UNIVERSITY OF NEVADA, RENO
MACKAY SCHOOL OF MINES

NEVADA BUREAU OF MINES & GEOLOGY SPECIAL PUBLICATION MI-1989

THE NEVADA MINERAL INDUSTRY 1989

Metals
Industrial Minerals
Oil and Gas
Geothermal

Exploration
Development
Mining
Processing
Directories of Operations

GOLD
OIL
SILVER
SAND & GRAVEL
BARITE
DIATOMITE
MERCURY
CRUSHED ROCK
CEMENT
LITHIUM
LIME
MAGNESITE
GEOTHERMAL
SILICA
CLAY
FLUORSPAR
TURQUOISE
ASPHALT
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THE NEVADA MINERAL INDUSTRY—1989

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This report, eleventh of an annual series, describes 1989 mineral and geothermal activities and accomplishments in Nevada: production statistics, exploration and development including drilling for petroleum and geothermal resources, discoveries of orebodies, new mines opened, and expansion and other activities of existing mines. Statistics of known bulk-mineable gold and silver deposits, and directories of mines and plants are included.

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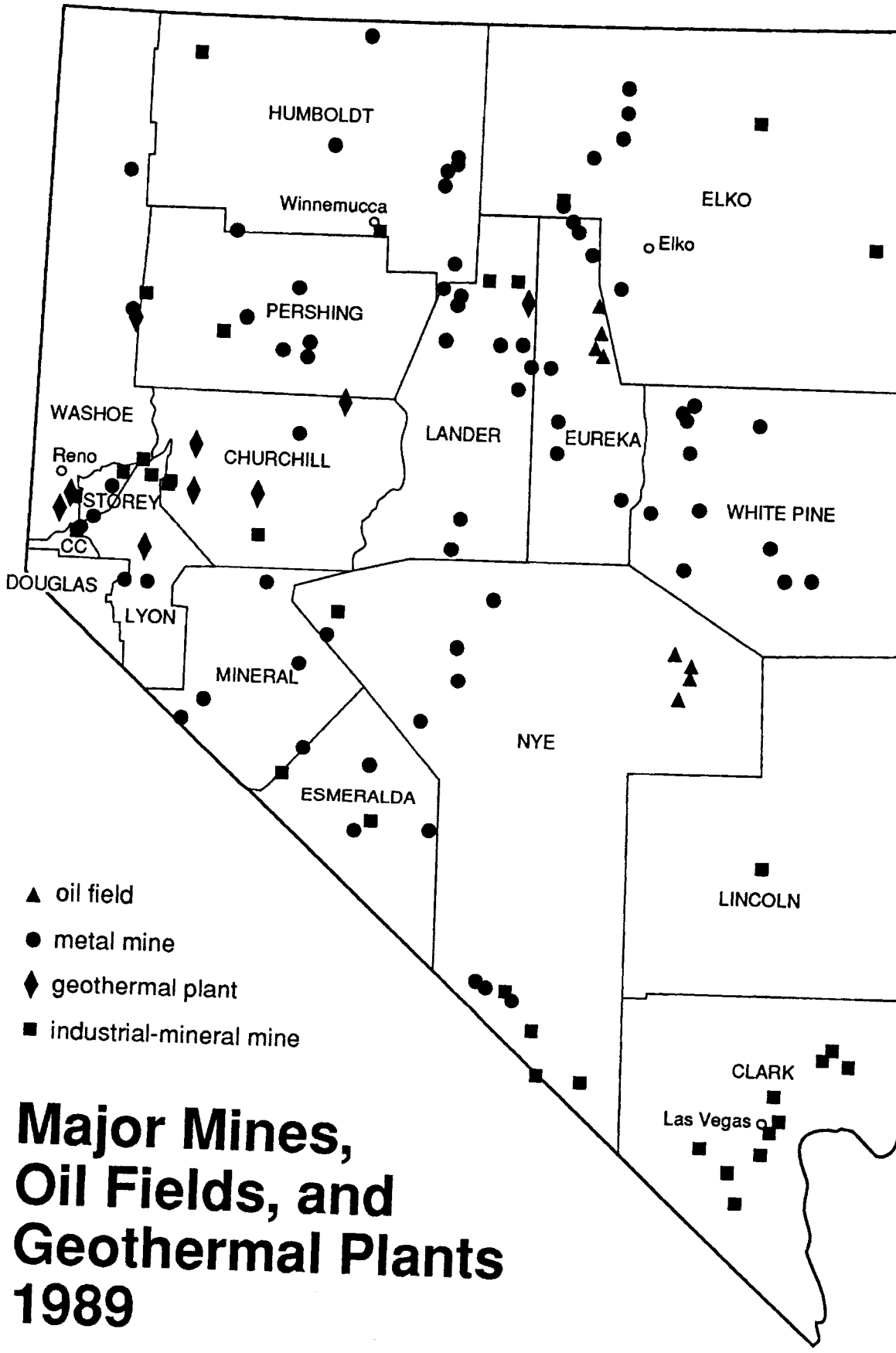


Major Mines, Oil Fields, and Geothermal Plants 1989

Summary

by Jonathan G. Price

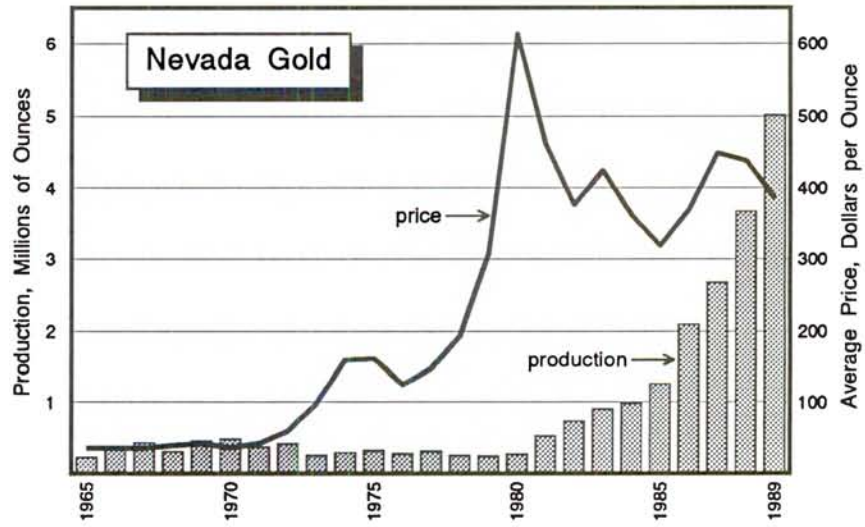
Nevada continues to be in the midst of two major economic booms, one in precious metals production and one in urban growth. Both booms have had major impacts on the minerals industry. This report highlights recent activities through 1989 in metals, industrial minerals, petroleum, and geothermal energy. For quick inspection of the data and trends, numerous tables and charts are included in this summary and throughout the individual chapters.

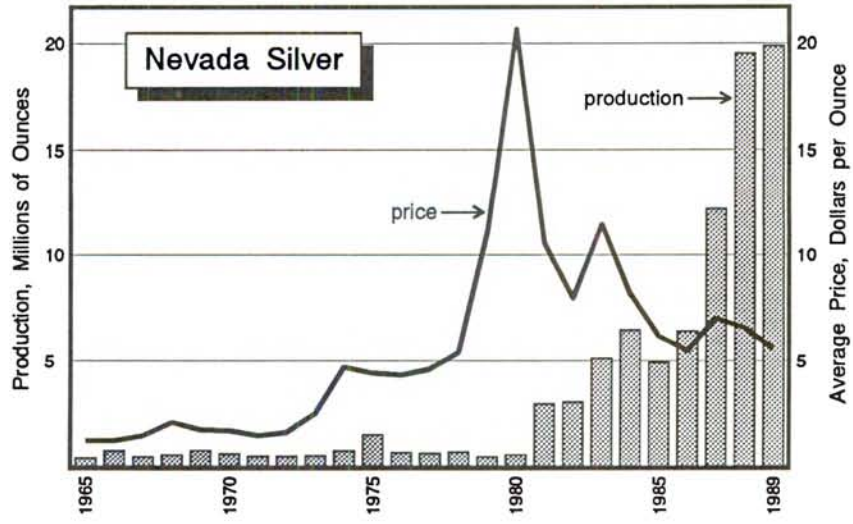
Nevada posted several annual production records in 1989. Record gold production (in ounces and dollars) boosted the total mineral production to a new high of nearly $2.5 billion. Increases in population of the urban areas and new construction to support the tourism and gaming industry, particularly in southern Nevada, have caused record years for both aggregate (sand, gravel, and crushed stone) and gypsum production. New peaks in geothermal energy production can also be linked to Nevada's rapid increase in population and the resulting demand for local power generation.

