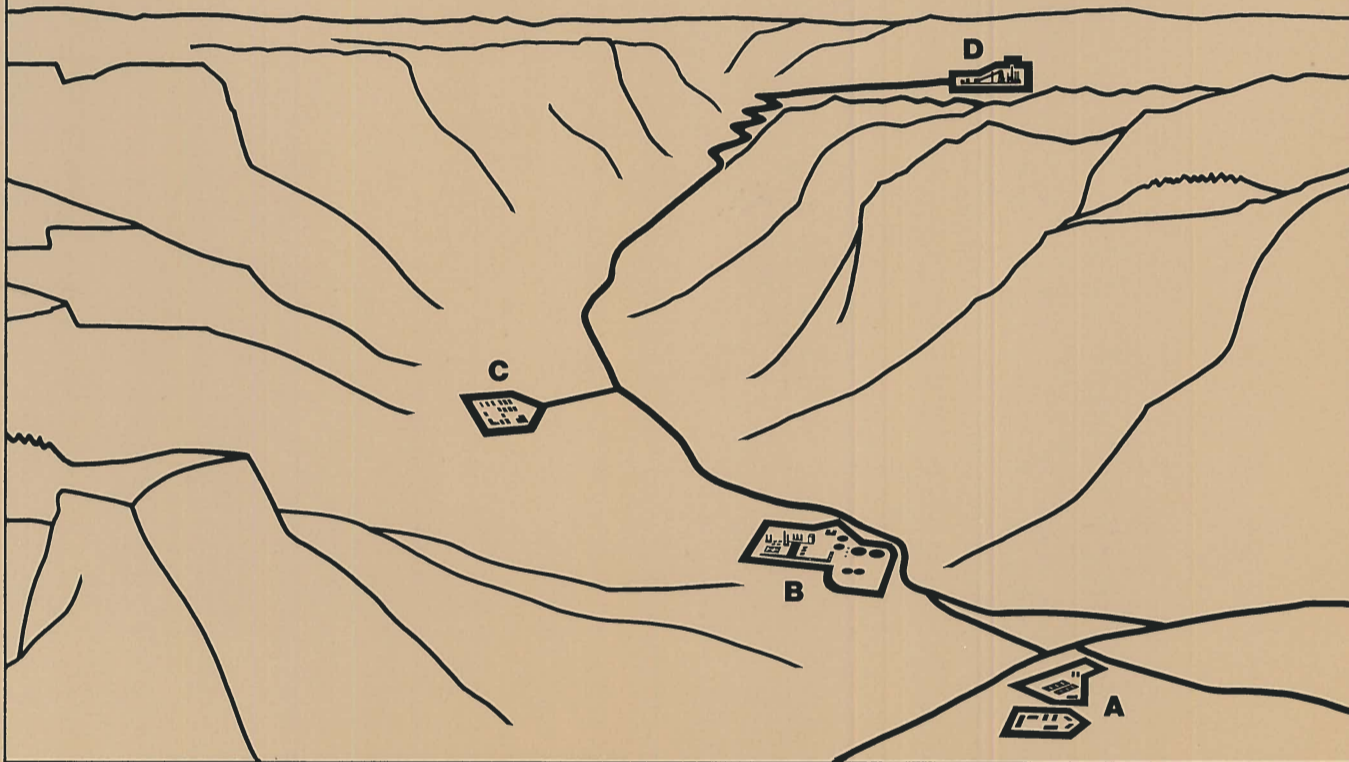


Parachute Creek Shale Oil Program



The Cover: An artist's concept of the Parachute Creek area, location of Union Oil Company's shale oil development in western Colorado. The facilities are: **(A)** apartment and mobile home community built by Union for workers and their

families, **(B)** shale oil upgrading plant to convert raw shale oil to high quality synthetic crude oil, **(C)** complete living settlement for single workers, and **(D)** the mine-retort site, shown in greater detail on pages six and seven.



Shale Oil: A Viable Alternative

Development of alternative fuels to supplement the nation's limited conventional oil and gas production is critically important. Dependence on imported crude oil threatens our country's security as well as its economic well being.

Of all the alternative fuels, shale oil most closely resembles conventional crude oil. It comes from a marlstone, several times the strength of concrete, containing a complex organic compound, kerogen. By heating this rock to temperatures of 700 to 900°F, the kerogen is released to form crude or "raw" shale oil.

Shale oil contains more hydrogen and fewer impurities than synthetic fuels made from coal. Present day technology enables a suitable refinery feedstock to be produced from shale oil more economically than from other alternative fuels.

While oil shale is found in many parts of the United States, the Green River formation in Colorado, Utah and

Wyoming contains the richest deposits.

A government study estimates that there are 1.8 trillion barrels of high grade shale oil in the three state area.

If only 600 billion barrels, or one-third of this shale oil, is ultimately recovered, it would represent about 20 times our nation's current crude oil reserves.

Up to 85 percent of the country's richest and most accessible shale oil reserves lie in the Piceance Creek Basin in western Colorado.

It is here that Union Oil Company of California will convert this resource into usable energy for Colorado and the nation, through operation of the country's first commercial shale oil project. Completion of the first phase of Union Oil's Parachute Creek Shale Oil Program in 1983 will help establish a new source of energy to supplement domestic crude oil and natural gas production.

This brochure describes Union's program for commercial shale oil production.

