

ARIZONA

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Mining

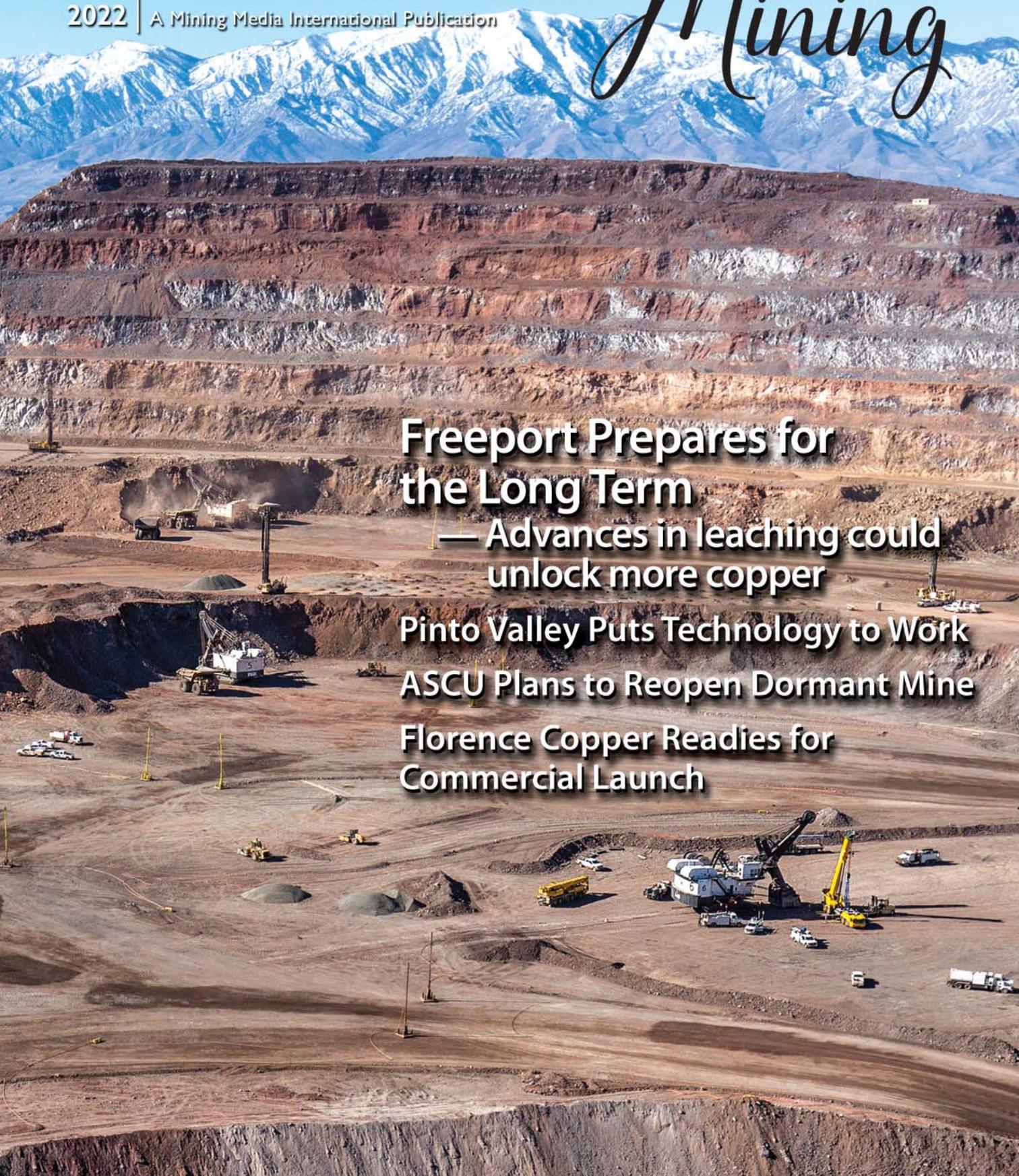
**Freeport Prepares for
the Long Term**

— Advances in leaching could
unlock more copper

Pinto Valley Puts Technology to Work

ASCU Plans to Reopen Dormant Mine

**Florence Copper Readies for
Commercial Launch**





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A Message From Arizona Mining and Industry Get Our Support – AMIGOS



Sydney Hay, President

Nearly 50 years ago, a handful of top mining suppliers founded AMIGOS to support the industry vital to their future — the mining industry. Little did they know, the organization they founded would grow to become a major force. AMIGOS stands for Arizona Mining and Industry Get Our Support. And that's what we, the members of AMIGOS do. We re-earn the moniker, "The Mines' Best Friends" every day by providing the best-of-the-best in goods and services to mines close to home and around the globe and by standing up to be counted whenever the mines need us.

Over the years, AMIGOS members have come up with amazing state-of-the-art technologies so mines can create wealth and quality of life, and a sustainable future.

And we, AMIGOS, are pretty good at creating quality of life, too. Our members employ tens of thousands of our Arizona friends and neighbors in high-paying jobs with good benefits. We are committed to a long and prosperous future for mining in our state.

AMIGOS members are an important collection of firms working on projects worldwide with a strong employment presence in Arizona. Our members include heavy equipment and machinery suppliers, engineering and construction firms, manufacturers, transportation and logistics firms, tire dealers, chemical companies, mining and environmental consultants, insurers, staffing firms, steel suppliers, and much more — a job-creation engine.

And, while our members work on projects throughout the world, mining must continue to thrive here at home. Our members will do all that we can to get new projects like Rosemont Copper, Copper World, Resolution Copper, Florence Copper, South 32 Hermosa project, and others up and running. We will continue to support longtime Arizona stalwarts like Freeport-McMoRan, Capstone Pinto Valley, ASARCO and others.

We, AMIGOS, are the suppliers who give back to the industry by which we make our living.

As our nation moves toward an ever-greener economy, mining will be more important in the future than ever before. Green technological innovations need vast amounts of copper, silver, gold, rare-earth elements and more. The future of mining is a bright one.

AMIGOS will also continue to help our member companies thrive. Our Zoom meetings now connect our members face-to-face with mines near and far. Our Reverse Expos that offer "speed dates" between suppliers and mine procurement personnel are hugely popular — and effective.

If you are a supplier, join us! As a member, you will have opportunities to interface with top decision-makers at the mines. You will get known within the industry. Our online buyers' guide at www.miningamigos.com will be a great tool for you. There you can proudly promote your goods and services, company news and blogs, job openings, and upcoming events.

Members tell us that they count AMIGOS membership as one of their best business decisions. Mining executives continually thank us for being in their corner.

We are more than 300 of the best-of-the-best in mining suppliers. We are AMIGOS. We invite you to be one, too.

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Freeport Prepares for Long Term

Leading copper producer invests in Arizona operations to maintain a steady copper production pipeline

By Steve Fiscor, Editor-in-Chief, *E&MJ*

Freeport-McMoRan produced 3.21 billion lb of copper in 2020 and about 1.42 billion lb came from its North American mining operations. The company operates seven open-pit copper mines in North America — Morenci, Bagdad, Safford, Sierrita and Miami in Arizona, and the Chino and Tyrone in New Mexico. The Morenci mine is the company's leading North American copper producer (707 million lb/y) followed by Bagdad (216 million lb/y), Sierrita (178 million lb/y) and Safford (161 million lb/y).

Operations continue to ramp up at the Lone Star mine, which is part of the Safford complex, and copper production is growing by leaps and bounds. Freeport brought the Lone Star project online at the end of 2020 and copper production has already grown to more than 200 million lb by the end of the third quarter. The company hopes to grow that annual figure to as much as 300 million lb/y.

Modern copper leaching technology is presenting an opportunity to increase production from all the mines and Freeport is currently studying a program that could recover substantial amounts of copper from existing stockpiles at Morenci. The company is looking to double the output at Bagdad. Freeport also has considerable undeveloped copper reserves in Arizona.

During February, Freeport appointed Kathleen Quirk as president, in addition to her role as CFO, recognizing her work and leadership over the years. Quirk joined Freeport in 1989 and became CFO in 2003, with her responsibilities over the years continually expanding into all aspects of the business. Today, she works closely with all of Freeport's operations, including Grasberg in Indonesia and the mines in South America as well as the company's North American operations.

Safety is the primary consideration at all of its mining operations. Similar to businesses in any area, however, Freeport has had to learn to adapt and work around COVID-19. The company quickly put policies in place to protect its workers and local communities, Quirk explained, following the Centers for Disease Control and Prevention safety protocols and in some cases, the company took it a step farther. "When vaccines became available last year, we strongly encouraged people to get vaccinated and offered incentives," Quirk said. As far as working with the corporate headquarters in Phoenix, Freeport has estab-

lished a Collaboration Hub where groups get together on a need-to basis, while at the same time taking advantage of the efficiencies gained and learned during the pandemic.

Reviewing the company's Arizona mines, Quirk is excited about the company's recent accomplishments with the Lone Star mine at Safford. She and the team have a few projects on the horizon that could increase copper production from existing Arizona operations. Her objectives for the future focus on plan execution and building and maintaining a healthy pipeline to fulfill the world's growing need for copper.

Producing More Copper From Existing Operations

Lone Star is mining from an impressive orebody in a historic Arizona district. "We are just starting at Lone Star," Quirk said. "We began with the original oxide project,

which leveraged Safford's infrastructure, and that's been operating since late 2020 very effectively. We started at a rate of 200 million lb/y of copper, we're now currently achieving 250 million lb/y, and we've got some evaluations that could bring production up to 300 million lb/y."

A 50% increase in production from the original design is a significant achievement for any business. Quirk attributes the increase to eliminating bottlenecks. "It's a great, great way to start a project like this, which has a long life and a big future ahead of it, and the benefit of us expanding the oxides is that it not only generates a good

return on investment for that project, but it also exposes what we see as a major sulphide development."

Lone Star's mineral potential is 10 times the current reserves, and it's rather unusual to have such a large deposit in an area where the company has been mining for so many years. "People in the area are familiar with us," Quirk said. "We have a high level of community acceptance and we have a very, very positive outlook for the future of this operation."

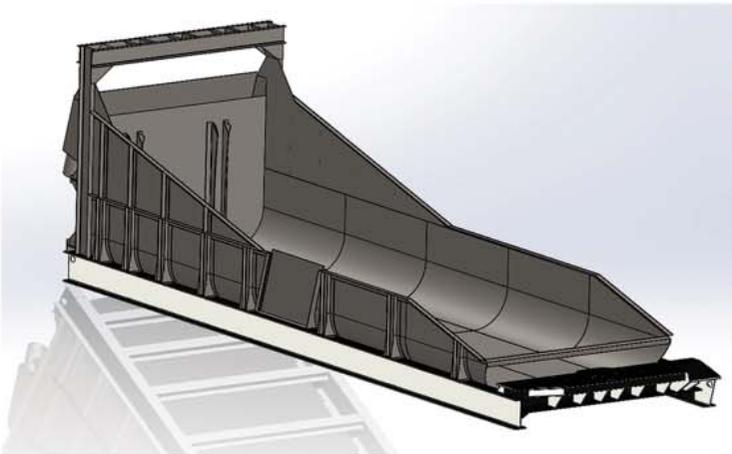
As it mines through the oxide cap, Lone Star is profitably pre-stripping a massive sulphide orebody. "We've done a lot of drilling in recent years, and we will be doing significant work to incorporate that drilling into our longer-term plans," Quirk said. She believes that Lone Star will become something of significance and scale for Freeport for decades to come.



Kathleen Quirk, president and CFO, Freeport-McMoRan.



