



BINGHAM CANYON MINE

A WORLD CLASS RESOURCE

**EDUCATOR AND TOUR GUIDE
INFORMATION BOOKLET**

APRIL 2007

THIS BOOKLET HAS BEEN PREPARED TO PROVIDE YOU WITH HELPFUL BACKGROUND INFORMATION AND FACTS ABOUT KENNECOTT'S OPERATIONS IN UTAH. PRODUCED BY KENNECOTT UTAH COPPER PUBLIC AFFAIRS DEPARTMENT, P.O. BOX 6001, MAGNA, UTAH 84044

KENNECOTT UTAH COPPER - A MEMBER OF THE RIO TINTO GROUP

- Kennecott Utah Copper is wholly owned by Rio Tinto, one of the leading mining companies in the world, which employs 35,000 people in 40 countries. Rio Tinto's worldwide operations supply a wide range of minerals and metals, including gold, silver, coal, iron, aluminum, diamonds, borates ... and, of course, copper.
- Kennecott Utah Copper operates as a separate entity from sister companies in Utah including Kennecott Minerals, Kennecott Exploration, Kennecott Land, Rio Tinto Technical Services, Rio Tinto Supportive Services, Inc., and Rio Tinto Procurement.

RECLAMATION/ENVIRONMENTAL PROJECTS (AS YOU MOVE SOUTH ALONG U111 TOWARD LARK ENTRANCE)

(About 1/10 of a mile south of railroad tracks)

- Kennecott Utah Copper's (KUC or Kennecott) reclamation and revegetation work can be seen on both sides of the road.
- Since 1991, KUC has voluntarily cleaned up more than 25 million tons of waste materials. Most of that waste was generated by mining operations that predate Kennecott. Another 20

million tons of clean material was returned to the sites. In the last decade, Kennecott has spent more than \$350 million on reclamation projects.

- All cleanup activities have met or surpassed cleanup levels established by the U.S. Environmental Protection Agency (EPA).

(Just north of the 11800 South intersection)

- Around the bend and again to our right, you will see a brown structure. This is a clean water well. This potable water services our Lark facility, and provides water to the local landfill and sewage plant.

(Just south of the 11800 South intersection)

- The old Lark area is off to the west. Non-Kennecott underground lead mining operations in this area generated approximately 1.7 million cubic yards of historic waste rock.
- KUC completed removal of the waste rock from the Lark area in 1993, and has totally reclaimed the site, returning it to wildlife habitat.
- The red buildings off to your right contain an old warehouse, as well as administration and shop facilities for the Bingham Tunnel. At one time, about 1,100 people were employed in this lead mining operation.
- The Bingham Tunnel, a now-abandoned underground mine, has thousands of miles of tunnels, which were worked for many years by other mining companies, notably U.S. Mines. The tunnel has three levels and the entrance is at the 5,300-foot elevation.
- Throughout Kennecott's property there is an abundance of wildlife. Deer, elk and birds of prey are frequently seen and occasionally cougars. KUC works with the Utah Division of Wildlife to manage these wildlife resources.

FACTS ABOUT THE LARK TOWN SITE

(AS YOU TRAVEL THROUGH THE ENTRANCE TO THE BINGHAM CANYON MINE)

- Lark was a lead mining and ranching community. The stand of trees off to the right at one time provided shade for rows of homes in this area.
- Kennecott eventually purchased the town site and relocated the last remaining citizens and homes to Copperton.

FACTS ABOUT BINGHAM CANYON OVERBURDEN ROCK REPOSITORIES

- The large, cone-shaped mountain due west is the Keystone waste rock repository. It is more than 1,000 feet high. Overburden repositories are sites where overburden or waste rock (the material that is considered uneconomic to process), is brought for disposal. At the present time, KUC is not extending these east side waste rock repositories, commonly called dumps. The overburden is now being deposited on top of the east side dumps or in Bingham Canyon.
- As you begin heading north, off to the left you will see two structures, one of which looks like a yellow guard rail. This is one of several solar powered monitoring stations that are part of the Eastside Water Collection System. A series of dams collects the water that drains off the dumps and returns it to a facility at the mouth of Bingham Canyon, where it is recycled.