Gold captures the spotlight of Nevada mineral production, and in 1989 an annual production record of 5 million ounces was attained. Gold production jumped 38 percent over 1988, continuing the rapid upward trend experienced in recent years. The increases are expected to begin to slow in 1990. If production continues at or above the level of 5 million ounces per year, Nevada will produce more gold in the decade of the 1990s than in the previous 130 years since the discovery of the Comstock Lode. Despite a drop in average selling price from $438 in 1988 to $385 in 1989, the production increase led to a record year in terms of value: $1.9 billion.

The chapter in this report on **Metals** summarizes the 20 major exploration discoveries, 4 new mines opened, and various expansion projects announced in 1989. The table on **Bulk-Mineable Precious Metal-Deposits** lists reserves and resources, grades, and other pertinent information on most of the deposits for which information has been publicized. The second edition of Nevada Bureau of Mines and Geology Map 91, *Bulk-Mineable Precious-Metal Deposits and Prospects in Nevada*, was published in 1989. The 1:1,000,000-scale map now lists 107 properties.

Low international gold prices may limit the production of some low-grade deposits, but reserves of relatively high-grade ores should assure that Nevada gold production will continue at significant levels for at least two decades. In 1989 the Nevada Bureau of Mines and Geology established a computer database on *Nevada Mineral Reserves and Resources*, which includes current reserves, resources, annual and total production figures, and references (company annual and quarterly reports and clippings from newspapers and mining trade journals) for mineral deposits in Nevada. Near year-end, the total identified Nevada gold resources, which range from measured, economic reserves to inferred, perhaps subeconomic resources, stood at approximately 118 million ounces.





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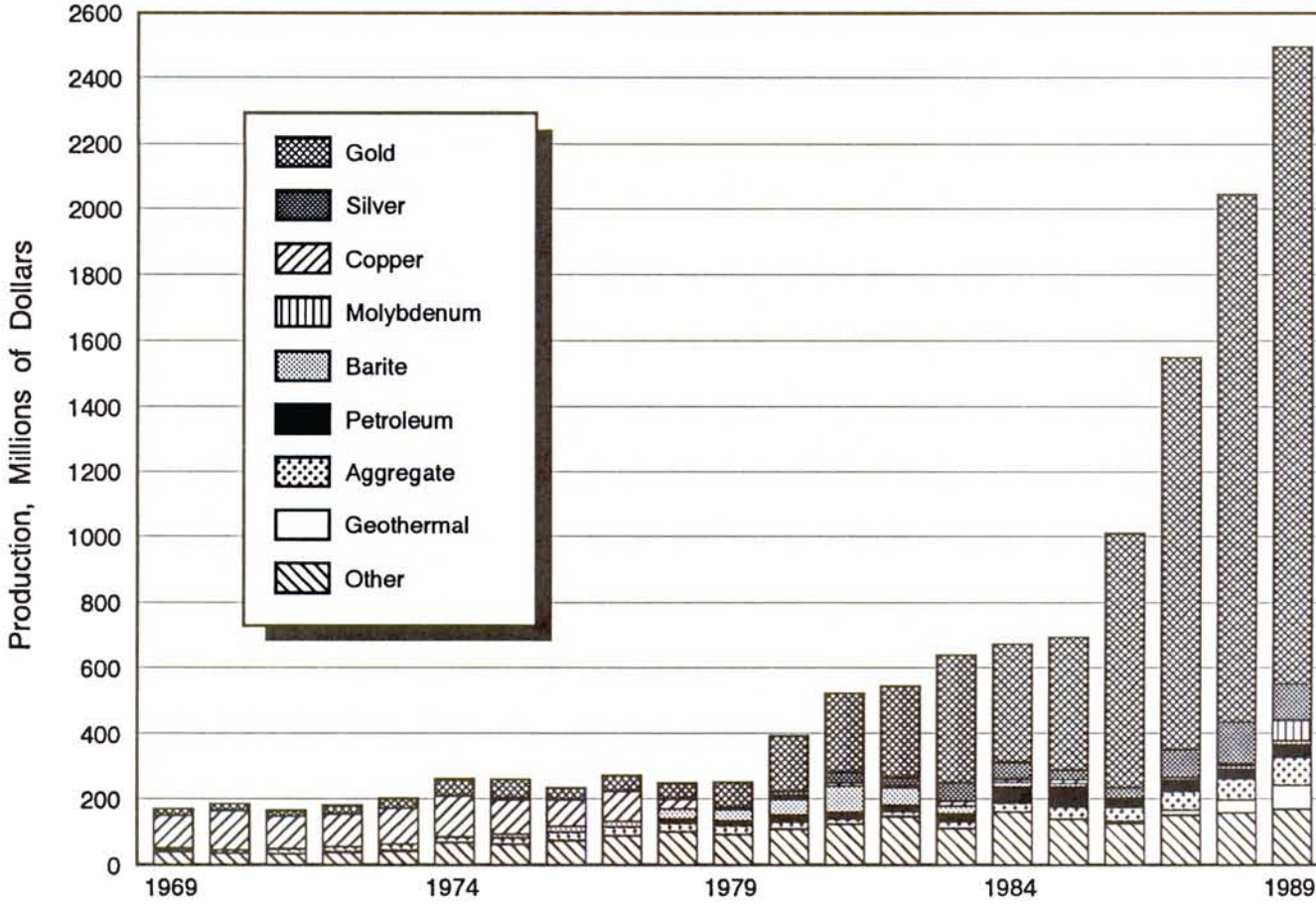

Nevada mineral, petroleum, and geothermal production, 1969–1989.

MINERAL, PETROLEUM, AND GEOTHERMAL POWER PRODUCTION IN NEVADA[1]

Minerals	1988		1989		% change from 1988 to 1989	
	Quantity	Value (thousands)	Quantity	Value (thousands)	Quantity	Value
Barite (thousand short tons)	201	$9,600	203	$10,000	1%	4%
Clays (thousand short tons)	34	8,800	44	9,900	30	13
Copper (thousand pounds)	w	w	2,375	3,088	NA	NA
Geothermal power (thousand megawatt-hours)	475	39,067	827	72,790	74	86
Gold (thousand troy ounces)	3,676	1,611,020	5,055	1,946,375	38	21
Molybdenum (thousand pounds)	w	w	17,938	63,143	NA	NA
Petroleum (thousand 42-gallon barrels)	3,228	29,056	3,218	39,705	−0.3	37
Sand, gravel, and crushed stone (thousand short tons)	15,400	65,450	20,000	85,000	30	30
Silver (thousand troy ounces)	19,535	127,760	19,867	110,147	2	−14
Other minerals[2]	—	155,215	—	155,135	NA	0
Total	—	2,045,968	—	2,495,283	NA	22

NA = not applicable; w = withheld, value reported with other minerals.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers); compiled by the Nevada Bureau of Mines and Geology, the Nevada Department of Minerals, and the U.S. Department of Interior, Bureau of Mines.

[2]Production data for cement, copper and molybdenum in 1988, certain clays (fuller's earth in 1988, kaolin), diatomite, fluorspar, gemstones (precious opal), gypsum, lead in 1988, lime, lithium carbonate, magnesite, mercury, perlite, salt, silica sand, stone (crushed dolomite), and zeolite are combined. See text for details of some of these commodities.