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Another established mining area is Freeport's Bagdad mine in northwest Arizona. Freeport has operated there for decades. Unlike Lone Star, which is a leaching operation, Bagdad operates a concentrating mill that produces both copper and molybdenum in concentrate. "We have an opportunity at Bagdad that we've been discussing for some time," Quirk said. "Because the reserve life is so long at Bagdad, on the order of 80 years at the current milling rates, we started looking at upgrades, such as automation, to improve the plant's throughput and recoveries without investing a lot of capital."

Using machine learning and artificial intelligence, Freeport determined they not only had the ability to increase production and improve recoveries through automation, which they are currently implementing, it also pointed the way to the next phase: investing in second concentrating line. "We will be in feasibility this year on that project," Quirk said. "It could essentially double the capacity at Bagdad."

The Sierrita mine, which is located near Tucson, is using a throughput and recovery optimization model to predict, based on data, the best way to process various types of ores passing through the plant at any given time. "This model was developed by data analysts working in conjunction with our operators and we're seeing good performance of these models relative to the historical way that we use data, and this really gives us much more ability to predict and know the cause and effect of the actions we take," Quirk said.

Across the North American operations, Quirk said they are considering advanced leaching initiatives, especially at Morenci, which has advantages to enhance and modernize solvent extraction/electrowinning (SX/EW). "The processing at Morenci is much different," Quirk explained. "The leached material does not have to be smelted, but the recoveries are much lower than a concentrator, and we and others in the industry are embarking on a major effort to find ways to improve recoveries from leach production."

Freeport has a variety of leaching initiatives under way, both internal research and development and partnerships with third parties, to look at ways to improve recoveries from our leach stockpiles. "We have 38 billion lb of copper in stockpiles today that are not included in our reserves or resources," Quirk said. "We didn't expect to recover it and we're looking at ways to recover some of it now. If we just get a 10% to 20% increase in recoveries, that's similar to bringing a new mine online without the mining and capital. We're talking low incremental costs, very low capital, and importantly, a very low carbon footprint."

As Quirk and the team survey the situation around the world with respect to copper, they see a new element of demand emerging with respect to demand from de-carbonization, especially with battery-electric vehicles and renewable energy. "When we look at how copper supply matches up with this new element of demand, it's not obvious where that copper will come from," she said. "There aren't a lot of actionable development projects available to the industry,



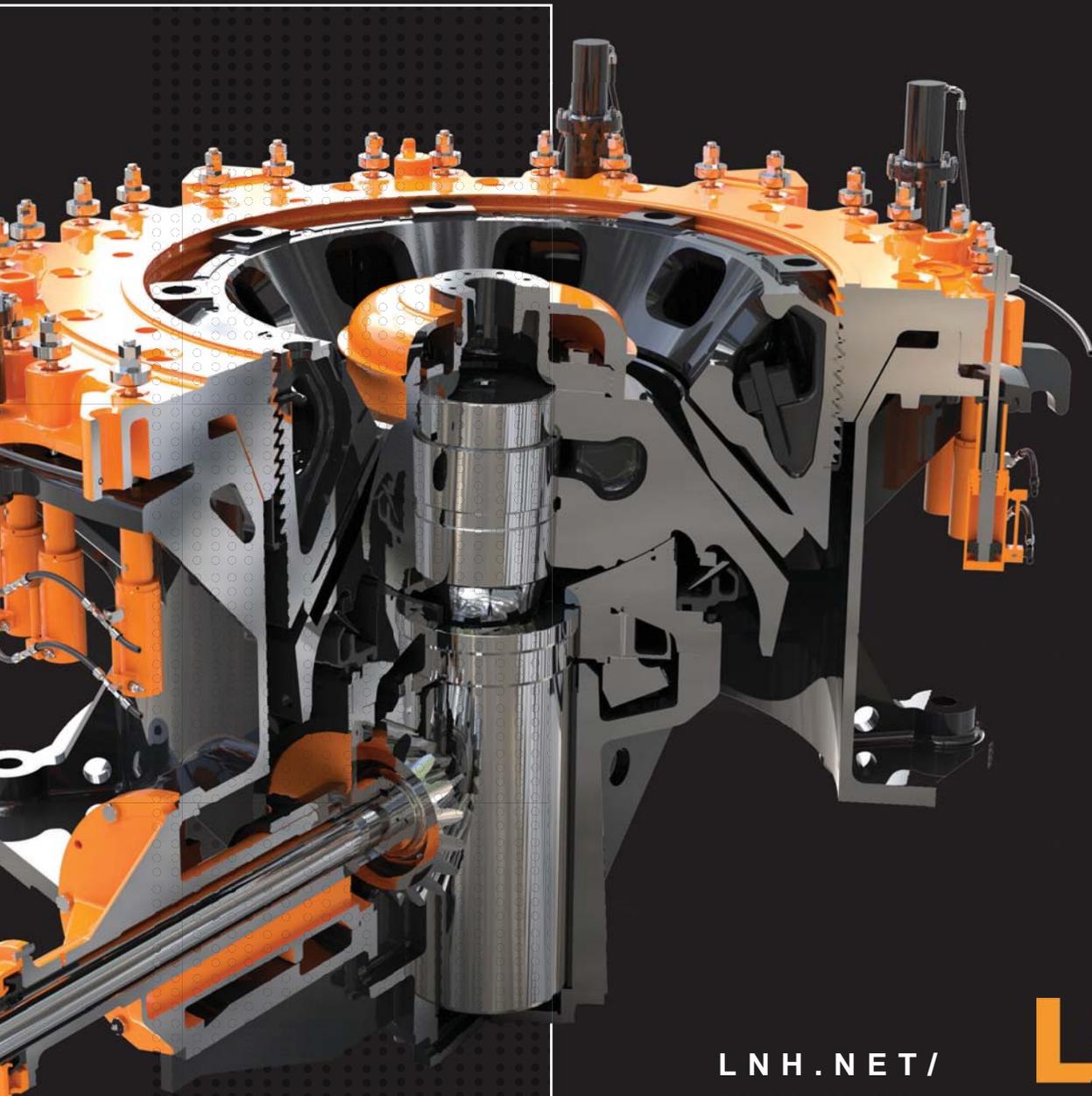
Freeport is considering advanced leaching initiatives, especially at Morenci (above), which has advantages to enhance SX/EW processing.



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A haul truck at the Lone Star mine cycles back to the pit.

like there once was. The industry will have to find new ways to produce more metals and we believe these advanced leaching methods, if we can crack the code, will be a new source of mine supply that the market really needs to respond to increasing demand from decarbonization.”

About half of that 38 billion lb is at Morenci. “That’s why we’re focusing most of our efforts on the Morenci leaching program,” Quirk said. “It has the ability to really move the needle. The ways in which we are able to use data these days is amazing. In the past, with leaching, it was much more of a trial-and-error process. Now, with data analytics, we know a lot more about what effect different technologies have on leach recoveries.”

Morenci generates no waste rock. It processes all the mined material. Some of it may be very low grade with little copper recovered. Higher grades are processed through the concentrator and lower grades are stacked on the leach pads. “With this new technology, how the ore responds could change the way we operate,” Quirk said. “Accurately predicting where the ore should be processed could be a game-changer when it comes to more complex ores.”

Quirk described Freeport’s leaching initiative as a collaborative process, one that involves engineers, metallurgists, mine planners and geologists. “We have developed an agile way of working during the past few years,” Quirk said. “We were always collaborative, but we really started to ramp up an agile approach to problem-solving. It really helps to have the ability to go across functions and bring people and resources together to bounce around ideas and move more quickly than we have in the past.

“Rather than over-analyzing the situation, we’re trying things more quickly, and making incremental progress,” Quirk said. “Hopefully, during 2022, we will make more meaningful progress on this, but it’s still in the research and development phase.”

Dealing With Rising Costs

Copper is commanding a higher price these days. In 2020, Freeport sold copper at an average price of \$2.82/lb.

During 2021, the average price of copper sold was \$4.22/lb, but increasing costs are partially eating into those profit margins. In 2021, oil prices and energy prices in general rose significantly. “Energy costs definitely impact our cost structure,” Quirk said. “For a number of years, we have been working on energy efficiency projects, but we still consume a lot of energy in operations.”

Other consumables like sulphuric acid and ammonium nitrate have been a major factor for Freeport as well. Those items are more of a supply-demand factor as opposed to traditional inflation, Quirk explained. “Ammonium nitrate has been affected by high ammonia prices and high natural gas prices, but our team has been managing the supply chain well. They take a strategic view with our suppliers, and we work with them, providing forecasts so they know our plans and they can plan their business.

Labor has also been a factor lately. “We have a number of open positions in the U.S., and the mining industry is a very competitive environment right now,” Quirk said. “We are implementing programs to try to help retain and attract the best people to our mine sites. We have a really good workforce that’s dedicated and committed to our values. However, we need to continue to recruit new workers and that’s a challenge in today’s world, even when you offer a really good work environment, very good pay and benefits, and an inclusive culture.”

Looking toward the future, Quirk said she is laser focused on execution. During 2020 in the midst of a pandemic, the Grasberg mine in Indonesia successfully transitioned from open pit to underground mining. “We’ve got significant operations in Peru and a major development opportunity in Chile,” Quirk said. “On top of all that, our balance sheet is in super shape. We’re investing in the mines and opportunities for them, and we’re returning cash to shareholders.”

“For me, it’s about executing that strategy and thinking about what the next 10 years will look like,” Quirk said. “We need to make decisions now that will set us on a course to maintain large-scale production for decades to come.”

Freeport has completed climate-related initiatives and it recently published a comprehensive climate report. “We’re also documenting our ESG [environmental, social and governance] strategy,” Quirk said. “It’s been a feature of our industry forever because we’ve operated in remote communities for decades. We have demonstrated our ability to be really great stewards of the environment and great partners with communities over a long period of time. Today, there’s so much more emphasis on ESG from a reporting, disclosure and accountability perspective, and we’re taking that very serious.”

Freeport is fortunate to have a pipeline of opportunities and to be able to rank those opportunities in sequence to ensure a long-term successful future. Quirk believes the best is yet to come.

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Pinto Valley's Mine-to-Mill Innovation Program

Teaching an old dog new tricks

By Steve Fiscor, Editor-in-Chief, *E&MJ*

Capstone Copper operates the Pinto Valley mine in Arizona's Globe-Miami mining district. During 2020, the operation produced more than 119 million lb of copper and it was on track to beat that figure for 2021. During Q3 2021, the company reported a year-to-date production increase of 13% compared to the same period last year. It attributed the improvement to higher head grades for 2021 (0.34% versus 0.30% in 2020) and improved flotation plant recovery performance (87.3% versus 84.5% in 2020).

Pinto Valley recently completed its \$31 million PV3 Optimization project, which took place in two phases. Phase 1 work was completed in 2020 and it included improved blast fragmentation processes, installation of two new secondary crushers, and nine new screen decks, as well as one new ball mill shell. As a result, Pinto Valley was able to reliably achieve throughput of 58,100 metric tons per day (mt/d) in Q1 2021.

Phase 2 of the PV3 Optimization work was completed during Q3 2021. Capital was invested into tailings thick-

eners, pumping upgrades and installation of a second new ball mill shell. In September, milled tonnage reached 60,212 mt/d and a new monthly record was set in October at 60,758 mt/d.

They are posting those figures from the same six mills that were installed at the mine in 1974. At the time, they were billed as the world's largest, processing 6,047 mt/d, and today peak processing rates exceed 11,900 mt/d.

