the dewatering of approximately 8.7M cubic metres of accumulated mine water over a 13-month period, before any mining can take place underground (Figure 1). Although the mine water has been shown to have a neutral pH and has low levels of contaminants, environmental regulations require the water to be stored in lined dams. The accumulated mine water is planned to be pumped from underground, via the existing 1km deep Hutchings Shaft, using a cascading system of pumps into a surface, 1M cubic metre volume, lined dam from which all the water will be evaporated, using a combination of natural and mechanically assisted evaporation. The base case plan does not include storage in unlined dams nor the reuse of the water, both of which are opportunities to improve on estimated capital costs. The plan is also premised on zero discharge of the

water from the project site, which presents another major opportunity to improve the project timeline, should offsite discharge approvals be obtained.

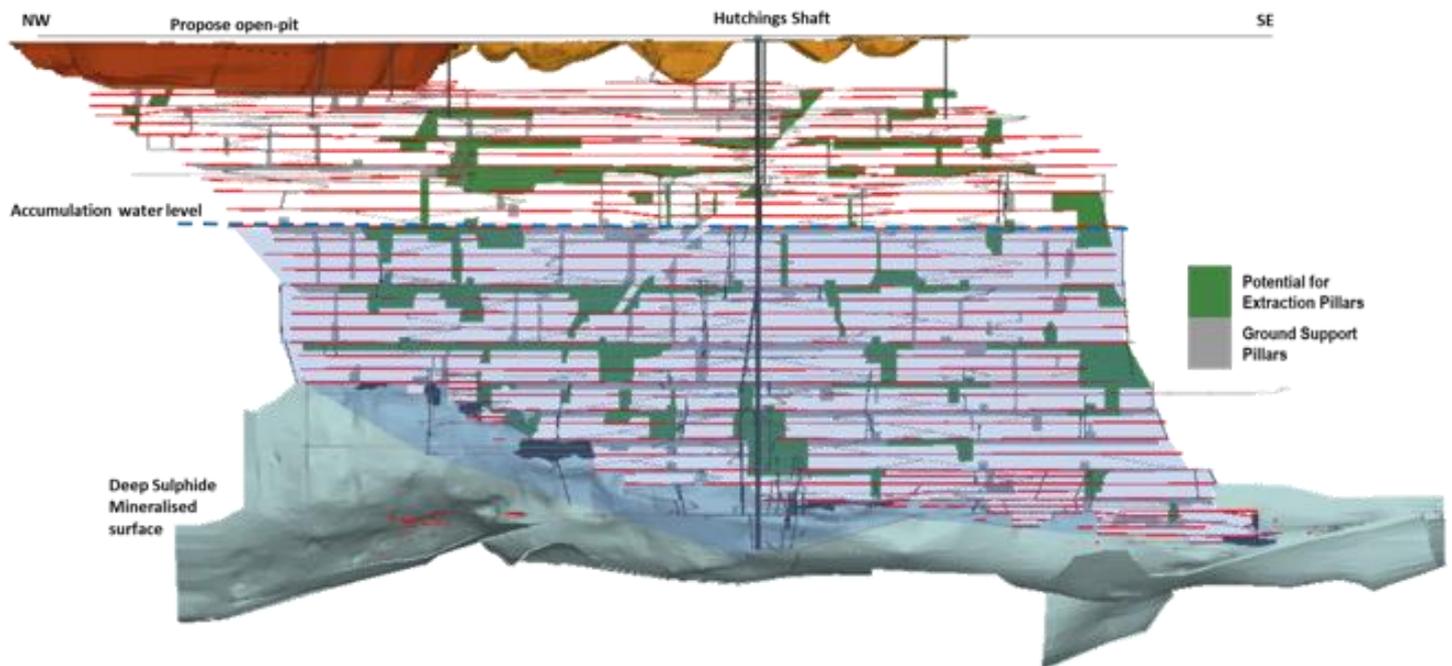


Figure 1: Long-section view of the Prieska Project underground workings showing the accumulated water level.

Pilot-scale trials have now been commissioned to further test water qualities, refine the proposed pumping system, investigate means of cost-effective water-treatment and to confirm the size and arrangement of evaporator units to be used. Water treatment trials are being conducted first and are due to be completed during Q3 2019. Thereafter, evaporator field trials are planned and are due to be completed before year-end 2019.