Products milled or processed in Nevada but mined from deposits in California are not included. Specifically, 111,292 ounces of gold and 53,888 ounces of silver from the Buckskin Leach Plant in Douglas County and 11,710 tons of calcium borate from the Lathrop Mill in Nye County are excluded.

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In 1989 Nevada, the Silver State, continued to lead the U.S. in not only gold but also silver production. Much of the silver production is, however, a by-product of gold production. Only two mines, the Candelaria mine in Mineral County and the Trinity mine in Pershing County, produced significantly more value in silver than in gold in 1989. Silver is the major co-product with gold at the Rochester mine in Pershing County. Whereas silver production in Nevada rose a modest 2 percent from 1988 to 1989, the drop in price from $6.54 in 1988 to $5.54 in 1989 caused a decline in value of silver production. Nonetheless, total precious metal production in 1989 exceeded $2 billion. The total identified silver resources in Nevada stood at year-end at 479 million ounces.

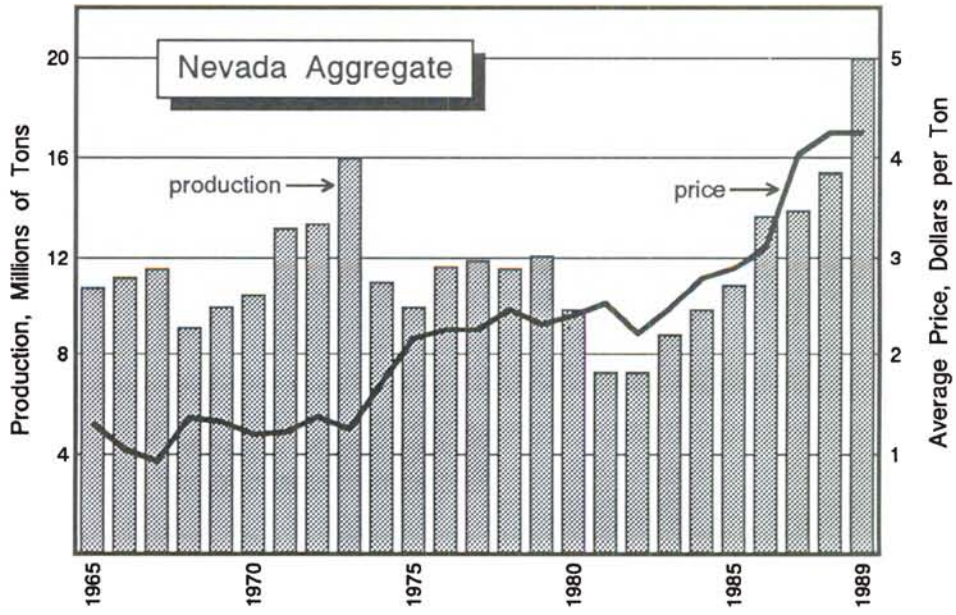
Through a survey conducted in January 1990, the Nevada Department of Minerals collected data used in Nevada Bureau of Mines and Geology Special Publication 10, *Major Mines of Nevada 1989*, which includes, in handbook form, small-scale location maps, names and telephone numbers of operators, numbers of employees, and non-proprietary 1989 production figures for most mines in Nevada. The data from the survey of mines are used, along with information from other sources, in the figures in this publication and will be used to update, revise, or check preliminary statistics collected and released by the U.S. Bureau of Mines. The Nevada Bureau of Mines and Geology also maintains a computer database of active mines and publishes a computer-drawn map of active mines at scale of 1:1,000,000.

Nevada ranked third in the U.S. in total value of nonfuel mineral production in 1989, according to figures provided by the U.S. Bureau of Mines. Arizona was first because of the continued high price of copper. California ranked second because its growing population needs large quantities of construction materials (cement and aggregate).

Along with copper, exploration for and development of some other metals are experiencing a resurgence in Nevada. Copper was produced in 1989 from oxide dumps at the Copper Tek (formerly Yerington) mine in Lyon County. Copper was also produced as a by-product of molybdenum mining at the Cyprus Tonopah mine in Nye County. The Ward Mountain mine in White Pine County is scheduled to begin producing silver, lead, zinc, and copper in 1990.

Nevada's population is growing faster than that of any other state, largely because of strengths in the gaming, tourism, and retirement industries, and in many rural counties because of increased mining activity. Clark County, in particular, is experiencing rapid growth, with over 1,000 new families moving into the county each month. In response to this growth and to some extent in response to increased demand from California, annual production of aggregate and gypsum in Nevada reached record levels. Aggregate production exceeded the previous high value in 1973, a peak year during construction of the interstate highway system. The chapter on **Industrial Minerals** highlights these and other commodities, including diatomite, lime, lithium carbonate, cement, barite, clay, magnesia, silica sand, salt, perlite, fluorite, and zeolites.

The Nevada metals and industrial minerals industries in 1989 employed approximately 13,500 individuals at 222 mines. These data were summarized from the **Directory of Mining Operations**, which lists the significant mines and plants throughout the state. Trends of increasing employment at large mines and closures of small mines continued from previous years. According to *Mineral Industries in the Nevada Economy—1990*, a special publication by Bureau of Business and Economic Research at the University of Nevada, Reno, Nevada's miners earn top wages: an average of



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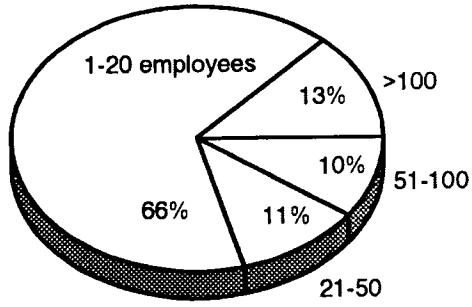
NUMBER OF MINES AND EMPLOYEES IN NEVADA'S MINERAL INDUSTRY

(Data for 1978–1987 are from the State Mine Inspector's Reports; 1988–89 data were compiled from the Directory of Mining and Milling Operations in this publication and Special Publication MI-1988.)

NUMBER OF MINES BY WORK-FORCE SIZE

Year	Work-force size (employees/mine)				
	1-20	21-50	51-100	> 100	Total
1978	306	18	9	9	342
1979	340	25	10	7	382
1980	392	30	11	17	450
1981	383	34	12	16	445
1982	312	22	8	14	356
1983	315	22	8	15	360
1984	325	24	12	18	379
1985	289	24	16	15	344
1986	250	26	14	21	311
1987	260	26	16	24	326
1988	155	25	22	33	235
1989	148	24	23	30	225



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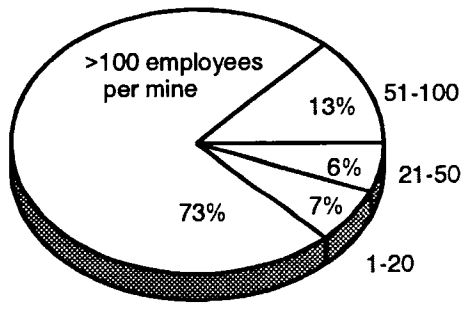
NUMBER OF EMPLOYEES BY WORK-FORCE SIZE

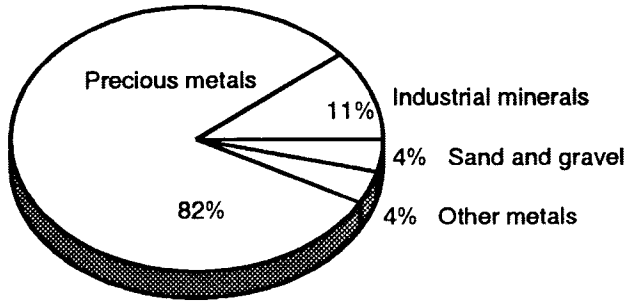
Year	Work-force size (employees/mine)				
	1-20	21-50	51-100	> 100	Total
1978	1,544	609	626	2,205	4,984
1979	1,738	791	588	1,311	4,428
1980	2,139	1,037	799	4,195	8,170
1981	2,124	1,128	884	4,400	8,536
1982	1,640	716	533	2,632	5,521
1983	1,635	742	561	2,812	5,750
1984	1,437	767	887	3,127	6,218
1985	1,279	722	1,129	3,310	6,440
1986	1,315	848	921	5,171	8,255
1987	1,376	799	1,166	6,973	10,314
1988	941	832	1,483	9,441	12,697
1989	945	854	1,821	9,936	13,556