"These mills are small by SAG mill standards, but we are pushing them to run basically twice the tonnage that they were being put through when they were installed 45 years ago," said Mike Wickersham, general manager for the Pinto Valley mine. "As far as the ball mills themselves, we have replaced mill shells on two of them. There is some worn steel in a couple of the mill shells, and we're planning to replace two more. They are the same size as the old ones just running harder."

Even though PV3 Optimization may be complete, Wickersham and his team are always looking at innovative ways to improve the operations.

"We are using many different tools to make the whole place run a little more efficiently and effectively," Wickersham said. "Some mining operations rely on one platform to solve all the problems. We found we could solve problems with lots of different solutions." He discussed how the mine is using new equipment and technology to improve safety, modelling, reliability, productivity and efficiency.

Improving Safety

In 2020, Pinto Valley began testing cameras from EDGE3 Technologies, which identify fatigue and other at-risk behaviors. "We have had some serious fatigue incidents," Wickersham said. "Nobody has been hurt fortunately, but we knew we had a problem. Onboard facial recognition cameras turned out to be a pretty good solution for us, and it's really reduced the number of chronic fatigue incidents. We still have some issues where people get sleepy. We can now detect it before it becomes a problem." Today, the mine's fleet of 23 haul trucks are all equipped with the technology.

Capstone also uses two slope-stability radar systems supplied by IDS Georadar and Ground Probe featuring rear aperture radar that gives precise, targeted monitoring for key areas throughout the pit. Pinto Valley also monitors 40 prisms with a laser monitoring system that links with Cloud-based Sensemetric for recording and reporting data. "We operate a large mine with a deep pit and, like most mines, we rely on this technology to monitor slope stability," Wickersham said. "This is a data acquisition platform that allows us to collect remote data from different aspects of the operation. So, whether it's tailings impoundments or reservoirs, pump



Capstone nearly doubles the original capacity of its six ball mills.

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A dozer operator works from an office setting.

or slope stability, all that data could be gathered and monitored.”

To protect its workers from hazards working around the stockpiles, Pinto Valley has been using telere-

ote technology on dozers. “We had a couple of instances with material sloughing on stockpiles and we were worried about a possible rollover,” Wickersham said. “The draw points beneath the piles create void spaces and we had a couple of close calls. We were concerned, so we just removed the operator from the cab entirely.” The operators now run two dozers from an office environment.

In the mill, technicians use a concave liner handling system to improve safety while maintaining crushers. “This system doesn’t have any bells or whistles or sophisticated electronics,” Wickersham said. “It’s a mechanical tray that holds all the concave liner segments. So instead of flying multiple pieces in and out over time, you just load it all up, and transport one big load. It’s a safer and faster process and we have fewer instances where people are at risk with overhead loads going back and forth.” Liner changes consisted of 50-plus crane picks and

lasted approximately 57 hours. When the setting rings were used, the crane picks were reduced to five and the job was completed in about 46 hours.

Capstone uses aeronautical drones to survey dumps, leach pads and tailings storage facilities (TSFs). “We use those to look at the pit for confirmation of our dig plans on each bench,” Wickersham said. “We use it for surface contours for our deposition of tailings. It’s just a very handy tool that we use weekly.” The data is used in conjunction with Propeller to produce a 3D map used in planning and volumetric surveys.

Drone bathymetry survey equipment (small, unmanned watercraft) is used to measure the bottom of the ponds to produce a plot file of coordinates to easily understand the current situation for planning purposes. “Water is a such a precious commodity in Arizona and we have to carefully monitor it,” Wickersham said. “We needed more than a surface survey drone, so we do bathymetry and that

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Modelling and Digital Twins

Even though it’s a smaller operation, Pinto Valley is an avid user of digital twins. “Our water twinning is done with GoldSim and we use Qerent for our production digital twin, which lets us model costs and tons across the entire value chain,” Wickersham said. “We have the standard tools that any modern mine would have for modelling geology, the orebody, the pit, ore grades, etc. The digital twins let you run the business with the proper models.”

Implementing the GoldSim water model has allowed Pinto Valley to effectively model water usage and conservation, while providing a platform to make sound production decisions relating to water usage.

Partnering with BSC Corp., Capstone constructed a digital twin for the Pinto Valley operations using Qerent, which allows them to create any sce-



A mechanical concave tray improves safety during crusher maintenance.

nario and compare it to what was budgeted and planned throughout the value chain. Ultimately, Wickersham said, the digital twin allows more informed business decisions. Pinto Valley also uses several different software suites to model lithology, grade and blastability.

Monitoring for Improved Reliability

To improve reliability, Pinto Valley turned to AspenTech analytics, mo-

tion amplification cameras (MACs), SPLIT cameras and Sensoteq sensors. “We talked with Google and IBM about big data and data analytics solutions,” Wickersham said. “You can collect lots of variables from the plant with these big data analytics systems. They can give you correlations, but it’s a mathematical oddity when you discover them and the real question is: What do I do about it?”

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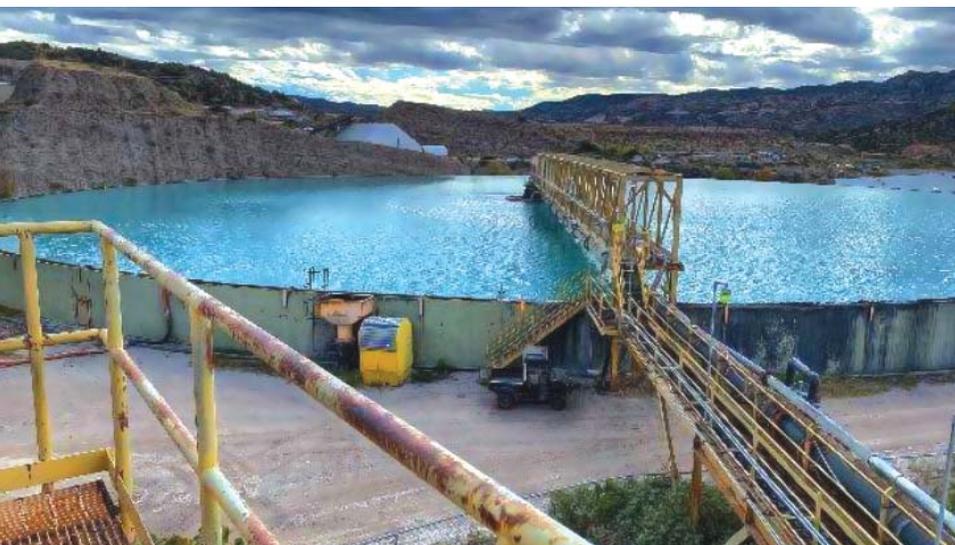
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Capstone upgrades two thickeners to handle up to 70,000-mt/d total plant output.

Ultimately, Capstone decided to use AspenTech and they installed field devices and deployed software to provide early warning of potential failures, which could lead to extended downtime on critical equipment. “AspenTech defines steady-state operating systems with multiple variables, being measured from crushers, ball mills, etc.,” Wickersham said. “They then look for departures from the steady state using agents, like those in *The Matrix*. They look for insipient departures. Instead of sending out an alarm, like a traditional distributed control system (DCS) that simply reports a high sump level or high bearing temperature, it says you’ve got a 30% chance of failure in this system based on bearing temperature in two weeks, or you have a 40% chance of catastrophic failure in four days based on particulate count in a lubrication system. It’s a more sophisticated way to define a departure from the norm, rather than just having an alarm.” He said lost production revenue from catastrophic failure more than outweighs the cost of this investment.

Using MACs demonstrated to Pinto Valley that a loose nut had allowed the crusher’s mainframe and its grouting to separate. This could be seen through an excessive amount of flexing in the crusher’s mainframe and countershaft. With this early as-

essment, the maintenance department could schedule a foundation repair without interrupting production.

“Basically, you take a digital video of a piece of operating equipment and the system looks at every pixel mathematically for slight variations or color changes and interprets that as a change in movement, then it amplifies that as a color change,” Wickersham explained. “Visually imperceptible vibrations that you might be able to feel with your hand or hear with your ears are translated to video in motion, jumping up and down, and that turns into detecting broken bolts or cracked frames or inadequate grouting in pedestals. It’s a really, really helpful piece of technology.”

Capstone uses SPLIT cameras to measure fragmentation or classify distribution at the mining face. “Getting the best fragmentation is really a lynch pin in our mine-to-mill program,” Wickersham said. “We’re doing a better job of blasting and fragmentation. To know where you stand, you must measure fragmentation and these SPLIT cameras let you do it.”

When he talked about the Sensoteq sensors, Wickersham explained that it is an expansion of the mine’s digital footprint for the physical assets. “For a plant that was built in 1974, having more instrumentation was really nec-

essary for us to monitor the assets in a more effective way,” Wickersham said. “These little Bluetooth sensors that can be loaded on to just about any piece of machinery provide real-time condition monitoring.” Capstone plans to mount nearly 150 Sensoteq wireless sensing devices on key equipment.

Productivity and Efficiency

Capstone recently began running Cat’s MineStar Fleet Management System using equipment assignment optimization. “For our fleet of haul trucks, we’re using the same system to manage productivity and dispatching from load point to dump point for the entire mining cycle,” Wickersham said. “This improves efficiencies of queue times at the source.”

Pinto Valley uses onboard drill data acquisition to calculate the blastability of the rock. “If we’re able to get some intelligence about how hard or how competent the ore or the waste is, we can modify our blast design and get much, much better blast fragmentation,” Wickersham said. “The fragmentation program using the SPLIT cameras really starts with the onboard data acquisition on the drills.”

The mill is using an advanced process control (APC) system that overlies a classic DCS. “Instead of a supervisor in the control room trying to run six ball mills manually, the APC runs it for optimization and the mill operator supervises the supervisory program. It just makes it much easier to optimize six mills running in real time, rather than trying to do it manually.”

As far as material handling, Pinto Valley has had a great deal of success with the Cat 994K wheel loader. It is equipped with the latest EPA Tier 4 engine technology that along with a redesigned powertrain consumes 30 less gallons of fuel per hour than the shovels. “The 994K loader is more flexible and just as productive as the large track-mounted excavator it replaced and saves 410,000 gallons of fuel and millions of dollars in maintenance,”

Wickersham said. “We have two of them now and we are considering the purchase of a third in 2022 or 2023.”

Capstone has been replacing the original secondary crushers with Raptor cone crushers, which increase throughput from 1,200 mt/h to 1,500 mt/h. “Moving from the crushers that have been in place for 45 years to these modern higher-capacity crushers is a big step forward and just lets us fill the fine ore bins so the mills can run a high capacity all the time,” Wickersham said. “We have got nine total crushers, three secondaries and six tertiaries, and we’ve upgraded two of the secondaries. If we need to go through another round of debottlenecking, we will probably take that third one as well.”

With all of the improved fragmentation in the mine, the screens were about to create a bottleneck. Capstone installed new screen decks and reduced the recirculating load allowing for an increase in the capacity reporting to the fine ore bins. “We needed more surface area because we have many more fines coming through than before,” Wickersham said. “We needed to be able to screen it away and send it to the mills without bogging that system down. We added about 20% more surface area to all those screens. That increased the ore delivery to the fine ore bins ahead of the mill, so that we can make sure we’re always keeping the mills fully fed.”

Capstone tried a new reagent it hoped would alleviate a sodium hydrosulphide hazard in the molybdenum plant. “It didn’t pan out, but in the process of mechanically refurbishing the plant, we basically doubled the amount of moly recovery,” he said.