- This collection system contains 27 drains and seven miles of pipe.
- You will see more reclamation work off to your right. KUC experiments with different bio-solids to determine which work best for reclamation at our sites.
- KUC has planted more than 150,000 trees in these mountains, and more seedlings are planted each year.
- The road you are traveling on is through an old waste rock repository. The different colors in the waste rock indicate how water has moved through the repository over time.
- KUC's Copperton Concentrator is off to your distant right. The A-frame stores the ore that is carried on a five-mile conveyor from the in-pit crusher in the Mine to the Concentrator. Conveying the ore, instead of hauling it in trucks, reduces air emissions and is more energy efficient.
- Beyond the Copperton Concentrator, you can see something that resembles a staircase in the mountainside. Those are the ore leach pads for the Barneys Canyon Mine, a Kennecott gold mining operation. (Additional information about Barneys Canyon is on page 12.)
- As you turn the corner heading west, you will be driving parallel to the Bingham Canyon Creek, which is several hundred feet below you in Bingham Canyon.

ALL ABOUT COPPERTON

(AS YOU CLIMB WEST UP THE ROAD TO THE MINE)

- The small community of Copperton is also in the canyon to your right. Copperton was built in the mid-1920s by the old Utah Copper Company as a company town for employees.
- Most of the homes in Copperton had roofs, window screens, gutters, and downspouts made of copper to demonstrate the uses of copper in home construction.
- In 1956, Kennecott sold the homes to employees for \$4,800 to \$6,000.
- Today, there are about 280 homes in Copperton housing a population of about 800, many of them retired and active Kennecott employees.
- Kennecott Utah Copper maintains a very good working relationship with the community – meeting regularly with the Copperton Town Council to discuss mutual interests and supporting numerous community activities.
- Copperton Community Park, built in 1927, is one of the busiest parks in Salt Lake County – a great place to stop for a picnic after your visit to the Bingham Canyon Mine.

FACTS ABOUT BINGHAM CANYON

- Bingham Canyon was settled in 1848 by the Bingham brothers, Thomas and Sanford. They weren't miners, however, they were ranchers.
- In 1863, soldiers stationed at Fort Douglas in Salt Lake City explored the canyon and discovered lead ore, creating Utah's first mining district that same year.
- In 1873, discoveries of silver, lead and gold created a mining boom in the canyon that lasted for 20 years. Miners came here from Northern and Western Europe during that time.

- In the early 1900s, a second boom, created by the development of large-scale, open-pit mining, brought immigrants from Southern and Eastern Europe and the Orient to Bingham Canyon to join American-born miners.
- Bingham Canyon was one of America's great early melting pots, with 40 different nationalities living here.
- At one point, Bingham Canyon's population was approximately 20,000.
- Up and down Bingham Canyon, the miners and their families lived in such places as Highland Boy, Copper Heights, Copperfield, Carr Fork, Heaston Heights, Telegraph, Dinkeyville, Terrace Heights, Greek Camp and Frog Town.
- In 1893, Daniel Jackling, a metallurgical engineer, and Robert Gemmell, a mining engineer, studied the deposit and recommended developing the ore body by a revolutionary, open-pit mining method and processing the ore on a large, industrial scale.
- In 1903, the Utah Copper Company was formed to develop the mine, based on the recommendations of Mr. Jackling and Mr. Gemmell.
- In 1906, the first steam shovels began mining away the waste rock that covered the ore body. Some of the shovels were the same kind used to dig the Panama Canal. The ore was found in a mountain that divided the main canyon into two canyons.
- Today, that mountain has been mined away . . . and in its place is the Bingham Canyon Mine.
- Bingham Canyon itself is now being filled with waste rock from the Bingham Canyon Mine, so one day most of the canyon will be filled.

THE GEOLOGY OF BINGHAM CANYON

- Every deposit of ore in the world is unique. There are no two ore bodies alike.
- Geologic forces went to work in the Oquirrh Mountains between 260 and 320 million years ago (Late Paleozoic Period.)
- About 30 to 40 million years ago, molten, metal-bearing rock deep within the earth's crust began to push toward the surface and formed Bingham's ore deposit. Volcanoes erupted above the evolving ore body. This particular ore body contains primarily copper, gold, silver and molybdenum (mo-lib-de-num).
- Tiny grains of ore minerals, mostly copper and iron sulfides, are scattered within what is called "host rock" . . . and there is more of the host than minerals. Thus, it is known as a low-grade ore deposit.
- Because this is a low-grade deposit, about 6/10 of one percent, a ton of ore contains only 13 pounds of copper.
- For every ton of ore removed, about two tons of overburden must first be removed to gain access to the ore.

HOW BIG IS THE BINGHAM CANYON MINE?