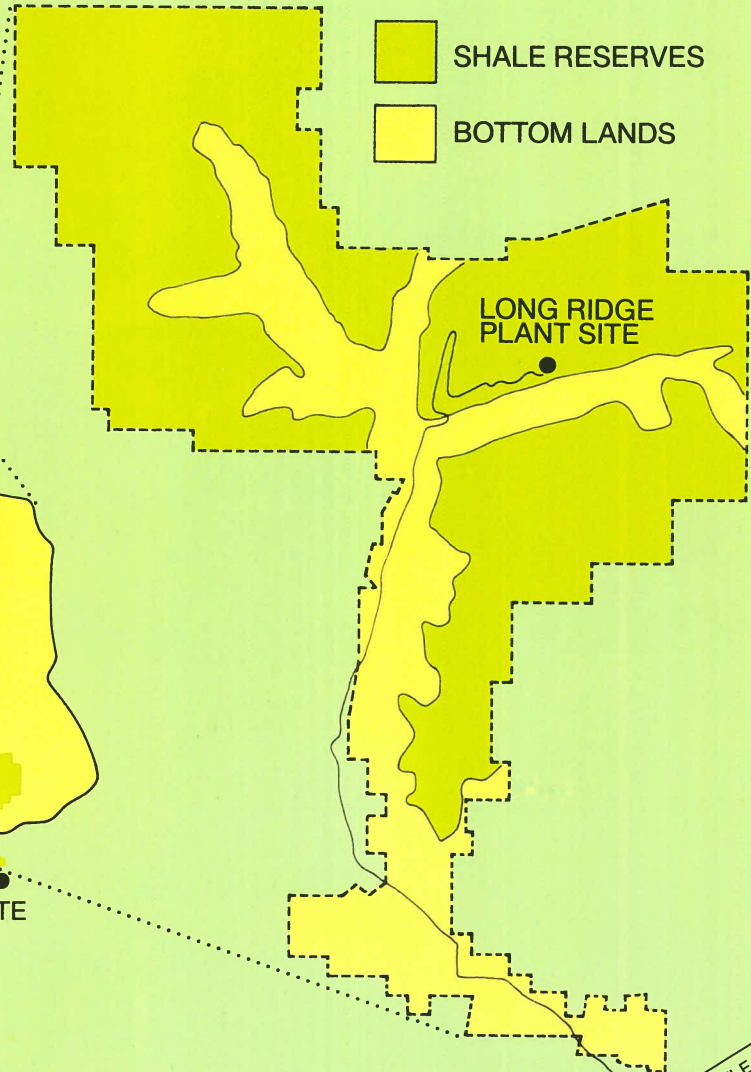
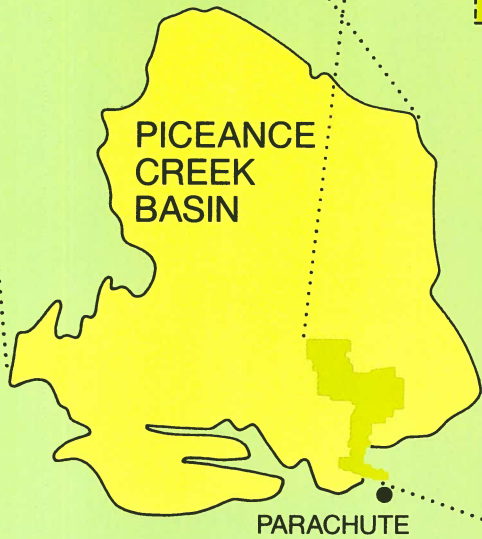


This piece of oil shale rock, weighing almost 59 pounds, will yield one gallon of shale oil when subjected to temperatures of 700 to 900 degrees.

Union's Parachute Creek Property



- SHALE RESERVES
- BOTTOM LANDS



Union Oil: A Shale Pioneer

Union Oil began acquiring properties in the Parachute Creek area of Garfield County in northwestern Colorado more than 60 years ago. The oil shale lands Union owns contain some 1.6 billion barrels of recoverable oil in the high yield Mahogany zone alone. These reserves are large enough to produce 100,000 barrels of shale oil each day for more than 40 years. In addition, there are about two billion barrels of reserves in adjoining lower quality zones.

Always aware of the potential energy value of these holdings, Union's scientists conducted a wide range of laboratory and field studies over a period of nearly 40 years. This research was aimed at developing technically, environmentally and economically feasible methods of extracting usable oils from shale.

In the early 1940s, Union built and operated a small, 50-ton-per-day pilot retort at its Los Angeles refinery. This study continued into the early 1950s. From 1955–58, the company field tested its retort techniques in Parachute Creek Valley, processing up to 1,200 tons of ore per day and producing about 800 barrels of shale oil per day. This was the largest oil shale retort ever operated in the United States.

As a result of this extensive research, Union perfected a retort process utilizing a unique solids upflow system. Result: the most efficient retorting technique that has

been developed.

The upflow technique produces a cleaner, more easily refinable oil and eliminates the oil shale agglomeration associated with some other retorting methods. For every equivalent barrel of oil consumed to operate the plant, approximately five barrels of syncrude are produced.

The company also developed technology for treating the oil so that it could be processed in a conventional refinery. During the 1950s, more than 13,000 barrels of shale oil were processed into gasoline and other products at a refinery near Fruita, Colorado.

Union's appraisal of its many years of research and development work, confirmed by detailed evaluations by experienced engineering firms, led to the conclusion that the company indeed had a viable process for extracting oil from shale.

Union's extensive pioneering investment in oil from shale has been recognized by the U.S. government. In July 1981, the company was the first to be awarded a contract under a Department of Energy program designed to encourage the development of commercial shale oil production in this country.