As far as tailings, two thickeners were upgraded to handle up to 70,000-mt/d total plant output. The upgrades included auto-diluting feedwells that enable tailings underflow densities up to 62%. “This one is a really powerful project for us. We have some instances where we lost production when the

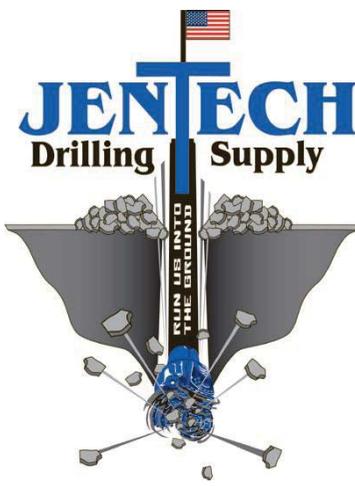
rakes in the thickener got stuck,” Wickersham said. “These are 280-ft diameter thickeners that don’t have a lift mechanism on the rakes. If you get too much mud built up, they just get jammed up and we couldn’t afford a retrofit to install a rake lift mechanism.

“With the new center well design, however, we see better settling rates, so the solids thicken and settle faster near the center, and that stops the torque from building up on the ends of the arms,” Wickersham said. “By preventing the rakes from sticking, we have much less water reporting to tailings. That’s where we have our biggest exposure to water loss, so what started as a production opportunity, turned into a water conservation project that now saves about 800 gpm of water that would have been lost to evaporation at the TSF.

Another tool being used for water conservation is interlocking HexDisks. “Some mines use floating balls, these

just happened to be flat disks. In addition to this, the mine using WaterSavr, an environmentally safe application that deposits a thin layer of cetyl alcohol to slow evaporation. “It’s like throwing a stick of butter in a boiling pot of water. The oil on top prevents the steam from rising from the pot,” Wickersham explained. “Same thing in the summer with our reservoirs. You disperse a little WaterSavr and it stops evaporation by about 45%. The HexDisks slow down evaporation by about 85%, but they are much more expensive. It’s a pricey way to save water, but in Arizona with a pan evaporation rate of around 96 in. a year, it will pay off in the long haul.

“People who are unfamiliar with Pinto Valley think that we are just running an old mill and may think we are not doing much,” Wickersham said. “The reality is that we have a great copper mining and processing operation that’s using all of the latest tools at its disposal.”



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Arizona Sonoran Prepares to Unlock Copper Deposit With Cactus Project

Using modern leaching techniques, mining company plans to reopen a dormant copper mine with a layered approach that begins with processing a waste pile

By Steve Fiscor, Editor-in-Chief, *E&MJ*

Headquartered in Tempe, Arizona, the Arizona Sonoran Copper Co. (ASCU) intends to develop the Cactus Project, which is located about 44 miles south of Phoenix near Casa Grande. Formerly known as the Sacaton mine, the Cactus Project today consists of a large private land package in copper country with an idled open-pit mine, a concrete lined shaft and a 500-acre, oxide-rich waste dump, and a significant copper mineral resource at Cactus West and Cactus East.

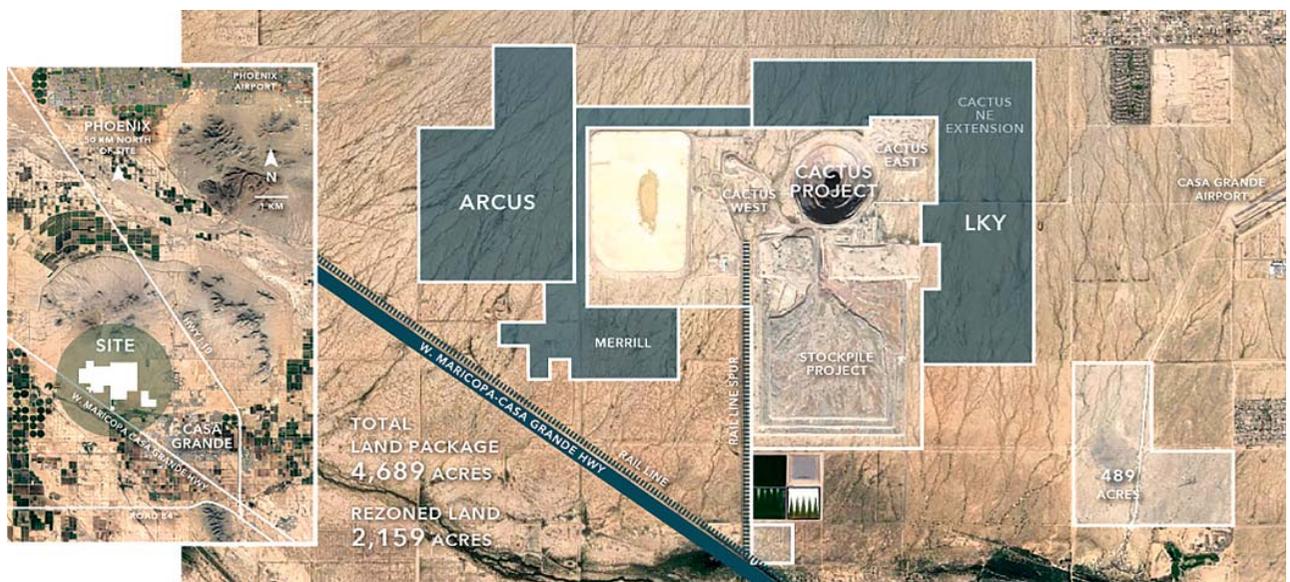
Yesterday's waste dump has become today's Stockpile Project. The current plan for the Cactus Project consists of three phases, the Stockpile, Cactus West and Cactus East, which span about 20 years. Back in the day when American Smelting and Refining Co.'s (ASARCO) was mining, the oxide cap was viewed as waste, and looking forward, ASCU plans to relocate the dump and use modern leaching technology to recover copper from it. Cactus West will involve reopening the pit and mining leachable ores with a layback that will ultimately lead to Cactus East portals accessing an underground leachable orebody.

During the last two years, ASCU has amassed a significant land package surrounding the Cactus Project. In July 2020, the company closed on a Purchase Agreement (PA) and a Prospective Purchaser Agreement (PPA) with the ASARCO Custodial Trust, Environmental Protection Agen-

cy (EPA) and the Arizona Department of Environmental Quality (ADEQ), respectively, to acquire ASARCO Sacaton-related land parcels now named the Cactus Project, as well as the remaining infrastructure and mineral rights. All of which was placed in a multistate custodial trust administered by the EPA as part of the 2009 ASARCO bankruptcy settlement, and subsequently remediated using the multi-state \$20 million fund prior to the ASCU acquisition.

ASCU also purchased the neighboring Parks/Salyer Project, and acquired a prospecting permit for nearby land, owned by the Arizona State Lands Department. In 2021, the company purchased an additional 1,750 acres of land adjacent to the Cactus Project. Today, it holds more than 4,300 acres of private land.

With titles in hand, ASCU mobilized exploration drills to the site and began resource definition drilling, ultimately bringing Cactus West to an inferred status while confirming historical ASARCO drilling of Cactus East as indicated. Today, ASCU has estimated 1.6 billion lb of indicated and 1.9 billion lb of inferred resources for the Cactus Project, as reported in their 2021 NI 43-(101) compliant resource report and Preliminary Economic Assessment (PEA). The company has also completed additional reclamation work and plans to release a prefeasibility study



For the Cactus Project, ASCU assembles a 4,300-acre private land package surrounding the dormant Sacaton pit.



An aerial photograph shows the pit in relation to the Stockpile Project and the reclaimed surface facilities.

(PFS) midyear 2022. Depending on the financing and the permitting processes, the company believes first production could be achieved by the second half of 2024.

Rich Copper History

ASARCO geologists first discovered the Sacaton mineral deposit in the early 1960s. “Focusing on an outcrop in the middle of a flat Sonoran desert, now known as Discovery Hill, these guys quickly found evidence of a leach cap and so they embarked on a six-hole exploration program, as the story goes,” ASCU COO Ian McMullan said. “Five holes in, they had not found the deposit. Another geologist came in from headquarters and had them drill in the opposite direction and they sunk a hole in the middle of what today is known as the Sacaton or Cactus West Pit.”

The ASARCO drilling program ultimately defined two copper mineralization zones, a west zone that contained an orebody that could be accessed by open-pit methods and a deeper east zone.

That discovery set the wheels in motion for a copper mining operation that ran from 1972 to 1984. Primary and secondary sulphide ores mined from the Sacaton pit was processed in a 9,000-ton-per-day (t/d) flotation mill and the concentrate was shipped to the ASARCO smelter in El Paso, Texas. ASARCO also sunk a shaft and performed some exploration drilling in the eastern zone, but didn’t get a chance to pursue it. The copper market softened, and the underground development was suspended in 1981.

The Sacaton mine was permanently closed at the end of the first quarter of 1984 after exhausting its reserves, but not before mining and processing more than 38 million tons of ore. Over the course of its life, Sacaton produced 400 million lb of copper, 27,455 oz of gold and 759,000 oz of silver.

What remains today is the pit, circular in shape (3,000 ft in diameter and 1,040 deep), the shaft and a 500-acre waste rock dump. The site also has a 300-acre tailings storage facility that has been revegetated. The ore crushing facility, flotation mill, maintenance buildings, and headframe have been dismantled and removed as part of the remediation process.

Seeing the Opportunity

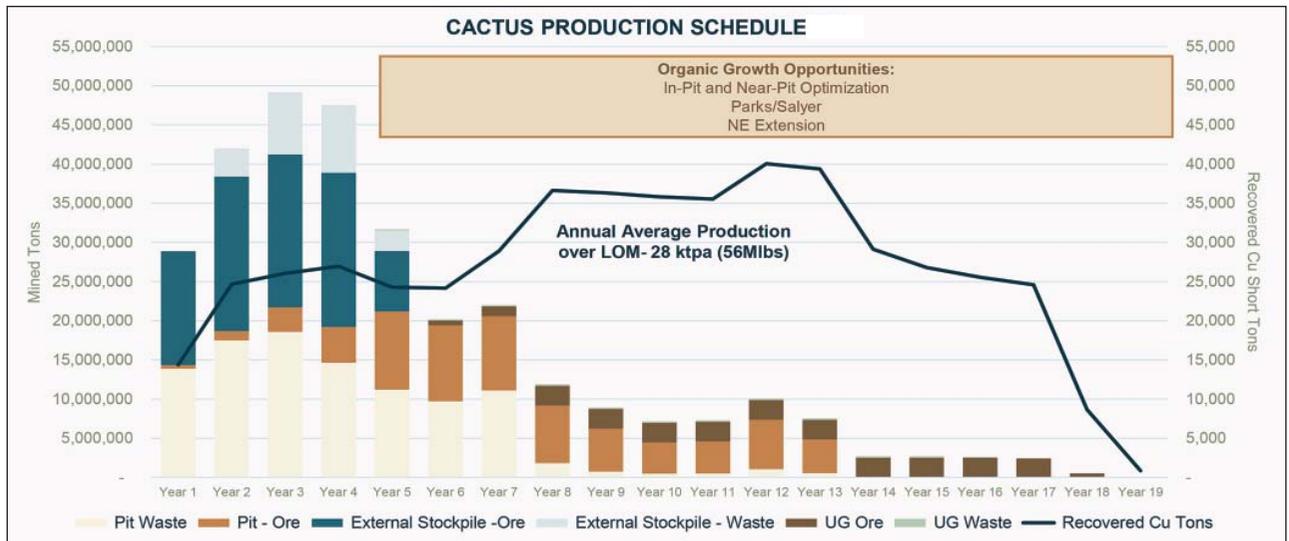
When the Sacaton mine was operating, all of the oxides and all sulphide copper mineralization below a 0.3% copper-grade cutoff were discarded. That waste dump and its high mineralization by today’s standards formed the basis of ASCU’s Stockpile Project. Meanwhile, with the solvent extraction/electrowinning (SX/EW) being a tested and true processing technique, the company was keenly aware of the significant opportunity to extract and process the oxides and enriched ores left in the ground by ASARCO.