The water treatment trials will provide engineering data to allow detailed design and costings for treating the mine water to a range of water purification specifications. Water treatment would allow offsite discharge and other secondary uses of water to be considered and so reduce the volume of water that needs to be temporarily stored in lined environmental control dams and force-evaporated. Reducing the footprint of the lined storage dam and the amount of forced evaporation required represents a major target for capital cost reduction. A combination of optimising placement of plant tailings as backfilling over life of mine, and a reduced requirement for sealed storage and evaporation area, could materially reduce the capital cost of the combined tailings storage facility/evaporation dams allowed for in the BFS.

A 5m<sup>3</sup> per hour pilot water treatment plant, bespoke for the Prieska Project's water and schedule requirements, has been constructed and commissioned. The plant is a combination chemical treatment, precipitation, ultrafiltration and reverse osmosis (RO) purification plant, configured to allow measurement and testing of key design parameters. The water treatment flowsheet is configured as follows, (see Figures 2 and 3):

- feed water is pumped from the mine into an aeration tank to oxidise dissolved metals and other oxidizable ions;
- the aerated solution then passes into a clarifier whilst being dosed with cold lime to remove dissolved hardness and to coagulate solid particles suspended in the water;
- the clarifier overflow, with reduced levels of suspended solids, hardness and dissolved oxidation load, collects in a clear well, before being pumped through an Elfi self-cleaning suction strainer. The suction strainer in use on the pilot plant, which is able to remove particles of down to 50µm in size, is the first of its kind in use in the Southern African Development Community region;

- the screened water is then passed through a Hydranautics HYDRACap Max ultrafiltration (**UF**) system. The UF is the final absolute barrier for solid particles, removing solids down to 0.08µm particle size, as well as any bacteria and viruses suspended in the water;
- thereafter the filtrate is ready for RO. The RO process uses pressure to force water molecules through a semipermeable membrane, filtering out contaminant ions as a concentrated brine solution that will reach, in the pilot setup, up to 4 times the concentration of the incoming water. The resulting permeate (treated water) can have up to 98% of ions removed and is thus purified enough for other uses such as agricultural, ore processing water and potable applications.

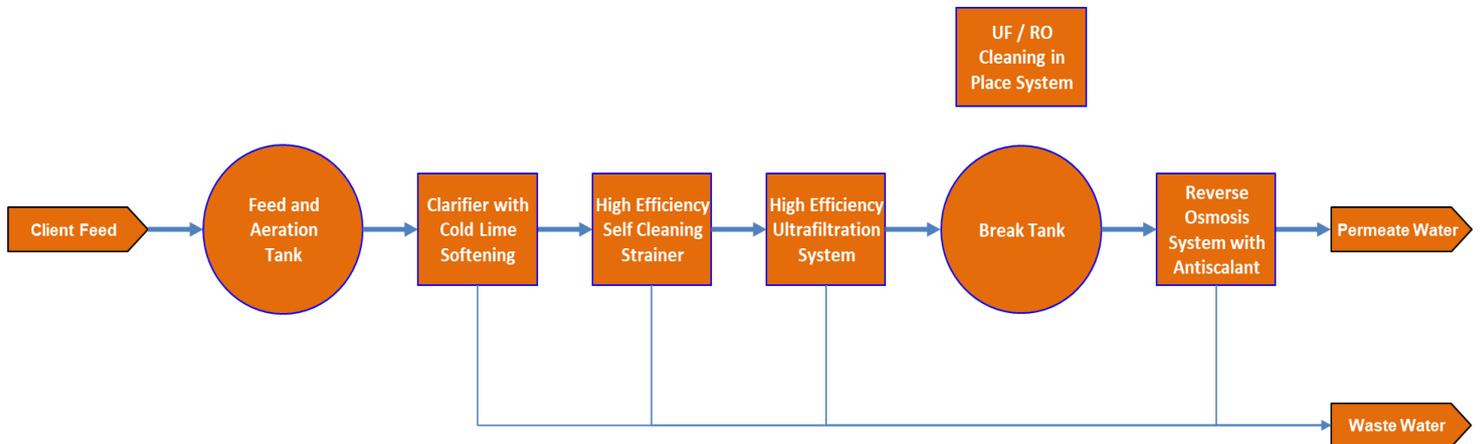
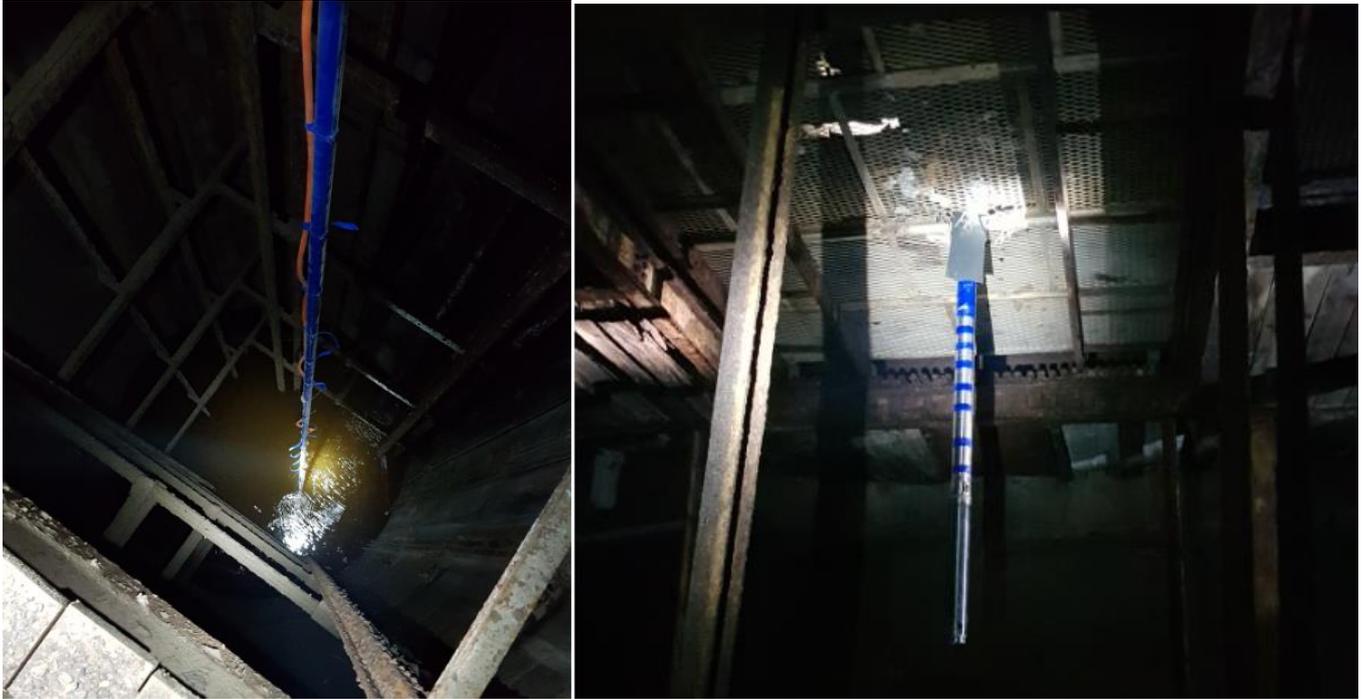