Under the 10-year contract, Union will supply the Department of Defense with 33 million barrels of military diesel and jet fuel on commercial terms, beginning with the start of shale oil production in mid-1983.



Mine entrance opening onto five-acre bench site where shale oil retorting facilities are being constructed.

Union Oil Company's Parachute Creek Shale Oil Program

Union Oil Company began construction of its oil shale mining and retorting project north of Parachute, Colorado, in January 1981. The site is 200 miles west of Denver and 320 miles southeast of Salt Lake City.

The company's holdings consist of about 20,000 acres of oil shale lands and 10,000 acres of valley lands. Included are water rights and adequate acreage for deposit of the retorted shale.

The project consists of a mine, a large shale retorting unit, an upgrading facility to remove impurities from raw shale oil and convert it to a high grade synthetic crude, provisions for disposal of the retorted shale, and necessary support facilities. To be completed in 1983 at an estimated cost of about \$570 million, it is designed to process 12,500 tons of shale and produce about 10,000 barrels of shale oil daily.

This operation will be the first commercial shale oil project in the United States.

Shale for the project will be mined from the rich Mahogany zone of the Parachute Creek section of the Green River geologic formation. In the first zones being mined, an average yield of 34 gallons of shale oil per ton of ore is anticipated.

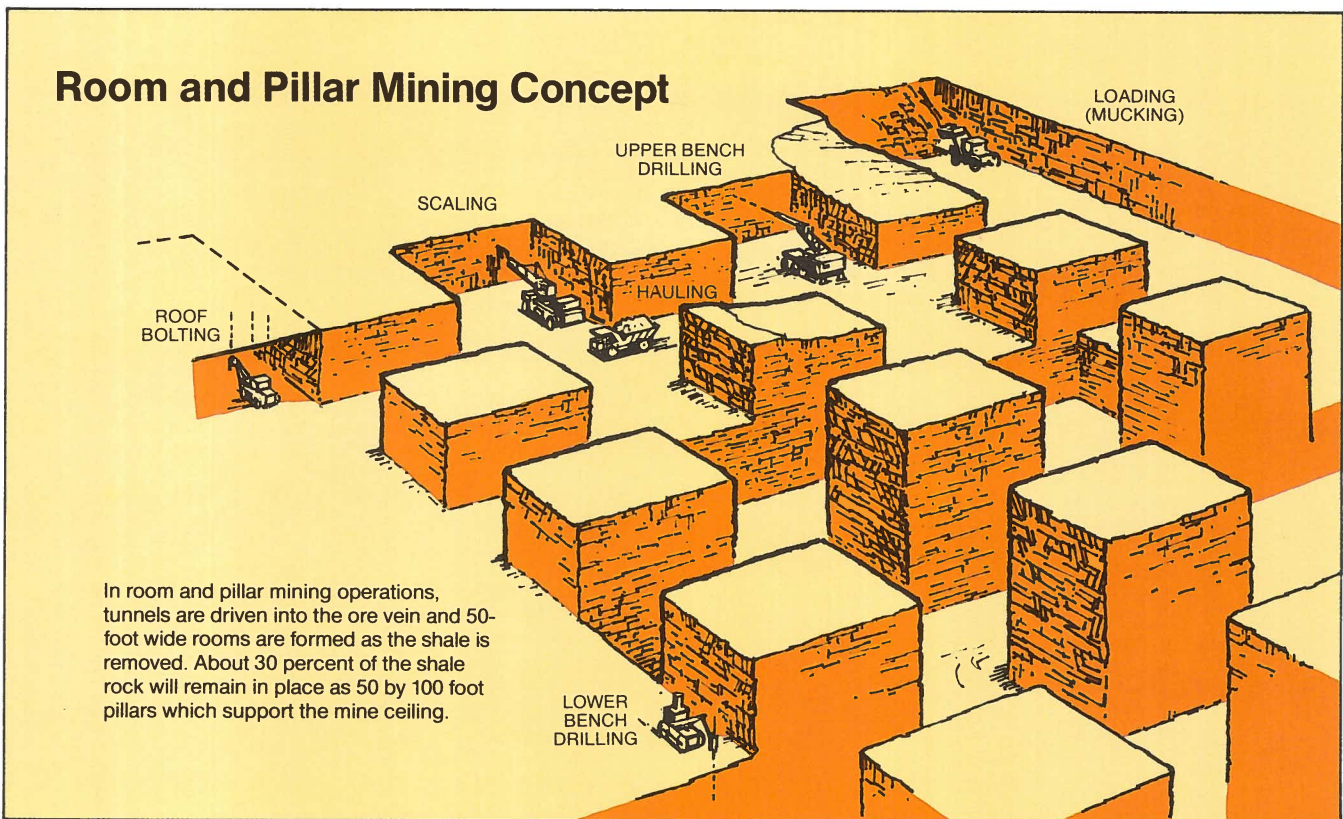
The entrances to the underground mine are located about 1,000 feet above the valley floor and will open on the south side of Long Ridge, which forms the north wall of the East Fork of Parachute Creek.

Conventional room and pillar mining techniques will be employed. Preliminary plans call for 50-foot wide rooms supported by 50 by 100 foot pillars and an overall mining height of 60 feet. Shale crushing and storage sites as well as support facilities, such as offices, maintenance shops and locker rooms for the mine work force, also will be located underground.