“When we first began to consider the site a couple years ago, we started looking at the records to better understand what resources were available,” McMullan said. “We realized there were oxides and enriched ores left in the ground, and an opportunity with the waste dump as far as low hanging fruit to access early mining activity to generate cash flow, while also advancing the in-ground ores, by reprocessing it on a leach pad.”

Following up on a March 2020 preliminary economic assessment (PEA) that only considered processing of the waste dump, or Stockpile Project, ASCU published a PEA in August 2021 that considered three overlapping projects: the Stockpile Project, the Cactus West Project and the Cactus East Project. Material handling would begin with the Stockpile Project. As copper recovery begins in that area, ASCU would start the Cactus West Project, mining a layback. Once Cactus West is in full swing, the company will begin underground development at the Cactus East Project.

“We have designed this as a layered approach,” McMullan said. “We start with Stockpile mining, which is concurrent with pit stripping operations, such that by year four, when the Stockpile is winding down, mining activity in the pit has fully ramped up, and then by year six, we’re developing Cactus East. By year eight, the pit and underground are operating at capacity and by year 13, the focus transitions to underground mining.”

For the Stockpile and Cactus West projects, the current plan is to operate a large front-end loader with a small fleet of 100- to 150-ton trucks mining from multiple faces.



The Cactus Project's annual average production over the life-of-mine is expected to be 56 million lb of copper.

“This is still in the planning stages, and we will determine the best mix of equipment for the PFS we are compiling,” McMullan said.

The other prize that ASARCO left behind was a concrete-lined, 20-ft diameter shaft that they had sunk to the 1,800-ft level. “From what we can tell from old records, they mined 500 ft laterally from the shaft bottom to establish a sublevel station,” McMullan said. “A pump station was in the process of being developed. We know they encountered water because they pierced a water bounding feature called the Basement Fault.” To date, ASCU has not identified any mineralization beneath the basement fault.

The current PEA considers transverse longhole stoping for the Cactus East Project. In year six, portal access to the underground orebody will be available when the pit layback reaches a depth of 700 ft, McMullan explained. “At that point, we will drive twin-portal declines more for ventilation and haulage later on when the mine reaches a steady state,” McMullan said. “It’s a quick run to the top of the orebody, and then from there, we would develop twin spirals to the bottom of the ore body. Midway down, we will drive a level in and through a 12- to 18-month process mine out a mid-sill and fill that with cemented rock.”

Longhole stoping would take place from the mid-sill up to the top of the orebody, then development would begin from the bottom up to that mid-sill in the lower portion of the orebody. “This allows us to split the mine into two smaller mines, a little bit of a derisking feature, before ultimately reaching steady state production of 7,000 t/d,” McMullan said.

The annual average production over the life-of-mine is expected to be 56 million lb of copper. The PEA contemplates a hydrometallurgical approach using heap leach and SX/EW to process the oxidized copper resources in the Stockpile Project and the oxide and enriched sulphides in the Cactus Projects. Initial plant capacity will be designed

at 22,000 t/y, expanding to 35,000 t/y concurrent with full ramp-up of underground mining by year seven of project startup. Significant organic expansion opportunities exist.

For the PEA, the Stockpile Project was drilled to an inferred category (400-ft spacing). “For the upcoming PFS, we will complete drilling on the Stockpile Project down to a 200-ft facing with a view to making that material resource improvement to indicated and then applying a mining plan and metallurgical recoveries,” McMullan said.

For the drilling on Cactus West, ASCU relied on historical data. Cactus East, the underground orebody, was largely already indicated from all the drilling ASARCO had done previously, McMullan explained.

“Since early third quarter, we have been drilling to bring Cactus West to an indicated level as well as doing some expansion drilling, step-out drilling of the Cactus East orebody, and we will bring portions of both Cactus East and West to a measured level by this time next year,” McMullan said.

ASCU expects to release a PFS report midyear 2022. “Because we will have accomplished a lot of early drilling and engineering upfront work during PFS, we think we can deliver the bankable feasibility study by the end of 2022,” McMullan said.

Permitting is never simple, but it is a streamlined process on private land, McMullan said. “There is no federal nexus,” McMullan said. “We work with state, county and city regulatory agencies for all of our permitting. With an 18-month build, we could see first production by the second half of 2024.”

Reclaiming Brownfield Lands for Carbon-free Copper

Of the \$71 million in funding established by custodial trust in 2009 to clean up 18 ASARCO sites in multiple states, \$20 million was set aside to remediate the Sacaton site. The remediation of Sacaton was completed to the approval of the ADEQ prior to the acquisition by ASCU, McMullan ex-

plained. “The TSF was reclaimed with 8 in. of alluvium cover and hydroseed was applied,” McMullan said.

The waste dump was originally part of that reclamation plan and ASCU convinced the EPA to leave it out so the company could drill it. “We wanted to understand it a little better,” McMullan said. “It became an important aspect of the deal, whereby we would take on the waste dump as a reprocessing opportunity, which could also be viewed as a clean-up opportunity because we would be moving the material from an unlined facility to a lined facility. We would realize an economic benefit from doing so. Or, if we found it was not worth it, we would then have had to reclaim the waste dump ourselves in place.”

Reclaiming a brownfield site falls in line quite well with ASCU’s ESG (Environmental, Social and Governance) goals, McMullan explained, and part of that overall strategy is trying to be a low-carbon or carbon-neutral copper producer.

Indeed, ESG is a large part of ASCU’s upcoming PFS study and McMullan said it will feed into the ultimate capital requirements for the site. “When we first formed as a company back in 2019, all the way through to today, and especially given the proximity of our site to the local community, we have proven to all the local officials, including the mayor of Casa Grande, city manager, state county supervisors, and state governor’s office that we will be good neighbors,” McMullan said. “We want to be good neighbors to the community. It is a fundamental company value.”

There are a lot of considerations in the development of an ESG strategy. As an example, McMullan said ASCU

secured water rights last year and plans to install technologies that will allow the mine to be a zero-discharge operator with respect to water. “As far as power is concerned, and more importantly, carbon emissions, we are working with external consultants to assess our carbon emission program including Scopes 1, 2 and 3,” McMullan said. “We’re very interested in electrifying as much of the site as we can. We’re also looking at alternate energy sources, possibly a solar facility. We have powerlines easily capable of supplying the minimum 8- to 12-MW load that the site will require.”

ASCU is currently discussing its needs with local energy providers. With its Palo Verde nuclear operating station, Arizona Public Service (APS) supplies energy that is about 50% carbon free. “As our main power supplier that gives us a leg up,” McMullan said. “We’re looking intently at how we can supplement the other 50%.”

ASCU is developing a long dormant site that could quickly become a midlevel copper producer in the next five or 10 years. Part of that strategy includes reinvigorating a brownfield and there are greenfield opportunities too, such as the Parks/Sayler orebody. “No one has ever really put a strong exploration program forward for it,” McMullan said. “That could be serious organic growth for us in the outlying years.”

The future is bright for Arizona Sonoran Copper Co. With companies like Lucid and Nikola moving into the neighborhood, there may be synergistic opportunities for a local, low-carbon copper supplier.



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Community Outreach Programs Raise Awareness to Benefits of Mining

Resolution strengthens ties to communities as it awaits permit approvals

The Resolution Copper project is a proposed underground mine 60 miles east of Phoenix, Arizona, near the town of Superior. The project is a joint venture between Rio Tinto (55%) and BHP (45%). The ore deposit, which lies nearly 7,000 ft deep, represents one of the most significant untapped copper deposits, with an estimated copper resource of 1.787 billion metric tons (mt) at an average grade of 1.5% copper. The mine has the potential to supply nearly 25% of U.S. copper demand.

During January 2021, the U.S. Forest Service (USFS) published a Final Environmental Impact Statement (FEIS) for the Resolution Copper Project. The U.S. Department of Agriculture directed the USFS to rescind the FEIS in March 2021 to allow the agency to undertake a further review. During this time, Resolution Copper continued to consult and partner with local communities and Native American tribes to guide further shaping of the Resolution Copper project and the significant benefits it will deliver.

The mine itself will create several thousand direct and indirect jobs, with an economic value of several billion dollars. Resolution said it will also serve as an engine for economic

growth, and use best practices to create a safe, sustainable and environmentally friendly operation.

There are still many years of permitting, consultation and studies ahead for Resolution Copper, and they are using the time to continue to deepen dialogue with local stakeholders and Native American tribes. When an investment decision is made, Resolution expects to spend around 10 years building infrastructure to prepare for mining, which will only begin after all permits are obtained.

Renewable Drinking Water Technology

A new initiative sponsored by Resolution Copper and Stantec will provide Native American communities in eastern Arizona with a new source of clean drinking water using renewable “hydropanel” technology.

Resolution Copper and Stantec are partnering with White Mountain Apache community members to provide 64 hydropanels on the Fort Apache Reservation and supporting hydropanel installation programs in other Native American communities.

White Mountain Apache Tribe District II Councilman Jerold Altaha said: “Water is valuable; it’s the life force of humanity. Thanks to this wonderful opportunity with Resolution Copper, our community of Carrizo will have access to safe, clean drinking water. Due to high levels of manganese in the main water wells, our community has had to depend on portable water tanks as a means to obtain drinking/cooking water for years. The hydropanels will now enable us to draw water from the air, which will provide up to 10 liters of water or about 20 16-ounce bottles a day, at no cost to

the family. We are grateful for these opportunities, which continue to make a difference in everyday life for our people and community.”

Stantec Water Business Operating Unit Leader John Take said, “We are proud to be a part of this effort to provide safe, reliable drinking water to the Native American communities in eastern Arizona. Innovative and renewable methods such as the hydropanel technology are playing an increased role in helping solve these complex problems in a sustainable manner.”

Hydropanels are a one-of-a-kind renewable water technology that uses the solar energy to provide a safe and consistent supply of drinking water by drawing pure, constantly replenished water vapor out of the sky. The self-contained system converts water molecules in the air into liquid water, which is collected and mineralized in a reservoir inside the panel, creating high-quality drinking water that can be delivered directly to homes, businesses and community distribution centers.

“Water is a fundamental resource, and many members of our neighboring tribes do not have reliable access to safe drinking water,” Resolution Copper Project Director Andrew Lye said. “Projects like the hydropanel deployment will help alleviate some of the burden, and make a difference where it matters most. Resolution Copper continues to look for ways in which we can work in partnership to be part of the solution and support the communities around us.”

So far, Resolution Copper has invested nearly \$2.8 million through partnerships and donations to projects with Native American tribes and other communities in the Copper



Resolution Copper and Stantec are providing hydropanels (above) that will generate a renewable source of drinking water for the White Mountain Apache Tribe.



A wheel loader passes by the headframe at Resolution Copper.

Corridor in 2021. This includes, for instance, partnering with the Northern Arizona University Foundation to support the Indigenous Studies Program and provide 14 scholarships to local students. Resolution Copper also partnered with first responders, community groups and other agencies to aid communities and Native American tribes affected by the Telegraph and Mescal wildfires.