Figure 2: Water treatment plant flowsheet.



Figure 3: (LHS) Water treatment pilot plant mobilisation. (RHS) Commissioning the chemical treatment, filtration and reverse osmosis components of the pilot water treatment plant, setup to operate at 5m<sup>3</sup>/hr of feed water.

The pumping system, supplying the water for the treatment trials, forms part of the field trials. Specialised, self-supporting, flexible hose, supplied by Hose Manufacturers South Africa (Pty) Ltd (**Hose Manufacturers**), is being field tested for the planned Prieska vertical lifts. Hose Manufacturers have developed the Deepset Hose (Boreline 400) able to self-support to a vertical lift of 1,000m. The Prieska Project dewatering trial assembly uses an 18.5kW borehole pump, attached to 3-inch diameter flexible hose, with a 378m vertical head as a single-lift, (Figure 4). This arrangement is the first such application under trial globally.



**Figure 4: (LHS) Boreline 400 flexible-hose suspended in the Hutchings Shaft, with a 378m vertical lift. This is the longest, single-lift pumping setup using self-supporting flexible hose under trial in the world. (RHS) The 18.5kW Vansan submersible bore pump being lowered in the Hutchings Shaft.**

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On completing of the water treatment trials, pilot-scale trials of the proposed mechanically assisted evaporation assembly are planned. The BFS relied on field trials using 15kW units. Trials using 75kW and 90kW units are planned. Results from the trials are expected to refine the number of and improve the operating efficiency expected from the evaporation units to be installed.