In the mining operation large hydraulic drills, called "jumbos," will bore holes for explosives in the mine face. Explosive charges will free the rock and large front-end loaders will load the ore into 50-ton off-road trucks. These trucks will haul the shale to the primary crusher in the underground shale preparation area.

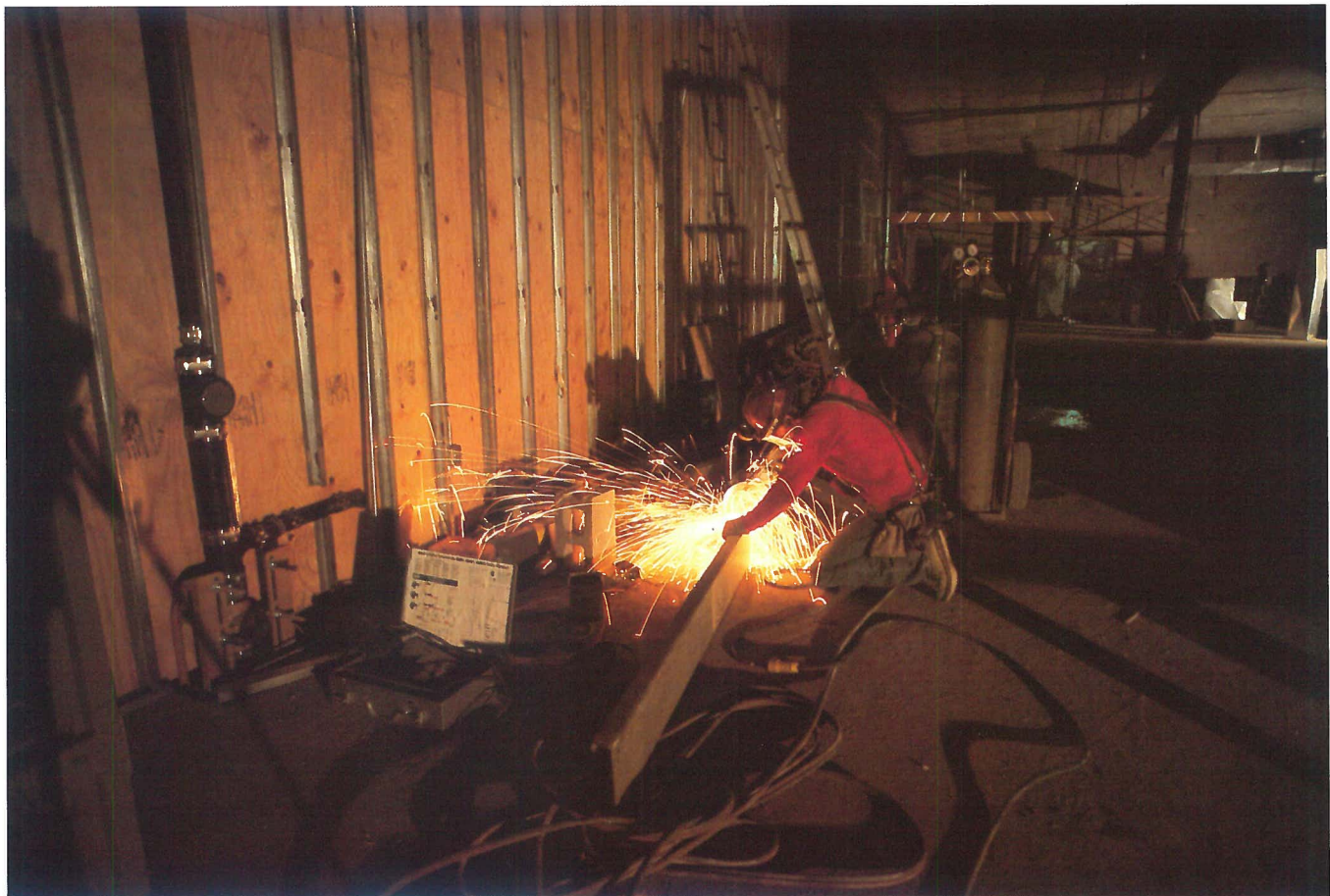
Two stages of crushing will reduce the shale ore to pieces of a size—less than two inches in diameter—suitable for the retort. The crushed ore will be transported to the surface by conveyor belt, and given a final screening before being fed to the retort.

Union's upflow retort, to be located on a five-acre

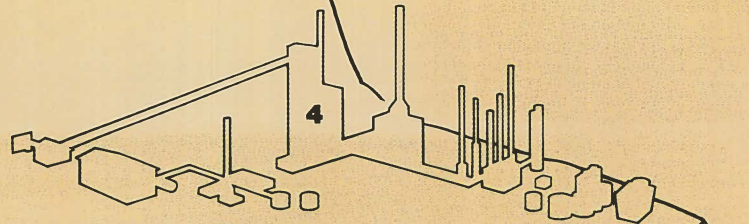
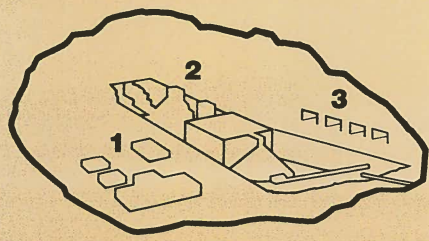




"Jumbo's," large self propelled hydraulic drills, bore holes ten feet into the mine face for explosives.