1989

NUMBER OF EMPLOYEES BY COMMODITY

Year	Precious metals	Other metals	Industrial minerals	Sand & gravel	Total
1978	1,096	1,859	1,479	550	4,984
1979	1,503	833	1,604	488	4,428
1980	3,808	1,918	1,804	640	8,170
1981	4,263	2,018	1,760	495	8,536
1982	2,905	867	1,357	392	5,521
1983	3,616	598	1,104	432	5,750
1984	4,097	646	1,049	426	6,218
1985	4,595	256	1,046	543	6,440
1986	6,460	175	976	644	8,255
1987	8,636	160	901	617	10,314
1988	10,638	412	1,090	557	12,697
1989	11,088	510	1,448	510	13,556



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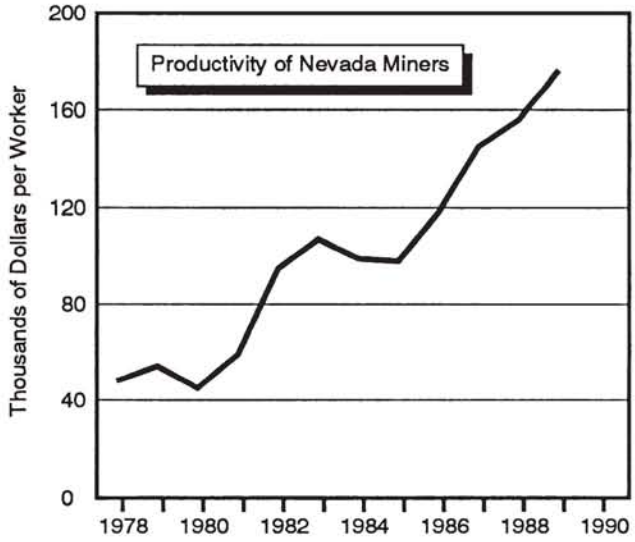


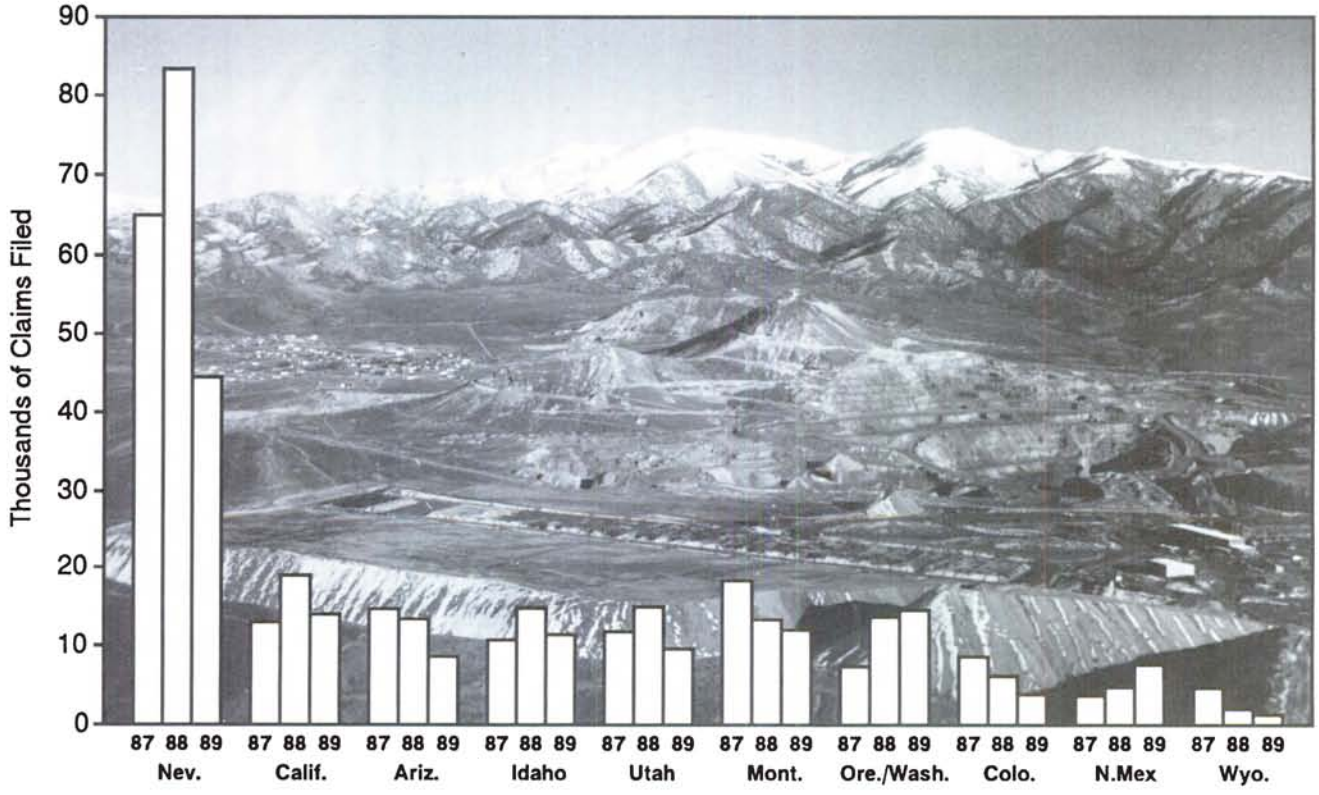
Total value of mined product per worker in Nevada (exclusive of petroleum and geothermal energy).

$36,000 per person in 1989. Productivity is also high. On the average, each person produced $176,000 in mined products in 1989.

The employment totals include only the company employees and contractors at the mines and do not include vendors who sell supplies to the mines or exploration groups who find the mineral deposits that will be mined in the future. Among other factors, steady declines in the price of gold and silver over the last two years have led to a decrease in exploration activity. This decrease is reflected in the decline in new claims filed with the U.S. Bureau of Land Management. Similarly, the Nevada Bureau of Mines and Geology has recognized a decrease in the sales of U.S. Geological Survey topographic maps and other publications since the peak year of 1988.

CLAIMS FILED WITH THE U.S. BUREAU OF LAND MANAGEMENT

	1976–1988	1989	Total active claims
Nevada	539,360	44,547	403,027
California	218,198	13,906	158,361
Arizona	291,809	8,567	134,121
Idaho	143,122	11,377	90,521
Utah	318,970	9,558	96,944
Montana	160,726	11,859	91,337
Oregon/Washington	110,987	14,630	57,784
Colorado	261,872	3,905	85,013
New Mexico	148,665	7,599	39,823
Wyoming	238,088	1,345	47,545



New claims filed with the U.S. Bureau of Land Management, 1987–1989.