Arizonans Support New Copper Production

A poll commissioned by Resolution Copper and conducted by OH Predictive Insights (OHPI) found that support for a mine in the region, such as the Resolution Copper mining project, is high, especially among those who are aware of copper's importance in the transition to renewable energies and electric vehicles.

This Arizona Public Opinion Pulse (AZPOP) was conducted during September and surveyed 1,000 Arizonans with a margin of error of $\pm 3.1\%$. The AZPOP provides regular updates on the moods, perceptions and opinions of Arizonans on hot topics facing the state.

The survey found that, if a company was attempting to develop a copper mine in eastern Arizona, emphasizing the importance of copper's role in the transition to renewable energy and electric vehicles would be instrumental in increasing support for the project. The survey found that just 46% of Arizona adults have heard anything about copper's role in the green ener-

gy debate. However, the more a person has heard about copper, the more likely they are to support the opening of an eastern Arizona mine.

Furthermore, after being informed about the degree to which renewable energy sources and electric vehicles rely on copper, 92% of adults in the state believe it is essential to develop new sources of copper — including one-third of adults who consider it “extremely” important to do so.

“Considering that copper is one of Arizona's famous Five Cs, it could be surprising to some that general awareness of copper's capabilities and value is limited,” said Mike Noble, OHPI chief of research. “The good news is, once given context, Arizonans concede on the need for unearthing new sources of copper.”

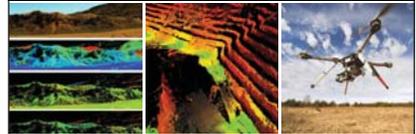
Arizonans have not heard much about the role copper plays in renewable energy. Only 5% of adults in the state have heard “a great deal” about the importance of the metal in this conversation, while more than half (54%) have heard nothing at all. Arizonans with a postgraduate degree (62% of whom have heard at least “a little” about copper's role), men (52%), and adults under the age of 55 (51%) have heard the most.

Support falls with a lack of knowledge. Support was lower among those who have only heard some (50%), a little (62%), or nothing at all (50%). When attempting to garner support for the opening of a new mine, increasing knowledge around the importance of copper is not a bad place to start.

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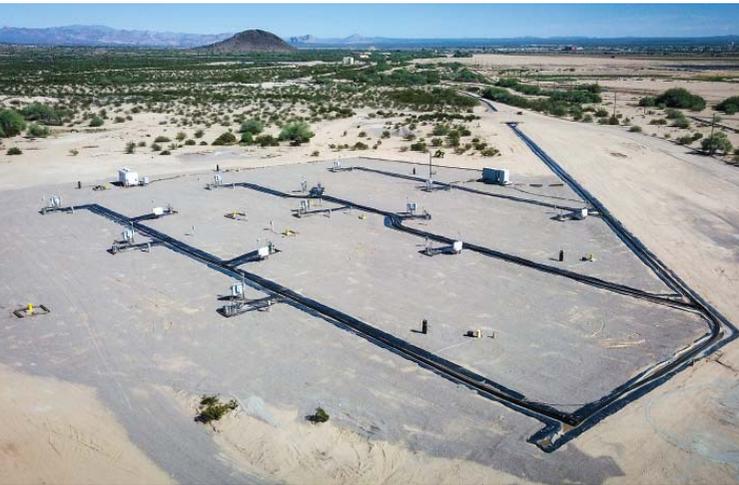

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Florence Copper Plans Commercial Operations

As final permitting stage approaches, purchases of long-lead equipment begins

By Steve Fiscor, Editor-in-Chief, *E&MJ*



Using the ISCR well field above for the Production Test Facility, Florence Copper extracts more than 1 million lb of copper.

Halfway between Phoenix and Tucson, in Florence, Taseko Mines operates the Florence Copper Project. It recovers copper, but it's not a typical copper mining operation. Florence Copper uses in-situ copper recovery (ISCR) to extract copper from an ore body without disturbing nearly as much land.

The Florence Project is broken into two phases. Taseko is currently approaching the end of Phase 1, which included a production test facility (PTF). A total of 24 wells were drilled for the PTF and a pipeline carried copper-rich solution from the wells to a solvent extraction/electrowinning (SX/EW) plant. “We successfully produced more than 1 million lb of copper cathode from the PTF,” said Brent Berg, general manager, Florence Copper. “We have a small well field as well as an SX/EW plant, which was idled in June 2020. Right now, we’re working on rinsing the well field back to Arizona water quality standards. We’re also doing a lot of work on detailed engineering and permitting for Phase 2.” Phase 2 is the launch of a commercial-scale ISCR well field and copper recovery operation.

ISCR mines are different compared to traditional mining operations. The process involves no mining, no material handling, no comminution and no waste or tailings storage. “We use 93% less fresh water than a traditional mine,” Berg said. “Energy consumption is 71% lower and carbon emissions are 83% lower.”

Florence Copper currently employs 33 people, but that figure will grow to 140 to 150 once the mine reaches

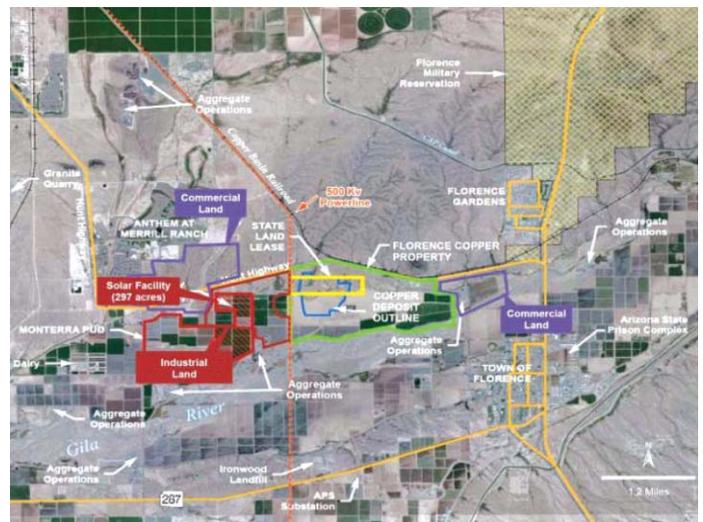
commercial operation. It will also employ 80 to 90 long-term contractors associated with drilling wells. “The well field will essentially be our mine development program,” Berg said. With probable reserves of 345 million tons grading 0.36% copper, the mine life for the operation is estimated at 16 years.

Once Florence Copper reaches commercial operation, it will generate a significant amount of income for the region, including \$3.4 billion in economic activity for the state of Arizona; \$2.1 billion in economic activity for Pinal County; and \$468 million in taxes and royalties for the Arizona government.

Engineering Commercial Operations

The commercial facility is expected to have a production capacity of 85 million lb/y of copper. It will consist of a commercial-scale SX/EW plant and the associated infrastructure needed to pump raffinate from 80 injection and recovery wells. “The wells will be spaced in the same manner as the PTF,” Berg said. “All of the wells, whether they are injection, recovery or observation, will have a common multifunction design. The only change we’re making is with the casing for the screened interval. We will use a slotted, fiber-reinforced plastic pipe rather than PVC, something we discovered while operating the PTF.”

The commercial project will also have a small reservoir. “We neutralize the solution and evaporate it, so we will have



The blue outline is the ore deposit. The yellow outline are lands leased from the state of Arizona. The green outline is the Florence Copper Project.

a process water impoundment,” Berg said. “With ISCR, we have to maintain the inward hydraulic gradient, so there’s some over pumping from the well field.”

Stantec has been working diligently with us on the engineering for the Phase 2 commercial facility, Berg said. “We’re advancing with commercial purchases,” Berg said. “We have purchased some long-lead equipment needed for the facility, like casings and other critical components, in anticipation of final permitting approvals. It’s good to finally be interacting with suppliers for this project.

One of the models Florence Copper uses (GoldSim) tracks all the hydrogeologic data, such as well flow rates, acid concentration, copper and acid recovery, active leaching zones, cut-off grades and well sequencing. “This system can model what each well will produce in real time,” Berg said. “Using actual data from the PTF, we have a pretty good idea of how the commercial facility will perform.”

Florence Copper is currently in the final stage of permit approvals. “We needed two key permits, the Aquifer Protection Permt and the Underground Injection Control (UIC) permit from the U.S. Environmental Protection Agency (EPA),” Berg said. “The Arizona Department of



Stantec helps engineer the commercial facility.

Environmental Quality approved the Aquifer Protection Permit in December 2020. As far as the final UIC, we have one for the PTF, but we need a much larger one for the commercial scale facility.”

On November 22, 2021, the EPA provided Taseko with a draft UIC for the Florence Copper Project. Taseko’s project technical team completed a review of the permit. The EPA will host a virtual 45-day public comment period. The EPA will respond and hopefully issue a final permit.

Detailed engineering and procurement activities are under way and, once Florence Copper has a final permit in hand, they will begin building the commercial plant and drilling the commercial well field with an 18-month construction window.



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Elevation Gold Realizes More Potential at Moss Mine

With a larger land package in Arizona's Oatman district and more exploration drilling, the company hopes to increase gold production from the Moss mine



The Moss mine produces gold in northwest Arizona.

This year was a year of change for Elevation Gold Mining, which started the year as Northern Vertex before it officially changed its name in September. In February, Northern Vertex bought Eclipse Gold Mining Corp. and the Hercules Project, giving the company exposure to gold in Nevada, and later in the year, the company tripled its land package surrounding the Moss mine, located in Mohave County, Arizona. During November, Elevation Gold offered updated mineral reserve, mineral resource estimates and a technical report for the Moss mine.

Elevation Gold's new management team believes the Moss mine and surrounding 168-km² land package possesses unrealized gold exploration potential. Consequently, the company began an aggressive near-mine and regional exploration drilling program in March to deliver new resource ounces while beginning to demonstrate the potential of the property. Elevation has completed approximately 100 drill holes and continues to encounter significant mineralization, not all of which was included in the mineral resource and mineral reserve estimates presented in the latest technical report.

The technical report highlights proven and probable mineral reserves of 12.7 million metric tons (mt) with grades of 0.45 grams/mt gold and 5.4 g/mt silver contain-

ing 184,500 ounces (oz) of gold and 2.2 million oz of silver; measured and indicated mineral resources of 38.9 million mt with grades of 0.39 g/mt gold and 4.6 g/mt silver, containing 490,200 oz of gold and 5.75 million oz of silver; and inferred mineral resources of 6.6 million mt with grades of 0.35 g/t gold and 4.5 g/t silver, containing 73,800 oz gold and 940,000 oz silver. A Life of Mine (LoM) plan based on the proven and probable mineral reserve estimate extends the life of the Moss mine to 2025, mining ore at 11,000 t/d with an average strip ratio of 0.88:1.

"The Moss mine has been historically constrained by tenure and permitting that limited the mine's footprint and production capacity," Elevation Gold Chairman Douglas J. Hurst said. "It has also hindered the company's ability to expand the resources and reserves. These constraints have now largely been removed, and the potential of the property is just beginning to be realized."

"The updated reserve estimate and mine plan for the Moss mine is a foundational piece in the transformation of the company," Elevation Gold President Michael G. Allen said. "Additional near-mine to regional exploration opportunities are being targeted and will be systematically drilled later this year and well into 2022."

The current reserves are larger than the total ounces produced by the mine to date, Allen explained, demonstrating its ability to replace ounces through exploration. The proven and probable reserve estimate was constrained by the existing infrastructure of the mine. In the future, infrastructure may be relocated to allow the Moss mine to realize the full economic benefits of the additional near-mine mineralization being defined by the ongoing exploration drilling program.