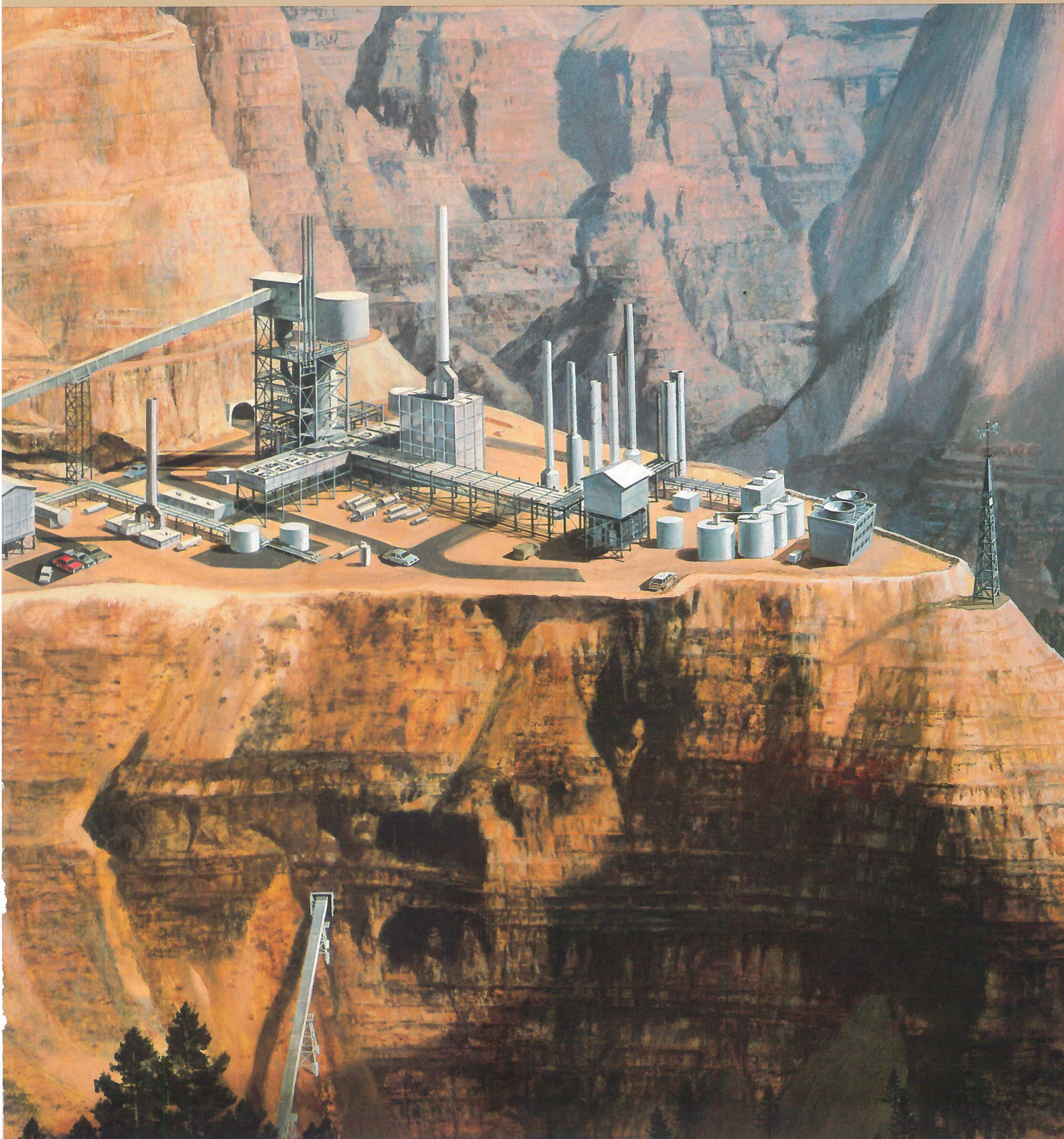


Construction of warehouse facilities, located underground along with offices, shops and shale rock crushing equipment.