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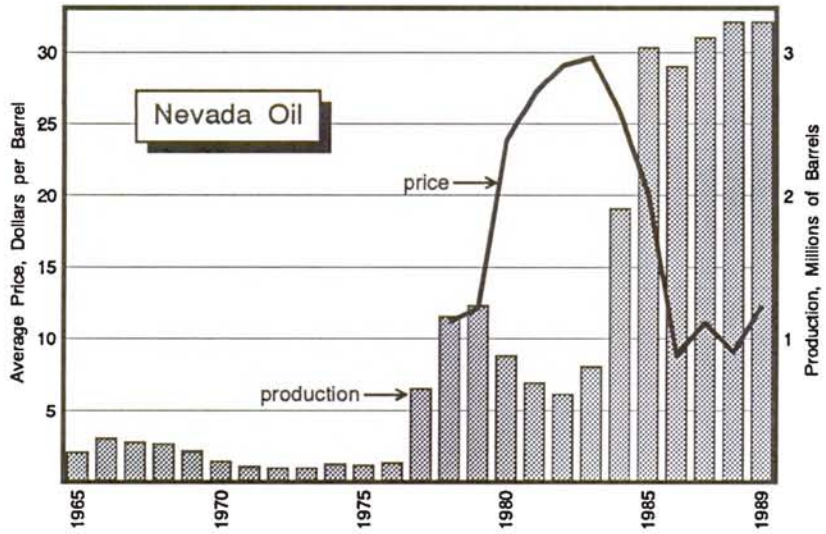
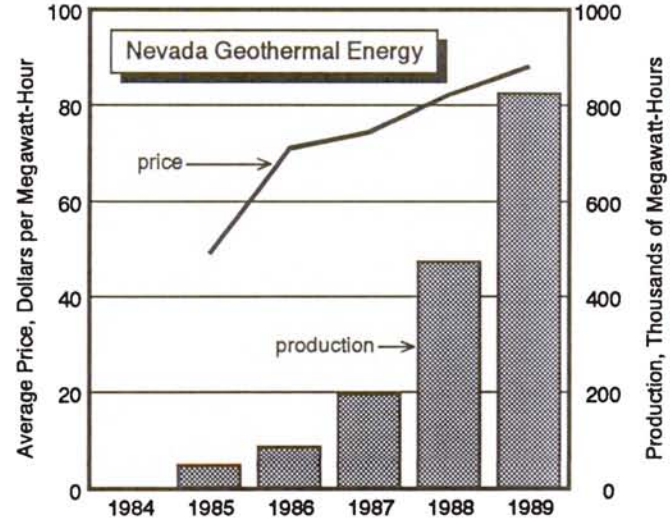


Nevada's petroleum industry is thriving. Although production was essentially flat from 1988 to 1989, higher prices caused an increase in the value of petroleum produced. The trend in Nevada is quite different from that seen in the rest of the United States, which suffered a 6.8 percent decline in petroleum production and an 8.2 percent increase in foreign imports from 1988 to 1989. In 1989 new oil from the producing areas in Railroad Valley in Nye County and Pine Valley in Eureka County offset closures of old wells. The infield success rate of approximately 80 percent indicates that petroleum geologists are beginning to understand the complications of Nevada oilfields well enough that each new hole is no longer considered a wildcat. Details of significant wells drilled in 1989 are given in the chapter on **Oil and Gas**. The Nevada Bureau of Mines and Geology maintains the *Nevada Oil and Gas Well Catalog*, a computer database on all wells drilled in the state and prints a computer-generated 1:1,000,000-scale map showing the locations of wells.

Geothermal power capacity in Nevada reached a record level of 130.8 megawatts and geothermal energy production reached a record level of nearly $73 million in 1989. More than 400 megawatts of additional known geothermal resource await future development. Specifics on the new plant that came on line in Churchill County, new applications, and expansions to older plants are included in the chapter on **Geothermal Energy**. The Elko County Courthouse is now heated with geothermal energy. With the completion of its new injection well, the Peppermill Hotel/Casino in Reno is again using geothermal heat. Geothermal energy also is being used to warm waters to increase heap-leach recoveries and to extend processing year-round at gold mines in Pershing and Nye Counties.

The mining, petroleum, and geothermal industries pay certain taxes and fees directly or indirectly to the State of Nevada. As gold and other mineral production has increased in recent years so have the revenues from the tax on net proceeds of mines. Changes in the tax rate during the 1989 Nevada legislative session resulted in a sharp increase in this tax from 1988 to 1989. Approximately 86 percent of the land in Nevada is managed by the federal government. The State receives a percentage of the revenues from oil and gas and geothermal leases, mining claim fees, and oil production taxes. Additional mining-related revenues are received by the State through reclamation and other permitting fees and through sales taxes paid on supplies purchased by the mines, on travel and other expenditures by exploration crews, and on purchases made by employees.

The Nevada mineral industry is vital to the State and U.S. economies. Although precious metals clearly dominate the value of minerals produced in



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ANNUAL TAX ON NET PROCEEDS OF MINERALS

Year	Annual net proceeds[1] (thousands)	Annual tax (thousands)
1982	$159,999	$1,800
1983	245,688	4,152
1984	184,987	3,222
1985	198,263	3,527
1986	374,664	6,091
1987	627,330	12,083
1988	778,253	13,568
1989	748,065	36,238

Source: Nevada Department of Taxation "1989-90 net proceeds of minerals."

[1]Net proceeds are gross income minus direct costs incurred at the mine site.

MINERAL LEASING REVENUES PAID TO THE STATE OF NEVADA BY THE U.S. GOVERNMENT
(as provided by Section 35 of the Mineral Leasing Act of 1920)

Fiscal year[1]	Revenue (thousands)			
	Oil and gas	Geothermal	Other	Total
1982	$11,618	$934	$44	$12,596
1983	9,538	639	21	10,198
1984	8,013	432	39	8,484
1985	9,533	301	69	9,903
1988	6,966	367	81	7,414
1987	4,214	377	147	4,738
1988	4,866	858	542	6,266
1989	7,048	1,156	1,078	9,282

Source: U.S. Bureau of Land Management annual progress reports for Nevada.

[1]October 1 through September 30.

OTHER REVENUE TO THE STATE OF NEVADA FROM THE MINERAL INDUSTRY

Fiscal Year[1]	Mining claim fee[2] (thousands)	Oil production tax[3] (thousands)
1983	$158	NA
1984	158	$ 52
1985	160	129
1986	160	155
1987	175	146
1988	337	158
1989	402	161

Source: Nevada Department of Minerals.

[1]July 1 through June 30.

[2]The State receives a fee of $1.25 for each new claim and each assessment report.

[3]Does not include drilling permit fee: $.05 per barrel of oil produced.

recent years, many other commodities are either currently being mined or can be mined in Nevada. Under favorable economic conditions, new metal and industrial mineral mines and petroleum and geothermal fields are likely to be brought into production. Population growth will maintain strong demand for construction raw materials, such as aggregate, cement, and gypsum. Much of the Nation's hard rock mining and exploration expertise resides in Nevada, and Nevada's mineral endowment is immense and diverse.

Metals

by Richard B. Jones

Gold Quarry heap-leach pad. *Newmont Gold Co. photo.*

The information in this section was compiled primarily from news releases in Rocky Mountain Pay Dirt and in the Mining Record, Northern Miner, and Reno Gazette-Journal newspapers. Some information was extracted from company annual reports. Production costs given in this section are direct mine production costs and do not include exploration, development, start-up, or overhead costs.

Churchill County

The **Fondaway mine** (sec. 1,T22N,R33E), owned by **Tenneco Minerals**, began production in September at a cost of 2.5 million. Production during the projected 2- to 3-year initial mine life is expected to be 12,000 ounces of gold annually. It is an open-pit, heap-leach operation and by year-end had produced slightly more than 1,000 ounces of gold. Ongoing exploration is focused on a larger, higher-grade refractory ore zone which would have to be mined by underground methods.

Inland Gold & Silver Corp. announced a 50-50 agreement with **N.A. Degerstrom** to develop and mine the **Bell Mountain** property (sec. 10,T15N,R34E). It will be an open-pit, heap-leach operation with production expected in 1990. Announced proven reserves are 30,000 ounces of recoverable gold and 125,000 ounces of recoverable silver. Cash production costs over the projected 3-year mine life are estimated to be $320 per ounce gold equivalent.