During the third quarter of 2021, Elevation Gold mined more than 730,000 mt at the Moss mine compared to a little less than 707,000 mt in Q3 2020. The gold grade, however, dropped to 0.40 g/mt from 0.69 g/mt when compared to Q3 2020. The amount of gold produced during Q3 also dropped to 6,526 oz from 13,083 oz during the same period last year.

The Moss mine's production in the third quarter was negatively impacted by a transition from the Phase 2 leach pad to the Phase 3 leach pad, Allen explained. That transition constrained the company's ability to stack and leach crushed ore for 40 days during the quarter. In addition, grade was impacted as marginal ore was stacked as overliner, which is coarsely crushed and placed on top of the liner

before ore is stacked. Low-grade ore is used for overliner as the coarser crush decreases recovery. Operations were normalizing and consequently, the management is expecting to report improved gold production figures for Q4 2021.

Tripling Oatman Land Package

During June, Elevation Gold significantly expanded its property holdings around the Moss mine from 47 km² to almost 169 km² through a combination of staking and land acquisition. It also obtained property-wide hyperspectral alteration mineral data. The property expansion was driven by the results of a detailed review of the regional geology, publicly available online mineral resources spatial data, and information in a comprehensive historical database compiled by the company, which highlighted the district-scale exploration potential surrounding the Moss mine.

The land package certainly establishes Elevation Gold as the dominant mineral rights holder in the Oatman District via staking. The Oatman District has historical production of more than 2 million oz of gold but has seen very little modern exploration. Establishing a large, highly prospective land package then systematically exploring it is a time-tested strategy, and it helps to have an established mine in the district supporting the effort.

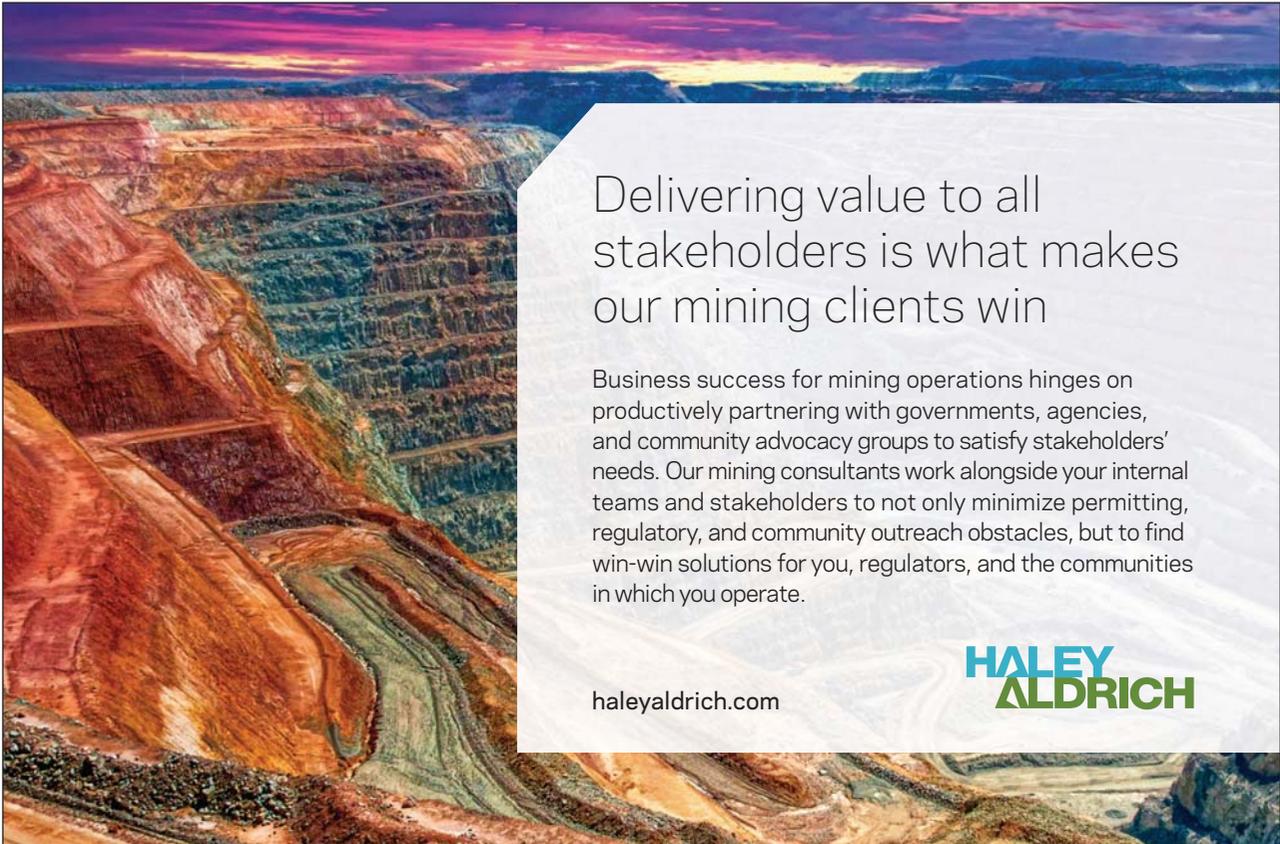
“The presence of numerous historic mines, adits, workings, and showings in the broader Oatman Mining

District and their apparent relationship to key regional to local geological structures, underlined the district-scale potential around the Moss mine and was the driver behind acquiring more land,” Northern Vertex Vice President of Exploration Warwick S. Board said. “A preliminary review of the hyperspectral alteration mineral data has already supported the decision to expand our land package, and it is being used to optimize our exploration plans.”

Mapping hydrothermal alteration minerals is a powerful tool for vectoring toward mineralization and mineral deposits. Alteration minerals have distinct electromagnetic spectral signatures that can be used to map out their spatial location and associations. Hyperspectral imaging collects and processes data from across the electromagnetic spectrum, allowing different alteration mineral signatures to be differentiated and mapped.

When Northern Vertex acquired Eclipse Gold in February, the company said it was creating a well-funded gold producer and consolidator, operating entirely in the western U.S. The move consolidated properties in the Walker Lane Trend, which runs parallel along the diagonal Nevada-California border into northern Arizona. It also brought two leadership teams together with a strong balance sheet.

Elevation Gold said it is executing a clear strategy that expands production and resources at the Moss mine in Arizona while aggressively exploring the Hercules Project in Nevada.



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South32 Completes PFS for Taylor Deposit

Hermosa could fulfill the needs of critical metals

South32 Ltd. recently completed a prefeasibility study (PFS) for the Taylor Deposit, which is the first development option for the Australian company's Hermosa project located in the Patagonia Mountains, about 80 kilometers (km) southeast of Tucson. The Taylor PFS envisions a multidecade operation, establishing Hermosa as a globally significant producer of metals critical to a low-carbon future, delivering attractive returns over multiple stages. An initial development case demonstrates a sustainable, highly productive zinc-lead-silver underground mine and conventional processing plant, in the first quartile of the industry cost curve.

The Taylor Deposit will progress to a feasibility study, including work streams designed to unlock additional value by optimizing operating and capital costs, extending the life of the resource and further assessing options identified to target a carbon-neutral operation. Completion of the feasibility study and a final investment decision to construct Taylor are expected in mid-2023.

Separately, a scoping study for the neighboring Clark Deposit has confirmed the potential for a separate, integrated underground mining operation producing battery-grade manganese, as well as zinc and silver. South32 said Clark has the potential to underpin a second development stage at Hermosa, with future studies to consider the opportunity to integrate its development with Taylor, potentially unlocking further operating and capital efficiencies.

While exploration drilling to date has been focused on the Taylor and Clark deposits, South32 has continued to complete surface geophysics, soil sampling and other exploration programs across the Hermosa land package. This work has defined a prospective corridor including Taylor and Clark as well as the Peake and Flux exploration targets, which will be prioritized for drill testing in 2022. To date, 13 drill holes have been completed at Peake.

"The Taylor Deposit provides an important first development option for the Hermosa project," South32 CEO Graham Kerr said. "Completing the PFS for the Taylor Deposit is an important milestone that demonstrates its potential to be a globally-significant and sustainable producer of base and precious metals. Beyond the Taylor Deposit, Clark offers the potential to realize further value from the investment in Hermosa."

Unlocking Hermosa's Potential

The Taylor Deposit is a large, carbonate-replacement, massive sulphide deposit that extends to a depth of approximately 1,200 meters (m) over an approximate strike length of 2,500 m and width of 1,900 m. The mineral resource estimate for the Taylor Deposit is 138 million metric tons (mt), averaging 3.82% zinc, 4.25% lead and 81 grams/mt silver. The deposit remains open at depth and laterally.

The mine design contemplated in the PFS is a dual-shaft access mine, which prioritizes higher grade mineralization early in the mine's life. The mining method is longhole open stoping, with the geometry of the orebody enabling the operation of multiple concurrent mining areas. This supports an assumption of an initial 22-year resource life with high mining productivity. Ramp up to nameplate capacity of up to 4.3 million mt per year (mt/y) is expected to be achieved in a single stage. Ore will be processed by a conventional sulphide ore flotation circuit producing separate zinc and lead concentrates with substantial silver credits.

The Clark Deposit is interpreted as the upper oxidized, manganese-rich portion of the upper 600 m of the mineralized system that hosts the Taylor Deposit. As it advances both the Taylor and Clark studies, the company said it would maintain the option to merge this work and assess an integrated underground mining operation. While such a scenario would require separate processing circuits to produce base and precious metals, and battery-grade manganese, an integrated development has the potential to unlock further operating and capital efficiencies.

The third focus at Hermosa will be unlocking value through exploration of the regional-scale land package.



The Taylor PFS envisions a shaft mine accessing a deep orebody and a flotation plant producing zinc and lead concentrates.

Through the completion of surface geophysics, soil sampling, mapping and interpretation of recently acquired data, South32 has identified a highly prospective corridor that will be prioritized for future drilling. Within this corridor, it plans to drill the Flux prospect following receipt of required permits, anticipated in the second half of CY22. The Flux prospect is located down-dip of a historic mining area that has the potential for carbonate-hosted, Taylor-like mineralization.

South32 said it is actively reshaping its portfolio for a low carbon future, investing in opportunities that increase its exposure to base and precious metals, with strong demand fundamentals and low-carbon production intensity. The Taylor Deposit is the company's most advanced development option at the Hermosa project, which has the potential to provide a multidecade platform at the operation that would further improve the company's exposure to the metals required for the transition to a low-carbon future.

Sustainable development forms an integral part of South32's development strategy. "We are designing the Taylor Deposit to be our first 'next-generation mine,' using automation and technology to minimize our impact on the environment and to target a carbon-neutral operation in line with our goal of achieving net-zero operational carbon emissions by 2050," Kerr said. The company has also completed initial work programs and studies with respect to our communities, cultural heritage, environment and water, and any future development at Hermosa will be consistent with its approach to sustainable development.

Mining and Processing

The Taylor PFS envisions a direct capital investment of \$1.230 billion and approximately \$470 million to establish the first development option with sustaining capital of approximately \$40 million per year. The construction period is expected to be approximately four years. Mining capital expenditure includes the shafts (~\$310 million), development, mobile equipment and infrastructure. Surface facilities include the processing plant (~\$350 million), tailings and utilities. The capital estimate reflects assumptions for key inputs including steel, concrete and labor, as of the first half of fiscal year 2022. Indirect costs include contingencies and engineering, procurement and construction management (EPCM) costs. Sustaining capital expenditure is expected to average approximately \$40 million per year and primarily relates to mine development.