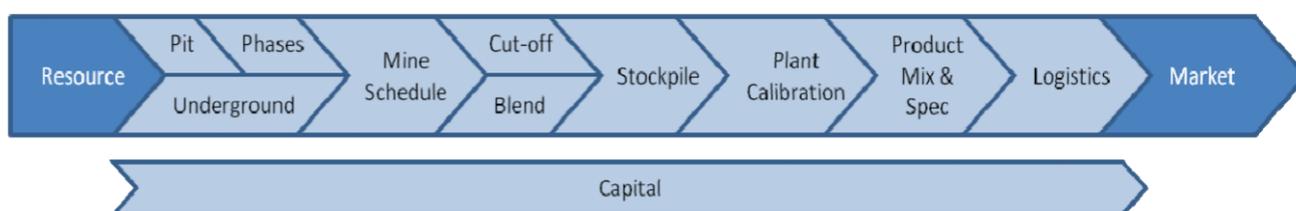
**Figure 5: Feasibility study field trial of effectiveness of a 15kW evaporator at the Prieska Project. The planned pilot trials aim to test 75kW and 90kW units as the next phase of the program.**

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## Enterprise optimisation

Whittle Consulting (Pty) Limited (**Whittle**) has been engaged to undertake enterprise optimisation of the business plan that was formulated as part of the BFS. The enterprise optimisation process is expected to significantly improve project economics whilst also mapping out key business processes to aid operational control and a better understanding of the real value drivers unique for the Prieska Project business plan. Whittle has a demonstrated track record of having dramatically improved base case plans, with previous projects having achieved in the order of 10% - 30% improvement in net present value (**NPV**) from the base case.

Enterprise optimisation is a methodology for increasing the economic value of mining and mineral processing operations through better long-term planning decisions. It involves a combination of ten mechanisms, which deal with decisions at different stages of the mining value chain. A decision made at any point in the system potentially affects the optimal decision for all other points in the value chain. The process involves the detailed and accurate mapping and linking of the whole value chain, from the Mineral Resource inventory to the marketed product. Thereafter, critical value drivers along the value chain are simultaneously varied until optimal permutations are identified. Fundamental parameters such as cut-off grades, mining sequence, mining rates, targeted metal recoveries, mill throughput rates, targeted grind sizes, feed blends, product specifications, product logistics routes and variances in metal prices are all considered as one integrated system to derive a series of optimal business scenarios. Whittle has, over a 30-year period, developed sophisticated software that enables this complicated simultaneous optimisation of the whole value chain to be undertaken.



**Figure 6: Value chain to be optimised using the Enterprise Optimisation Process.**

The Whittle optimisation process will be conducted along with ongoing refinements and value engineering of the individual components making up the project value chain such as optimised process plant layouts to reduce footprint, streamlined mine sequencing including backfilling, and the selection of the simplest and most cost effective route to transport the concentrates to market. The optimisation process is expected to be completed by Q4 2019, resulting in a refined mining plan, ready for execution and that also incorporates recommendations collected from key service providers and suppliers now being engaged as part of the preparation for project execution.

## Negotiation of Key Supply Contracts

The negotiations for key supply contracts and to secure long lead time plant and equipment are now being advanced. Activities are being targeted to ensure the project is ready for execution by year-end and to take advantage of potential savings in capital expenditure that can be secured with early down payments for critical items of plant and equipment. Key contracts under consideration include:

- obtaining grid power from the national power utility, Eskom: whilst Eskom has approved the Company to undertake the power connection works as a self-build program, administrative connection charges and power tariffs are yet to be finalised;
- commissioning the next phase of renewable energy supply studies: a collaboration agreement with juwi Renewable South Africa (Pty) Ltd is already in place that provides the framework for advancing the plan to have over 50% of the project power needs supplied from renewable energy sources (refer ASX release 5 March 2019);
- securing water supply infrastructure and tariffs;

- placement of orders or option down-payments for long lead time items: suitable rock hoisting and materials transportation winders, as well as ball mills have been identified that, if secured early, would result in significant improvements in the project execution timeline and the mine construction cost.
- engagement of project management contractors;
- engagement of key workstreams service providers; and
- the marketing of copper and zinc concentrates.

### Mine Operating Licences

Applications for the permits to mine the portion of the Prieska deposit within the Repli Prospecting Right boundary were first submitted in April 2018 (refer ASX release 9 April 2018). These include an Integrated Water Use Licence application (**IWUL**), Mining Right Application and a request for an Environmental Authorisation (**EA**). Applications for the Vardocube Prospecting Right portion of the deposit were submitted in September 2018. Demonstrable progress has been made with the Repli EA being granted on 3 July 2019 (refer ASX release 8 July 2019). The imminent granting of the Mining Right and IWUL, represent the final permitting milestones required to complete the Project's regulatory approvals.

Along with the focus to prepare the technical and administrative aspects of the project for execution, Orion continues to advance project financing discussions with the intention of having the project in construction phase during calendar year 2020.



Errol Smart  
**Managing Director and CEO**

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