Elko County

Freeport McMoRan Gold Co. was the largest gold producer in the county in 1989 with production coming from the **Jerritt Canyon** and **Big Springs** Complexes. The Jerritt Canyon Complex poured its 2 millionth ounce of gold during the year, having accomplished this in only 3½ years of operation. Investment in property, plant, and equipment during 1989 was around $48 million. A large part of this amount was spent on the installation of three fluid-bed roasters—one at the Big Springs operation and two at Jerritt Canyon. All three were in operation by year-end and they are expected to increase production by several tens of thousands of ounces of gold per year. Freeport's revenues were down for the year, averaging $381 per ounce of gold as opposed to $434 per ounce of gold in 1988. Production in

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1989 was 296,927 ounces of gold from the Jerritt Canyon Complex and 60,376 ounces of gold from Big Springs. A new gold discovery was made in 1989 approximately 2,500 feet south of the current Jerritt Canyon mining area. This zone, not fully delineated by year-end, is approximately 1,000 feet by 500 feet with the top of mineralization varying from 585 feet to 820 feet below the surface. The calculated geologic resource, as of year-end, was $21 million tons grading 0.228 ounces of gold per ton. Newly defined ore reserves in 1989 more than replaced ore mined during the year. In November Freeport McMoRan, Inc. stated that Freeport McMoRan Gold was for sale; Minorco purchased the company in 1990 and renamed it **Independence Mining Co.**

The **Dee gold mine** produced 44,500 ounces of gold and 45,000 ounces of silver during 1989. **U.S. Gold Corp.** sold its 29.33% interest in the mine for $4.07 million to **Rayrock Yellowknife** and **Corona Corp.** The transaction left Rayrock and Corona each with 44% ownership in the mine. During the year, drilling tested geophysical targets related to the northerly extension of Newmont's Bootstrap-Capstone deposit and low-grade gold mineralization was found. Further drilling is planned along the 2,500-foot structure.

The **Hollister** gold deposit, in the Ivanhoe mercury district, did not make it into production in 1989. Further in-fill drilling and review and modification of the initial feasibility study were done during the year, with the result that production is scheduled to begin in late 1990. Current proven and probable oxide reserves are 18.4 million tons grading 0.035 ounces of gold per ton. This is a 50-50 joint venture between **Cornucopia Resources Ltd.** and **Galactic Resources Ltd.**

The **Tuscarora gold mine** produced 13,932 ounces of gold and 13,026 ounces of silver during 1989. Since **Chevron Resources Co.** entered into the joint venture, exploration at the mine has proceeded on two fronts: deep drilling with the hope of finding a large discovery like those being found in the Carlin Trend, and near-surface exploration in search of open-pit oxide deposits. The exploration budget for fiscal 1990 is expected to exceed $1.5 million. Development drilling around the current pit increased reserves and identified new mineralization during the year.

Eureka County

The largest gold producer in Eureka County is **Newmont Gold Co.** Their total gold production for the year was 1.5 million ounces, a 67% increase over the 896,000 ounces produced in 1988. This production comes from the **Carlin Trend**, which extends into Elko County in both the northwest and the southeast directions. Newmont has mines on both ends of the trend, which means that some of Newmont's total production comes from Elko County. Announced ore reserves at the end of 1989 were up 26% over 1988 reserves, to 20.5 million ounces of gold. Newmont's total geologic resources at the end of 1989 were 39.7 million ounces of gold, up from the 37.1 million ounces announced in 1988. In 1989 the company invested more than $20 million in exploration and reserve development. They now have 15 gold deposits within the Carlin Trend. Exploration drilling by Newmont in their Blue Star East Zone may have discovered a new gold ore zone. No information on the nature of this potential ore zone has been released by Newmont. Over the last two years Newmont has invested $490 million in three mills, three leach plants, and support facilities. From 1990 through 1993 they intend to invest $150 million annually for similar facilities with a large portion going towards the construction of two additional new plants to process refractory ores.

American Barrick is also expanding operations on its **Goldstrike** property. Construction began in 1989 with installation of the first of six autoclaves, designed to process refractory ores. Each unit is expected to process 1,500 tons per day when operating at full capacity. Expected recovery is 95%. Production from the property is projected at 900,000 ounces of gold annually by 1992. In 1989 the property produced 207,000 ounces of gold and is expected to produce 330,000 ounces of gold in 1990. At the end of 1989 Barrick announced total reserves of 18.4 million ounces of gold.

Exploration has identified three other areas of gold mineralization within the boundaries of the Goldstrike property: **Screamer, Rodeo Creek,** and **Purple Vein**. The most important of these appears to be the Purple Vein which is located one mile north of the Post-Betze deposit. The zone has not been fully delineated, but to date is approximately 1,600 by 600 feet with grade averaging more than 0.30 ounces of gold per ton.

The **Gold Bar mine**, owned by **Atlas Gold Mining, Inc.** (a subsidiary of Atlas Corp.), produced 66,000 ounces of gold during 1989, a 28% increase over the previous year. Early in the year a $5 million expansion was completed in the Gold Bar mill which doubled the processing capacity to 3,000 tons per day. At the current mining rate the Gold Bar deposit will be mined out by 1992. However, three more gold deposits have been found which will extend the property life to 1999. Exploration is continuing on the 50,000 acres surrounding the Gold Bar deposit.

The **Tonkin Springs gold mine**, owned by **U.S. Gold Corp.**, produced 1,753 ounces of gold and 1,402 ounces of silver in 1989. Due to delays and start-up problems, the new carbon-in-leach mill and bioleach process did not begin operation in 1989 as planned.

The **Bullion Monarch** property (sec. 10,T35N,R50E) underwent a drilling program during the year and the outcome was discovery of strong gold mineralization at depth. Most of the mineralization appears to be concentrated from 1,340 to 1,960 feet below the surface. No grades have been announced. Drilling has penetrated to 2,400 feet in at least two holes.

Currently the property is a joint venture between **United Mining Corp.** and **Westmont Mining, Inc.**, project manager.

Alban Explorations Ltd. has optioned two properties in the Carlin Trend. One is called the **Sheep Creek** property and totals approximately 80 acres. It is located about 1½ miles southwest of Newmont's Carlin mine. The second property consists of approximately 400 acres, is called the **Boulder Valley** property, and is located about 2 miles southwest of the Sheep Creek property. Each property carries a 5% net smelter royalty payable to the respective owners. In December, Alban began road construction to four drill sites. The drill sites are located along north-trending faults which exhibit strong zones of silica, barite, stibnite, and other disseminated sulfides. High geochemical values of arsenic from rock samples have been obtained along with some assays of up to 0.07 ounces of gold and 3.84 ounces of silver per ton. Reverse circulation drilling to average depths of 500 feet is planned to test these mineralized areas.

Humboldt County

The **Sleeper mine**, owned by **Amax Gold, Inc.**, produced 256,000 ounces of gold and 340,000 ounces of silver in 1989. The mill operated at a rate in excess of 1,500 tons per day with an average mill-head grade of 0.378 ounces gold per ton and a recovery rate of almost 95%. Production is also obtained from leach pads. Direct cash production costs for the year were $109.00 per ounce, up slightly from the $103.00 per ounce in 1988. Exploration drilling managed to replace almost all the mined reserves. Amax's marketing program enabled the company to obtain an average realized price for its gold of $411 per ounce compared to the 1989 average COMEX price of $382 per ounce. Amax's average realized gold price in 1988 was $448 per ounce.

In December, **Gold King Consolidated, Inc.** obtained an option on the **Adelaide Crown** property (~sec. 24,T34N,R39E) from the current owner, **Icarus Exploration Co.** The property consists of 146 claims divided into two parcels. In the South Pit area, proven resources are given as 585,000 tons grading 0.043 ounces of gold and 1.313 ounces of silver per ton. In this area, there is an additional proven resource of 165,000 tons grading 0.015 ounces of gold per ton. **Gold King** hopes to have the property in production by mid-1990 at an annual rate of 20,000 ounces of gold.