- To give you some idea about the size of this mine, it's three-quarters of a mile deep. Two Sears Tower Buildings stacked on top of each other would not reach the top of the mine. Closer to home, the mine is deeper than 6½ LDS Church Headquarters buildings.

- The mine is more than 2 3/4 miles across at the top . . . meaning that 12 aircraft carrier Enterprises could be laid end to end.
- The Bingham Canyon Mine is the largest man-made excavation on earth, and by the year 2018 it will be about 800 feet deeper than it is now.
- The north wall of the mine (to your right) is unique because it is the tallest high wall (continuous) in any mine in the world. That's quite an engineering feat, and it's still growing. There are thousands of miles of underground workings behind this wall.
- This mine has produced more copper than any other mine in history. More than 7 billion tons of material has been mined from here, producing more than 18 million tons of copper.
- Every day, Kennecott Utah Copper mines about 150,000 tons of copper ore and 270,000 tons of overburden . . . seven days a week, 365 days a year.

A KING-SIZED MINE NEEDS KING-SIZED EQUIPMENT

- There are nine giant electric shovels and one hydraulic shovel operating in the mine.
- The largest electric shovel has a 56-cubic-yard dipper that scoops up approximately 98 tons of material in a single bite, the equivalent of about 50 automobiles.
- The newest electric shovel costs more than \$16 million and weighs 3.2 million pounds.
- The shovel operator sits more than three stories above the ground (32 feet above ground).
- There are about 80 gigantic haulage trucks operating in the mine. These trucks carry from 255 to 320 tons of material in a single trip.
- A new haulage truck costs about \$2.8 million.
- Each truck tire costs between \$25,000 and \$32,000 and lasts about nine months . . . and each truck uses six of these radial belted tires.
- The rims on the 255-ton trucks are nearly five feet in diameter.
- The largest haulage trucks have 1,300-gallon fuel tanks and use very low-sulfur diesel fuel (.05 percent sulfur by weight), and the fleet of trucks will travel over 10,000 miles a day.
- In the pit, haulage trucks travel at an average speed of 13 miles per hour.
- The truck driver rides about 18 feet . . . or nearly two stories . . . above the ground.
- Dust control measures on haul roads are successfully accomplished using a fleet of five 190-ton (+40,000 gallon) water trucks.
- During a typical year, as much as 82,000,000 gallons of industrial water are sprayed on roads to keep the dust under control. Other dust control measures include chemical dust suppressants and paving heavily used areas, such as parking lots.
- The mine's large electric drills stand between 75 and 100 feet tall, and drill blast holes 55 feet deep.

HOW THE BINGHAM CANYON MINE OPERATES

- Every aspect of operations in the Bingham Canyon Mine is based on a master mine plan developed from assays, metallurgy and geotechnical information. Economic data, including

costs and expected metal prices, are combined with geologic and metallurgical data to determine the most profitable plan and the “cutoff” between what is ore and what is waste.

- Every function of mine operations is carefully structured and programmed by design.

DRILLING AND BLASTING

- Based on the mine plan, eight large rotary drills bore specific patterns of holes 55 feet deep into designated areas of the mine.
- The drills use water injection to minimize dust emissions and to lubricate the drill bits.
- About 1,000 pounds of special blasting agents are loaded into the drill holes.
- Two to four times a day, the explosives are detonated and the rock is broken up according to carefully engineered plans.

LOADING AND HAULING

- The electric shovels move into the recently blasted areas of the mine to begin mining the ore or removing the overburden.
- Some haulage trucks are assigned to carry overburden out of the mine to waste storage sites located in the Canyon and on the perimeters of the mine.
- Other trucks haul the ore to the in-pit crusher.
- The in-pit crusher reduces about 150,000 tons of ore per day to chunks less than 10 inches in diameter . . . about the size of basketballs and smaller. Very fine dust particles are captured in an air pollution control device called a bag house – similar to a very large vacuum cleaner.
- Ore from the crusher leaves the mine by a conveyor that runs three miles through the mountain and then two miles over land to the Copperton Concentrator, located just north of the town of Copperton.
- The basic sequence of drilling, blasting, loading and hauling is repeated over and over again, 24 hours a day, 365 days a year.
- During the summer, more than 1 million gallons of process water (industrial or non-drinking water) per day are applied to the haulage roads by water trucks to suppress dust. In addition, magnesium or calcium chloride is applied to access roads to minimize dust emissions.