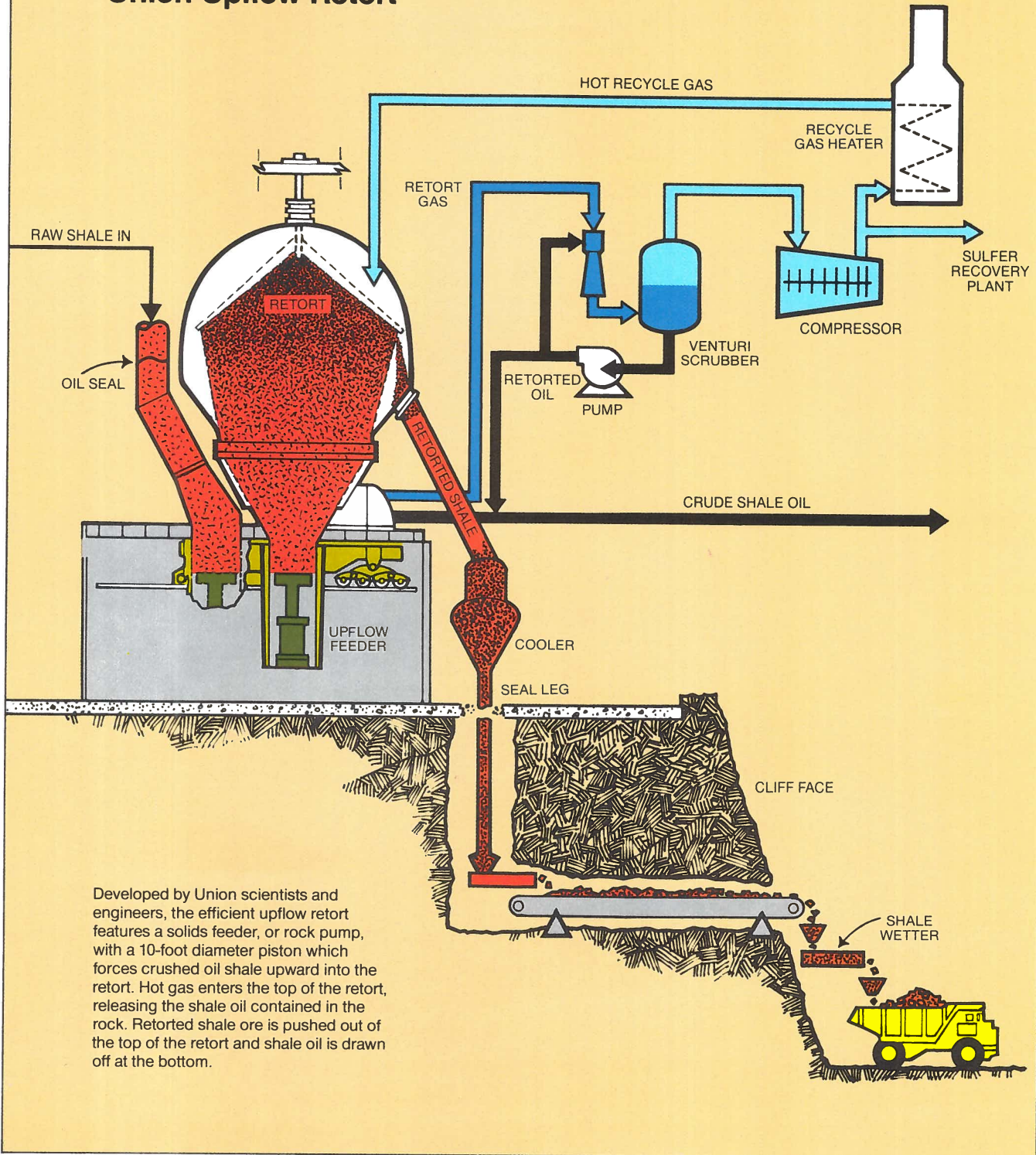


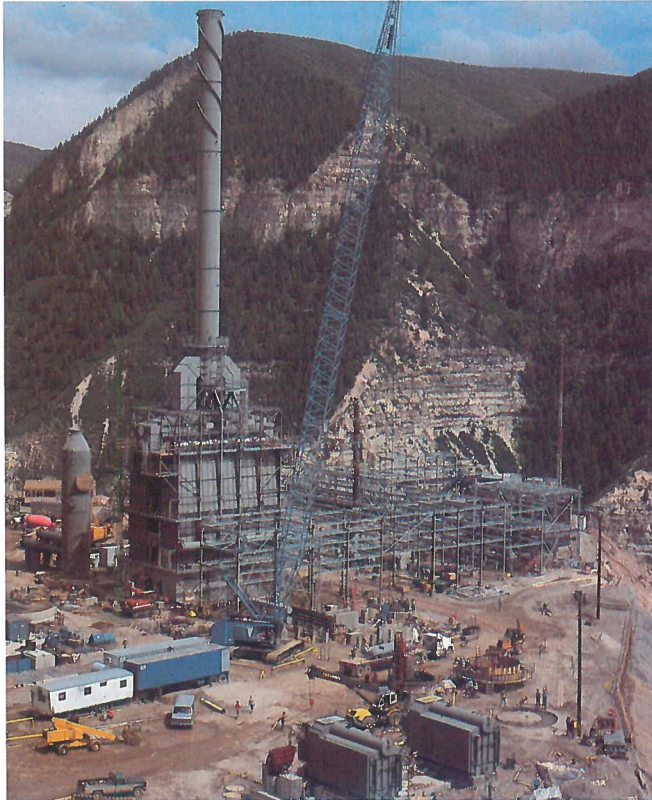
A close-up view of Union's shale oil mine and retorting complex located high on the side of Long Ridge, above the East Fork of Parachute Creek.

The cliff face is cutaway to reveal the interior of the mine containing (1) office and shop buildings, (2) shale crushers and conveyor system, and (3) room and pillar mining operations. The retort (4) is on a bench carved into the face of the cliff.



Union Upflow Retort





Gas heated to 1000°F in this recycle gas heater flows into the retort to release the shale oil from the ore.

bench site just outside the mine entrance, will be a large piece of machinery—40 feet in diameter and 100 feet high. Crushed ore will enter the solids feeder, or rock pump, underneath the retort where a 10-foot diameter piston will force the ore upward into the retort.

Gas heated to 1000°F will enter the top of the retort, decomposing the kerogen contained in the shale and producing raw shale oil in both gaseous and liquid forms. Most of the hot vapors will condense. High quality gas produced with the shale oil will be purified and burned to heat the recycle gas within the retort system as well as to provide steam to operate the retort equipment.

The retorted shale, with all the oil removed, will be forced up and over the edge of the retort cone. From there it will fall, by gravity, into a sealing leg shaft for cooling and depressuring.

The cooled retorted shale then will move by conveyor belt to an enclosed chute which will transport it to the canyon floor. It will be spread, compacted, contoured and planted with native vegetation to blend into the surrounding landscape.