The **Marigold gold mine** commenced production in September 1989 and by year-end had produced 16,000 ounces of gold and 484 ounces of silver. The property covers approximately 30 square miles and is a joint venture between **Santa Fe Pacific** (30%) and **Cordex VI Syndicate** (70%). **Rayrock Yellowknife** (member of the Cordex Syndicate) is the operator. Capital costs to bring the property into production were approximately $37 million. Initially a 1,250-ton-per-day mill and a 730,000-ton-per-year heap-leach facility were built. When in full operation the mine is expected to produce 60,000 ounces of gold per year at a projected direct operating cost of approximately $165 per ounce. Currently four orebodies are known on the property and as of September 1989 announced reserves totaled 4.4 million tons of mill-grade ore at 0.105 ounces of gold per ton and 7.6 million tons of heap-leach ore grading 0.026 ounces of gold per ton. Mine life is expected to be 10 years. The mine employs about 150 people.

At the end of the year Rayrock Yellowknife announced a new gold discovery called **Stonehouse** in the northern part of the Marigold property (~sec. 11,T34N,R42E). Fifty vertical reverse circulation rotary drill holes, totaling 27,000 feet had been completed by the end of October in a 1,200- by 1,800-foot area. The deposit appears to have a northerly trend and westerly dip. Significant mineralization occurs in two zones, a shallow oxide zone and a deeper primary sulfide zone. Two of the better-grade holes in the upper zone had intercepts of 0.28 ounces of gold per ton from 45 feet to 85 feet and 0.13 ounces of gold per ton from 215 to 265 feet. A third hole intersected oxide mineralization grading 0.083 ounces of gold per ton at 555 to 870 feet, followed by refractory sulfide mineralization grading 0.405 ounces gold per ton from 870 to 900 feet.

Immediately adjacent to the Stonehouse discovery, a new discovery called **Lone Tree Hill** was made by **Santa Fe Pacific Minerals**. By the end of the year 13 holes had been drilled that indicated mineralization over a length of more than 3,200 feet. When combined with the strike length of the adjacent Stonehouse deposit, the mineralization extends for at least 5,000 feet. One of the better drill intercepts assayed 0.12 ounces of gold per ton from 130 to 185 feet.

The **Getchell mine**, owned by **FirstMiss Gold Inc.**, produced 120,731 ounces of gold and 9,407 ounces of silver. Average sale price for the year was $393 per ounce of gold versus $457 per ounce in 1988. The new mill began operation in February, processing oxide ore. The first of three autoclaves began operating and the remaining two were scheduled for start-up by mid-year. However, due to problems with oxygen sparger lines and high-pressure flash tanks the autoclaves did not get into operation until September. The autoclaves are 12 feet in diameter and 85 feet long. The mill treated 241,895 tons of ore having a head grade of 0.194 ounces of gold per ton. Recovery approached 90%. Average direct production costs for the fiscal year (ending June 1989) were $185 per ounce, versus $174 per ounce in fiscal year 1988. Costs are expected to increase to $240 or more per ounce with full operation of the mill.

FirstMiss spent $2.3 million on exploration during fiscal year 1989 and drilling found reserves to replace mined ore. Heap-leach reserves from old tailings were exhausted and mining began in the **Summer Camp** area, a new low-grade oxide deposit

that will be heap-leached. Two years of reserves have been proven for this deposit. Proven and probable reserves at the end of June were 8.1 million tons of mill ore grading 0.154 ounces of gold per ton and 1.43 million tons of heap-leach ore grading 0.049 ounces of gold per ton. In addition to these reserves there is a geologic resource totaling 5.7 million tons of sulfide resources grading 0.092 ounces of gold per ton and 2.6 million tons of oxide resources grading 0.055 ounces of gold per ton.

The **Rabbit Creek gold mine** (~sec. 19,T39N,R43E), 100% owned by **Santa Fe Pacific Minerals Corp.**, continued development during 1989. By the end of the year more than 600 drill holes had been completed and calculated proven and probable reserves were 4.1 million ounces of gold. There are approximately 12 million tons of oxide mill ore averaging 0.13 ounces gold per ton, 38 million tons of oxide heap-leach ore averaging 0.028 ounces gold per ton, and 8.5 million tons of refractory ore averaging 0.174 ounces gold per ton. In addition, there is a geologic reserve in refractory material estimated at 1 million ounces of gold. It is currently estimated that 3 million ounces of gold will be recovered: 2 million ounces from oxide material and 1 million from refractory material. The deposit is still not completely defined and exploration drilling is ongoing. Start-up is anticipated the third quarter of 1990 with production projected at 100,000 ounces of gold per year. Announced mine life is 10 years and, when in full production, about 180 people will be employed.

The **Crofoot/Lewis mine**, operated by **Hycroft Resources & Development, Inc.**, produced 82,300 ounces of gold and 123,000 ounces of silver during 1989. This was 8 to 10 thousand ounces less than projected, due in part to an agreement reached in January with participants in the **Lewis mine** whereby ore from the two mines would be commingled and processed at the **Crofoot** facilities. As a result of this agreement the crushing facility at the Lewis mine was shut down and sold more quickly than had been anticipated. Leaching of existing pads at the Lewis mine will continue until about mid-1990. At the Crofoot mine conveyor belts and an automatic stacker are used to develop heaps. According to Hycroft there is a substantial savings utilizing this system. Hycroft announced that $1 million had been allocated for a deep exploration drilling program on the property. Drilling will begin around the current open pit at the Crofoot mine.

North Peak project (T32N,R43E), a joint venture between **Brican Resources** (20%), **Bow Valley Industries** (30%) and **Santa Fe Pacific Mining** (50%), has a $600,000 budget for 1990 and will continue to evaluate several gold discoveries made since 1987. By the end of 1989 ore-grade gold mineralization had been intersected in drill holes on four separate discovery sites: one in section 13 (called Lucky 13), one in section 7 (Cottonwood), one in section 33 (Mud Spring), and one in section 11. In section 11, in one bulldozer trench, a 120-foot-wide zone of gold mineralization was exposed which assayed 0.12 ounces gold per ton. In December two drill holes near this trench intersected gold mineralization: hole 2 intersected 30 feet of 0.12 ounces gold per ton, and hole 4 intersected 95 feet of 0.06 ounces gold per ton. In 1990 exploration will continue to test known gold occurrences as well as try to find new areas of gold mineralization.

Lucky Eagle Mines, an exploration company jointly owned and operated by **Agnico-Eagle Mines** and **Hecla Mining**, completed a first phase drilling program on its **Trout Creek** project. The property (sec. 32,T33N,R43E) lies about 3 miles south of the **Marigold mine**. The discovery was made in 1988 and 152 reverse circulation drill holes had been completed by the end of 1989. Results indicate a disseminated gold deposit about 1,500 feet long and 500 feet wide with mineralization occurring 200 to 400 feet below the surface. Work to determine if a viable ore deposit exists is in progress. Indicated reserves at the end of 1989 were approximately 50,000 ounces of gold.

Lander County

Battle Mountain Gold Co. earnings in 1989 were down 56% from 1988. This was due in part to a drop in the price of gold. In 1989 the company realized $386 per ounce of gold compared to $447 in 1988. Gold production in 1989 was 254,507 ounces, up from the 243,000 ounces produced in 1988. Silver production was 301,272 ounces, down from the 693,000 ounces produced in 1988. Direct cash production costs in 1989 were $132 per ounce of gold. Approximately 85% of the production came from the **Fortitude mine** and the remainder from the **Surprise mine**. Reserves at the Fortitude mine are expected to be exhausted in 1994. **Canyon Placer** had minimal production in 1989 because of persistent materials problems. Battle Mountain Gold Co. expects to begin heap-leaching the **Labrador** satellite gold deposit in 1990. This deposit, near the Surprise deposit, is expected to produce 8,000 ounces of gold in 1990 and 16,000 ounces of gold in 1991.

Continuing exploration in 1989 at the 50-square-mile site resulted in discovery of the **Reona** deposit just south of the Fortitude mine. Drilling is ongoing in this area. At the end of 1989 Battle Mountain Gold's Fortitude, Surprise, and satellite deposits combined proven and probable ore reserves were nearly 6.7 million tons grading 0.13 ounces of gold per ton and containing 3.15 million ounces of silver. Canyon Placer had reserves of 48.4 million cubic yards, containing 245,000 ounces of gold.