IN SUPPORT OF THE MINE OPERATIONS

- The haulage trucks, rotary drills and electric shovels are monitored by a Global Positioning System (GPS) network to improve their operating efficiency.
- Due to the large size of the mine, it acts like a funnel, capturing rain and melting snow, as well as “seeps” from groundwater. Day in and day out, more than 1,100 gallons per minute (gpm) are pumped from the mine, with peaks of 2,000 gpm in wetter times. The water is then used on haulage roads to suppress dust and in other parts of the operation.
- There are 180 various kinds of support vehicles, including different types and sizes of bulldozers, loaders, scrapers, pickup trucks, vans, maintenance equipment, etc.
- There are approximately 800 employees at the mine, performing a very broad range of assignments. There are many different kinds of managers, engineers (including safety and

environmental), scientists, geologists and technicians . . . specialized mechanics, craftsmen and highly skilled equipment operators.

ABOUT OTHER KENNECOTT UTAH COPPER OPERATIONS

COPPERTON CONCENTRATOR

- About 150,000 tons of ore are crushed and ground every day to reduce the material from the size of basketballs to a finely ground product the consistency of face powder.
- There are four grinding lines at Copperton, each with one SAG (Semi-Autogenous Grinding) mill and two ball mills. A SAG mill grinds the ore using water, the ore itself and 5¼" steel balls that each weigh 22.5 pounds. A ball mill does the same thing, but uses 3" balls that each weighs about 4 pounds.
- The finely ground wet ore passes through a flotation process, which separates minerals from the ground ore to produce about 1,125,000 tons of copper concentrate annually, over 37,000,000 pounds of molybdenum concentrate, a steel-hardening agent that is a by-product of the Bingham ore deposit. The flotation process uses 3,000 cubic-foot capacity flotation cells, some of the world's largest.
- The concentrate produced by flotation contains about 26 percent copper.
- The copper concentrate, in slurry form, is then pumped 17 miles north through a six-inch steel pipeline to the Smelter. The copper concentrate also contains gold and silver, which are later refined in a precious metals refinery.
- There are about 230 employees at the Copperton Concentrator.

TAILINGS IMPOUNDMENT

- Tailings, the barren material with non-economic metal values, are slurried from the Copperton Concentrator to the 9,200-acre tailings impoundments north of the town of Magna. The older South Impoundment is no longer operational and more than 4,500 acres have been reclaimed. A peripheral discharge system keeps the impoundments' entire surface area wet to minimize airborne tailings. The majority of the process water is then decanted and recycled back to the production facilities for reuse.
- A \$500-million tailings impoundment modernization project was completed in 2001. A North Impoundment of about 3,500 acres will provide tailings storage capacity for the estimated future life of the Bingham Canyon Mine.
- As part of the tailings modernization, Kennecott has made several seismic improvements to the tailings impoundment, and created the Inland Sea Shorebird Reserve and Wetlands Bank to protect 4,000 acres of wetlands, saline playas, and uplands for wildlife habitat.
- There are about 60 employees in the Tailings and Water Service Department.

SMELTER

- In 1992, Kennecott began an \$880-million modernization project at the Smelter and Refinery to produce the most technologically advanced and cleanest smelting complex in the world. The project, the largest privately financed project of its kind in Utah history, was completed after three years of construction.

- On a yearly basis, about 1,100,000 tons of copper concentrate are processed at the Smelter to produce about 240,000 tons of anode copper. The Smelter also recovers waste heat from the smelting and acid making processes and cogenerates about 30 megawatts, or 60% of its electric power needs.
- The Smelter uses the Outokumpu Flash Smelting Process to transform concentrate at 28 percent copper to a sulfide matte containing 70 percent copper. Matte is processed through a Kennecott-Outokumpu Flash Converting Furnace to produce 98.6 percent copper, which is then refined in the anode furnaces. The Flash Converting process is unique to Kennecott and it is believed that its technology will form the new standard for future copper smelters. The finished Smelter product is called an anode, which contains 99.5 percent copper with traces of precious metals. These 720-pound anodes are sent by rail to the Kennecott Refinery for further processing.
- Sulfur and iron are separated from the copper in the smelting and converting processes. The iron is converted to a slag, which is reprocessed in the Smelter Slag Concentrator to recover residual copper. The final slag tailings are slurried by pipeline to the Tailings Impoundment.
- The sulfur is converted to sulfuric acid that is sold to many consumers all over North America. About 830,000 tons of acid are produced annually. This represents more than a 99.95 percent capture of the sulfur in the concentrate received, which is the highest level in the world for a copper smelter.
- There are about 265 maintenance craftsmen and operators at the Smelter.