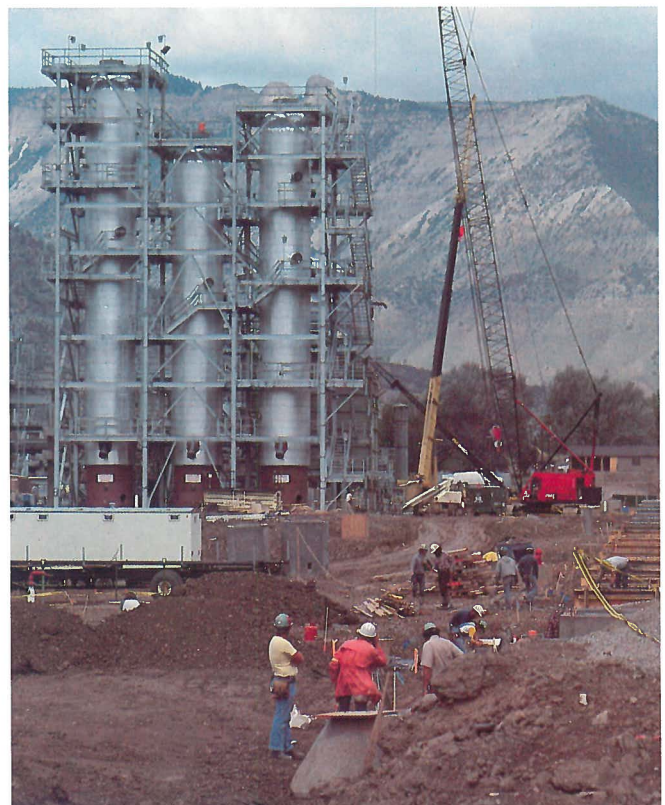
After solids suspended in the shale oil are removed, the

oil will be transported by pipeline to the upgrading facility eight miles south of the retort.

There a Unicracking/DW unit will subject the oil to high temperatures and pressures in a hydrogen atmosphere and in the presence of a catalyst to remove impurities and reduce the pour point to pipeline quality. The resulting synthetic crude can be readily converted into high octane gasoline, jet or diesel fuel in a conventional refinery.

Union's target for starting up the retorting and upgrading facilities is mid-1983. Following a "break in" period, the system will reach its full design production of 10,000 barrels of syncrude per day later that year.

Improvements in the process will be incorporated as experience is gained with full-scale commercial operation. Assuming the project is technologically and economically viable, and that necessary permits are secured on a timely basis, Union plans to add additional mines and retort modules on a phased basis to attain production of 90,000 barrels per day in the 1990s. The upgrading plant also will be enlarged to convert the additional shale oil into syncrude.



Unionfiner reactor vessels at upgrading facility, eight miles south of the retort site, near Parachute.

Environmental Protection

All of Union's activities in this project are designed to ensure an environmentally acceptable operation.

Changes in the land surface resulting from construction of the mine and retort facilities will not be visible outside the upper Parachute Creek Valley. Because of the isolated location of the private property where operations are planned, alterations in the topography will be apparent only to visitors coming to the site on business.

Steps will be taken to preserve and restore vegetation and to protect the area's wildlife and wildlife habitat. Vegetation of retorted shale has been successfully demonstrated and will be carried out on the retorted shale disposal areas. Union has worked with Colorado State University on the development of optimum vegetation methods.

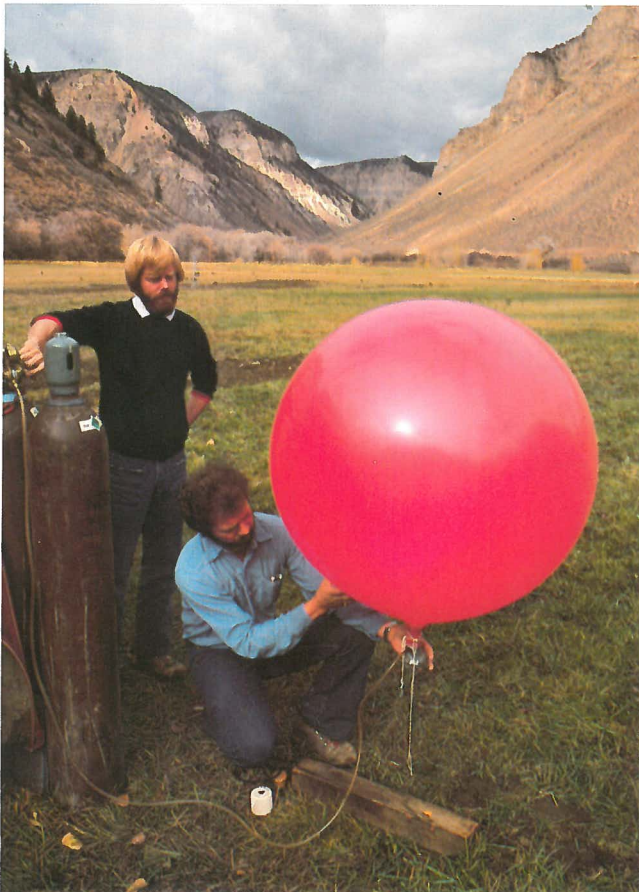
Another primary goal will be to safeguard local streams and underground basins. The bottom 10-foot layer of retorted shale will be compacted to reduce water movement upward or downward.

Monitoring of retorted shale is planned, and erosion testing is an ongoing activity.

During construction and operation of the shale oil program, air quality in the immediate operating area will be protected. Special controls will be installed as part of plant construction. Exhaustive studies indicate that the emission levels will be low, will meet all federal and state air quality standards and will not be harmful to residents of the area, to vegetation or to wildlife.