To maintain the preferred development path in the PFS, critical path items including construction and installation of infrastructure to support additional orebody dewatering is planned for the second half of 2022 at a cost of approximately \$55 million. The water wells and second water treatment plant (WTP) are expected to cost \$225



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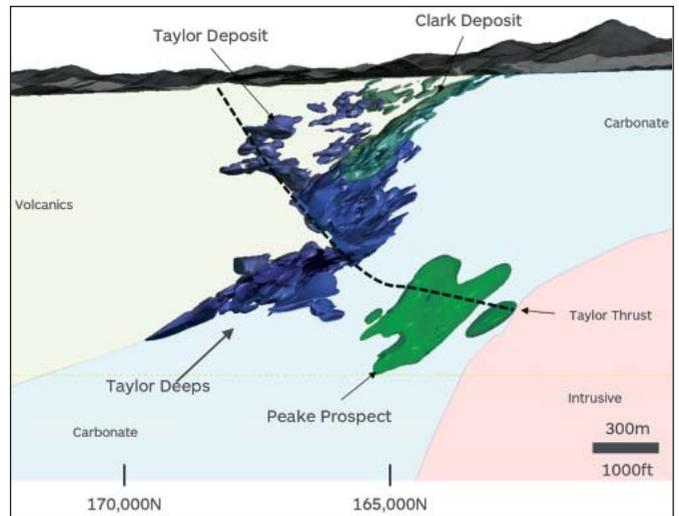
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million. A further \$140 million of dewatering costs are included within the indirect costs.

Depending on the final investment decision and receipt of required permits, shaft development is expected in fiscal year 2024. First production is targeted for fiscal year 2027 with surface infrastructure, orebody access, initial production and tailings storage expected on patented lands, which require state-based approvals. Surface disturbance and additional tailings storage on unpatented land will require completion of the National Environmental Policy Act (NEPA) process with the U.S. Forest Service (USFS). The project may benefit from the classification of metals found at Hermosa as critical minerals. Zinc is proposed to be added as a critical mineral by the U.S. Geological Survey while manganese (found at the Clark Deposit) already has this designation.

Ore is expected to be mined in an optimized sequence concurrently across four independent mining areas, crushed underground and hoisted to the surface for processing. The mine design contemplates two shaft stations, one for logistics and access, and the other for material handling. The primary haulage material handling level is expected to be located at approximately 800 m. The equipment spread would consist of jumbo drills, rock bolters, production drills, LHDs and haulage trucks. Taylor's feasibility study will evaluate the potential use of battery-electric



A cross section shows the relationship between the Taylor, Clark and Peake deposits.

tric underground equipment and trucks within the mining fleet, bringing further efficiency benefits, reducing diesel consumption and carbon emissions.

The PFS process plant design is based on a sulphide ore flotation circuit to produce separate zinc and lead concentrates, with silver byproduct credits. The flowsheet adheres to conventional principles with a primary crusher, crushed ore bins, comminution circuit, sequential flotation circuit, thickening and filtration. Tailings are processed by either filtration and drystacking, or by converting to paste and returning them underground. Approximately half of the planned tailings will be sent underground as paste fill, reducing the surface environmental footprint.

Pre-flotation and pre-float concentrate cleaning steps have been included in the plant design to prevent magnesium oxide and talc from affecting flotation performance and concentrate quality. Jameson cell technology is proposed to be used in place of some traditional mechanical flotation cells to enhance recoveries. Once filtered, concentrate would be loaded directly into specialized bulk containers.

The processing facility contemplated in the PFS has design recoveries of 90% for zinc and 91% for lead, and target concentrate grades of 53% for zinc and 70% for lead. Silver primarily reports to the lead concentrate, with a design recovery of 81%. The zinc concentrate is considered mid-grade with relatively high silver content for zinc, and the lead concentrate is considered high-grade.

The tailings storage facilities (TSF) would be designed in accordance with South32's Dam Management Standard, which is consistent with the International Council on Mining and Metals (ICMM) Tailings Governance Framework. The company is also progressing work on compliance with the Global Industry Standard on Tailings Management. Approximately half of the tailings produced will be thickened and filtered and sent back underground as paste

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backfill, reducing the surface environmental footprint. The remaining filtered tailings will be placed in one of two dry-stack TSFs. The first facility is located on patented land and is an expansion to the existing TSE, which was constructed as part of the voluntary remediation program completed in 2020. This already completed work established a state-of-the-art dry stack facility that will provide initial tailings capacity to support the commencement of operations. The PFS contemplates a second purpose-built facility on unpatented land, requiring federal permits.

Future site power needs are expected to be met through transmission lines connecting to the local grid. Grid power is currently generated from a combination of coal, natural gas and renewables, including solar, hydro and wind power. South32 is considering 100% renewable energy for the project, with options for grid-based renewable energy as well as new solar power projects to be advanced through the feasibility study.

Orebody dewatering is a critical path activity in the PFS schedule and capital expenditure has been committed to support construction and the installation of its related infrastructure, commencing from the second half of fiscal year 2022. The hydrogeological studies completed in the PFS and the design of the required water wells and infrastructure have been completed to feasibility-stage standards to support the execution of these early works.

Water treatment requirements are expected to be met through two proposed WTPs. WTP1 is already installed and treatment upgrades are expected to be commissioned in Q3 fiscal year 2022, while WTP2 is expected to be commissioned in Q4 fiscal year 2023.

Hermosa has existing nearby infrastructure for both bulk rail and truck shipments to numerous North American ports. The transportation of concentrates is expected to be a combination of trucking to a rail transfer facility (for subsequent rail transfer to port) and directly to port, for shipping to Asian and European smelters. Specialized bulk containers will be used to eliminate dust exposure from the time of load out until discharge to the ocean vessel. The expected trucking route in the PFS includes the construction of a connecting road to a state highway and other upgrades to road infrastructure.

PFS shipping costs assume transportation of concentrate to Asia and Europe. During feasibility, South32 said it will continue to investigate the potential to supply smelters in the Americas, substantially lowering its assumed transport logistics and shipping costs.

Development Approvals

The Hermosa project's mineral tenure is secured by 30 patented mining claims totaling 228 hectares that have full surface and mineral rights owned by South32. The



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patented land is surrounded by 1,957 unpatented mining claims totaling 13,804 hectares. The surface rights of the unpatented mining claims are administered by the USFS under multiple-use regulatory provisions.

The initial PFS mine development and surface infrastructure, including the processing plant, on-site power and the first TSF are designed to be located on patented mining claims. As a result, construction and mining of the Taylor Deposit can commence with approvals and permits issued by the state of Arizona. Several required permits for dewatering are already held, with the time-frame to receive the remaining state-based approvals expected to take up to approximately two years. Surface disturbance and additional tailings storage on unpatented land will require completion of the NEPA process with the USFS in order to receive a Record of Decision (RoD). The ramp-up to nameplate production assumed in the PFS could take longer than contemplated if the RoD is delayed, as production may need to be slowed so tailings capacity could be restricted to patented lands until the RoD is received.

The Clark Deposit is a manganese-zinc-silver formation located adjacent, and up-dip of the Taylor Deposit, which has a mineral resource estimate of 55 million mt, averaging 9.08% manganese, 2.31% zinc and 78 g/t silver. The Clark Deposit is interpreted as the upper oxidized por-

tion of the mineralized system, with the resource extending from near surface to a depth of approximately 600 m.

The Clark Deposit has the potential to underpin a second development at Hermosa. South32 recently completed a scoping study for the Clark Deposit, which has confirmed viable flowsheets to produce battery-grade manganese, in the form of electrolytic manganese metal (EMM) or high purity manganese sulphate monohydrate (HPMSM). Clark has advanced to a PFS for a potential underground mine development using longhole open stoping accessed from existing patented mining claims. The PFS is designed to increase confidence in South32's technical and operating assumptions and customer opportunities in the rapidly growing battery-grade manganese markets. The first phase of the PFS is expected to be completed in late 2022, at which point a preferred development pathway will be selected. Many areas of the PFS, including mine planning, hydrogeology, infrastructure, sustainability and permitting will benefit from work completed in the Taylor PFS.

South32 said it will also review the potential to pursue an integrated development of Taylor and Clark. An integrated development would comprise underground mining operations for Taylor and Clark with separate processing circuits to produce base and precious metals, and battery-grade manganese. An integrated development has the potential to realize operating and capital efficiencies.



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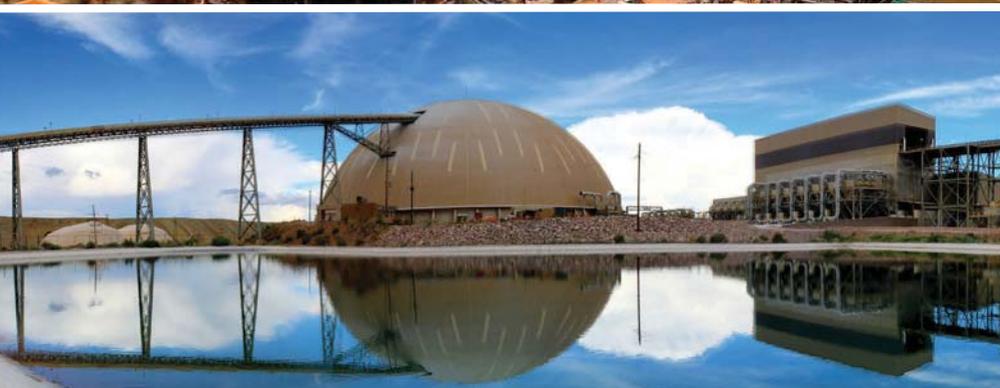
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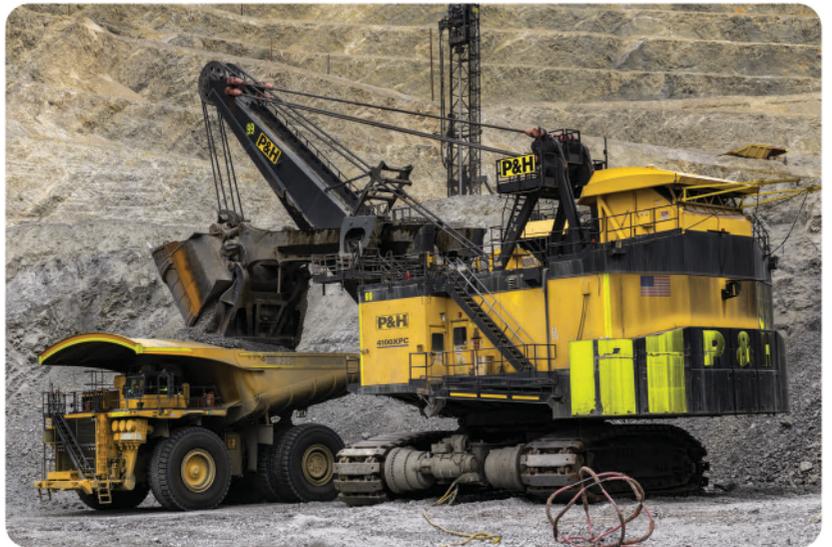
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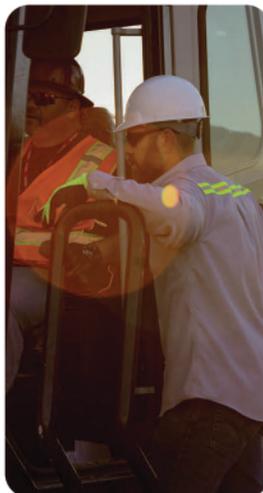
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