REFINERY

- The final stage of the copper production cycle takes place at the Refinery, located about two miles east of the Smelter.
- As part of the \$880-million modernization project, the Kennecott Refinery operations were upgraded and expanded to accommodate increased Smelter capacity.
- At the Refinery, about 240,000 tons of 99.99 percent pure copper cathodes are produced annually, along with 460,000 ounces of gold and 4,150,000 ounces of silver as by-products.
- There are about 150 employees at the Refinery.

BARNEYS CANYON MINE

- Kennecott's Barneys Canyon Mine is located 25 miles southwest of Salt Lake City, just north of the Copperton Concentrator. Its mining and ore crushing operations were suspended in December 2001 due to the end of mine life.
- Barneys Canyon was an open-pit gold mine that used an oxide heap leach and sulfide milling process.
- The Mine produced more than 1,600,000 ounces of gold since its inception in 1989.
- For the next few years, gold inventories will continue to be recovered with a small workforce through Barneys' heap leach operations.
- Reclamation and revegetation of mine waste dumps and haulage roads have been underway for several years concurrent with mining operations and were completed by the end of 2002. In 2004, Barneys Canyon received an Earth Day Award for reclamation from

the Utah Division of Oil, Gas and Mining. Final reclamation of the heap leach pads and other surface facilities will be completed about 2008.

KENNECOTT AND SUSTAINABLE DEVELOPMENT

- Kennecott is known worldwide and owned by Rio Tinto, a world leader in discovering, mining, and processing the earth's mineral resources in a responsible economic, social, and environmental manner.
- Kennecott is committed to sustainable development practices in every facet of its business. Kennecott's Strategic Objectives include: Economic Prosperity, Social Well-Being, Environmental Stewardship and Governance. When intertwined these practices help promote an economically strong, productive and responsible company along with a safe, vibrant community, and a clean environment.
- Kennecott Land's Daybreak is an example of Kennecott's vision of sustainable development. Situated on 4,126 acres in the city of South Jordan, Daybreak is a place where individuals and their families can grow together for generations to come - as a great community is created and sustained.
- KUC strives constantly toward being a good steward of its resources. This includes efficiency improvements to reduce consumed energy and green house gas emissions.
- KUC works with communities, local and state government agencies, and federal agencies to achieve mutually beneficial goals.
- Kennecott recognizes that people are its most important resource. KUC's safety record is four times better than mining industry accident rates in the United States.

COPPER FACTS

- Humans have used copper for more than 10,000 years, starting with prehistoric man who fashioned it into tools and weapons. Today, expert surgeons use copper-clad scalpels while the world's finest chefs use it to create gourmet dishes. Copper is found everywhere, from the inside of your computer to the ancient Dead Sea Scrolls. It helps power your house, deliver your water and keep your brain and blood vessels healthy. Copper is a cornerstone of human civilization.
- Here are a few more fun facts about copper:
 - ✓ Every person in America uses about 30 pounds of copper each year.
 - ✓ The typical new home contains about 500 pounds of copper, mostly as wiring, plumbing and brass fixtures.
 - ✓ The Statue of Liberty contains nearly 100 tons of copper.
 - ✓ Copper is the third most-used metal for industrial purposes.
 - ✓ Since copper is 100 percent recyclable, it is one of the most sustainable elements.
 - ✓ Copper can be rolled into sheets as thin as 1/1,000th of an inch.
 - ✓ Copper helps blood cells carry oxygen and is a critical micronutrient found in many foods.
 - ✓ Copper is critical in your diet. It also helps plants turn sunlight into energy, a process called photosynthesis.

- ✓ Copper boils at 4,000 degrees Fahrenheit. Compare that to water, which boils at 212 degrees.
- ✓ American Revolutionary War figure Paul Revere was one of America's most famous coppersmiths.
- ✓ The word "copper" comes from kyprios, the Greek name for the Island of Cyprus; ancient people mined copper on the island.
- ✓ Archaeologists exploring the Cheops Pyramid in Egypt discovered a portion of a copper water plumbing system. The 5,000-year-old system was still in serviceable condition.
- ✓ A vanished civilization mined copper in the Upper Peninsula of Michigan from 5000 to 1200 B.C.E.

**PRODUCED BY
KENNECOTT UTAH COPPER
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