As operations begin, Union will monitor the environment continuously to ensure that protective standards are met.

Water for the first 10,000 barrel per day phase of the project's operations will be taken from wells on Union's property and will be recycled to minimize water requirements. As future retorts and process facilities are added, water also will be drawn from the Colorado River, where Union has long-established water rights.



Every effort is being made to safeguard air quality and meet all federal and state standards.



Best procedures to vegetate retorted shale ore have been determined by use of these test plots.

Social and Economic Benefits



Parachute town hall and police facility. Union purchased and donated property to the town and provided funds to purchase police and fire safety equipment.

From the start, Union recognized that local communities would need additional housing and public services to provide for the growing population drawn by oil shale development. Every effort is being made to assist in easing these growing pains and to preserve the life style enjoyed in western Colorado.

The company has constructed housing and assisted local officials in financing services, such as schools, highways, water and sewer systems and public safety. Union has expended or committed nearly \$60 million through

1983 to ease social and economic impacts of the project in Garfield County.

The company is providing funds for emergency medical services, administrative services, law enforcement and fire protection in Parachute as well as for increased law enforcement and studies of solid waste disposal in Garfield County.

Union also provided \$4.2 million to finance a Parachute area middle school and has spent \$7.8 million for highway improvements.



Housing complex will accommodate 900 single-status construction workers.



This housing complex in the town of Parachute, with condominiums in the foreground and mobile homes in the background, was built to supplement local housing available to program workers.

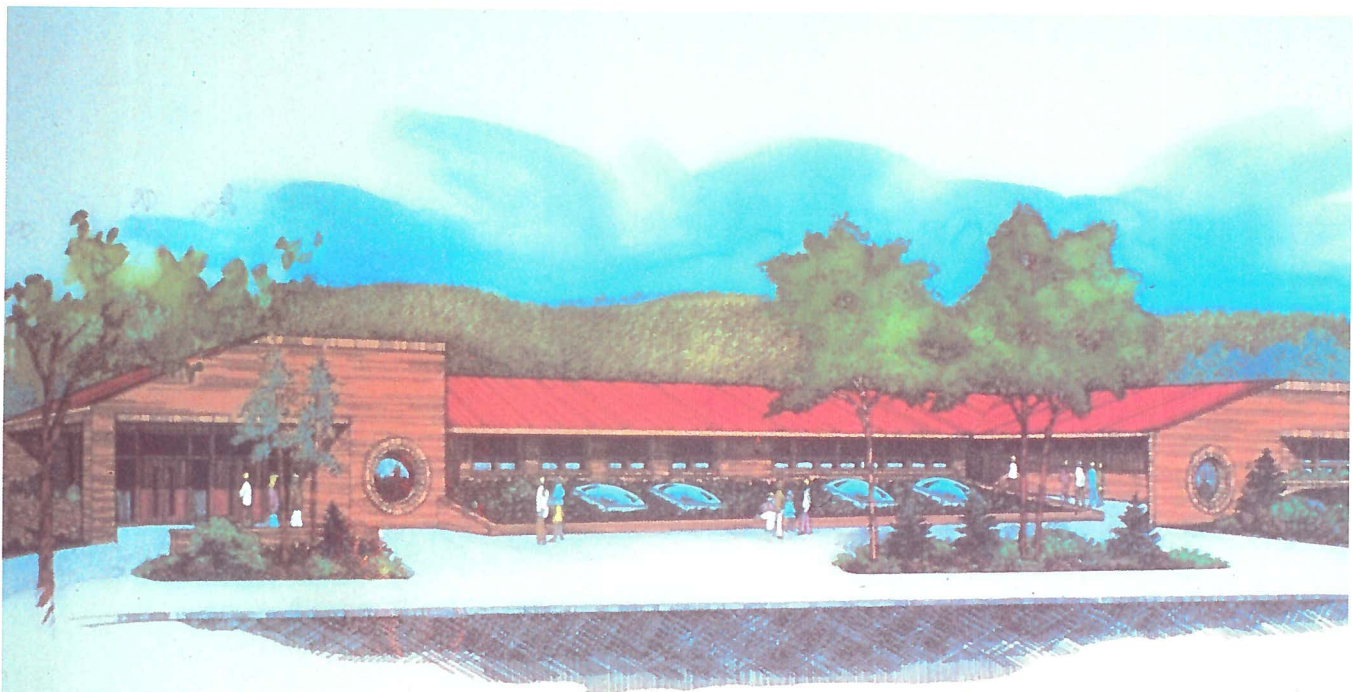
The company has developed single workers' housing on its property adjoining the project site. Accommodating 900 workers, it can be expanded to house additional contractor employees should the need arise. The facility, complete with cafeteria and recreation center, is self-contained and provides all services needed by resident construction workers.

Union also has built 192 apartment units, 129 condominiums and 40 mobile home units for employees bringing their families to the area, and for permanent employees during the project's operating phase.

The work force will peak at 2,400 employees during the construction period. In the operating phase, permanent employment will be provided for about 500 workers.

During construction, the payroll averages about \$50 million annually. During the project's operating phase, annual payroll will be about \$14 million, most of which will be spent in area communities.

Once Union's Phase I facilities are on the tax rolls, the taxes and other revenues received by the state, county and local communities will more than offset the cost of services attributable to project-related population growth.



Artist's concept of new middle school being built to take care of increased population in area. Union provided \$4.2 million to finance school construction. (Architects: Caudill Gustafson & Associates, Aspen, Colorado).

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