The company reached a milestone by pouring its one millionth ounce of gold in the first quarter of 1989 from the Fortitude mine and its satellite gold deposits. Operations began here in January 1985.

The **Robertson mine**, wholly owned by **Coral Gold**, had many problems during the year. The heap-leach operation encountered higher stripping ratios than expected, lower grades, and various operating problems which resulted in the suspension of mining

operations during the year. The mine, which was expected to produce 40,000 ounces of gold in 1989, produced only about 3,700 ounces. At the end of the year Coral announced that it had signed a letter of intent with **Amax Gold, Inc.** to explore and develop the property. Amax will be the project operator and can acquire up to a 60% interest by funding a four-phase exploration/development program budgeted at $10.5 million. They plan to concentrate on a deep drilling program with the hope of finding rich sulfide mineralization during the first phase. Target depths for this work are 2,500 feet. A secondary effort will be to resume operation of the open-pit/heap-leach facility. At the beginning of 1989 the property consisted of 8,000 acres but Coral obtained an additional 3,000 acres during the year.

U.S. Precious Metals, Inc. (50%) and **Ruskin Developments, Ltd.** (50%) sold their 100% interest in the **Hilltop** property (~sec. 4,T29N,R46E) to **Placer Dome U.S., Inc.** for $2.6 million. The 2,000-acre property is reported to have a geologic resource of 10.5 million tons grading 0.073 ounces of gold per ton, plus considerable potential for additional mineralization.

The **Kingston** underground gold mine, owned and operated by **Nevada Goldfield Corp.**, produced 25,131 ounces of gold at a production cost of $343 per ounce during the fiscal year that ended June 30, 1989. The mill-head grade for the year averaged 0.145 ounces of gold per ton. In August 1989 the mine was placed on standby. Underground exploration has been unsuccessful and projected ore reserves for fiscal 1989-90, when exposed, lacked continuity and were lower grade than was expected.

Echo Bay Mines reduced proven and probable reserves at the **McCoy/Cove mine** by 11% because of perceived contamination in their reverse-circulation drilling program. They also announced a decrease in additional geologic resources of 3.5 million ounces. At the end of 1989, proven and probable reserves were listed at 2.89 million ounces of gold and 128 million ounces of silver, and additional geologic resources were listed at 1.56 million ounces of gold. Despite this reduction in reserves, the property still has at least a 12-year mine life based on current production levels. Production in 1989 was 215,000 ounces of gold and 2.26 million ounces of silver.

A major expansion program was completed by mid-year with start-up of the oxide circuit in the new mill. The capacity was originally planned at 5,000 tons per day, but was increased to 7,500 tons per day during the construction period. By the end of July the mill was operating above design capacity and obtaining recovery rates of 88% for gold and 50% for silver.

Water problems encountered during the driving of the underground ramp at Cove slowed the completion of the ramp to the first-stage mining level of 600 feet below the surface. Water flow at the face of the decline reached 1,800 gallons per minute and an appropriate pumping/water handling system had to be installed. This ramp will eventually extend 1,200 feet below the planned 1,100 foot bottom of the open pit. This ramp level is to be completed sometime in 1990. Underground development will be by room-and-pillar methods with a production rate of 700 to 1,000 tons per day. Mining from the 600-foot level of the ramp will begin in 1990. The projected costs for the current expansion and development projects at the mine complex are up to $220 million.

A ramp is also being driven underneath the McCoy pit. Water problems here are much less serious than at Cove. This ramp will be used for diamond drill stations for underground exploration and to mine a 34,000-ton orebody which averages over 1.0 ounce of gold per ton.

Projected cash production costs for 1989 were $230 per ounce of gold and Echo Bay's averaged realized gold price was $400 per ounce in 1989, down from the $440 received in 1988.

Reese River Resources, Inc. and **Santa Fe Mining** concluded a joint venture agreement to explore approximately 26 square miles around the McCoy district. This agreement enlarges Reese River's holdings to approximately 88 square miles. This land package virtually surrounds Echo Bay's McCoy/Cove mine complex. Reese River will earn a 50% interest in the joint venture by spending $900,000 over the next four years. Santa Fe contributed approximately 15 square miles to the joint venture and Reese River holdings make up the remainder. Other companies associated with Reese River include **BMR Gold** (25%) and **Coral Gold** (25%). Reese River completed approximately 15,000 feet of drilling during the year on land not associated with the joint venture with Santa Fe. Drilling tested geophysical anomalies and geologic features. Initial results from this work indicated anomalous gold along a northwest-trending structure located along strike from the Cove mine and a sulfide-rich gold system southeast of Echo Bay property. Exploration is continuing.

Lincoln County

PIC Prospectors International Corp. signed an agreement with **Toodoggone Gold, Inc.** whereby Toodoggone may acquire an 80% interest in PIC's wholly owned PAK property in the Atlanta district, by developing it to production. The property consists of 139 claims and adjoins the Atlanta mine property, a former open-pit gold producer. Initial geological and geochemical work outlined an area favorable for gold mineralization over a strike length in excess of 2 miles.

Lyon County

Horizon Gold Shares, Inc. wholly owned **Fire Angel** project is shaping up as a potential open-pit, oxide, heap-leach mine. Located approximately in the south half of T15N,R21E, drilling to the end of 1989 totaled 148 reverse circulation holes which have

indicated 5 distinct gold zones. Mineralization is predominately in volcanic tuffs and breccias associated with a caldera complex. Approximately 2 million tons appears favorable to support a shallow oxide, open-pit, heap-leach operation.

The **Talapoosa** property (~sec. 3,T18N,R24E), controlled by **Athena Gold Corp.** underwent a reassay program in 1989. It involved 50 drill holes and 5,000 assays. Results of this program increased the geologic resource by 2.7 million tons grading 0.054 ounces of gold and 0.654 ounces of silver per ton.

The property consists of 9,500 acres and by the end of 1989, 256 holes, amounting to 72,000 feet, had been drilled by Athena and prior property owners: **Homestake Mining** (1977–78), **Superior Oil** (1978), and **Kennecott** (1981). Late 1988 and early 1989 exploration focused on three contiguous areas within the property: the near surface **Main Zone**; the **Extension Zone**, which is somewhat deeper than the Main Zone and directly adjacent to it on the south; and the **Bear Creek Zone**, at similar depths to the Extension Zone and adjacent to it on the south. Drilling in early 1989 showed that all three zones form one single large deposit that could be developed by one large open pit. It is expected that ongoing drilling in the Extension Zone and Bear Creek Zone will increase existing ore reserves.

At the end of 1989 Athena announced that it had entered into an agreement with **Placer Dome U.S.** which could lead to a joint venture between the two companies. If a joint venture were formed then Placer would have the option to earn up to a 51% interest in the property.

The **MacArthur** property (SE corner, T14N,R24E), an old **Anaconda** copper prospect, was purchased by **Timberline Minerals** in 1985. In 1988 **Bateman Engineers, Inc.** was commissioned to conduct metallurgical studies on the 6,000-acre property and prepare a feasibility report. Ore reserves are stated to be 44 million tons grading 0.3% copper. Timberline Minerals plans to process 1.5 million tons per year, producing approximately 8 to 10 million pounds of copper per year. Capital costs are projected to be $6 to $8 million and production costs are projected at less than 60 cents per pound of copper produced. Mine life expectancy is 13 years. It will be a heap-leach operation and mining will be by conventional open-pit methods. Processing will utilize solvent extraction and electrowinning (SX-EW). The product will be 99.99% pure copper. Permitting of the operation is expected to be completed in the first quarter of 1990.

Arimetco, Inc. (The Arizona Metals Co.) purchased the old **Anaconda** copper property in Yerington from a businessman there who purchased the property from **ARCO**. During the first phase of operations, plans call for production of 25,000 pounds per day of high-grade cathode copper using SX-EW. Estimated cost for this phase is $3 million. The company controls approximately 9,000 acres. Mining began in July 1989 and cathode copper was being produced by October. Total 1989 production from the Copper Tek mine, as it is now known, was 375,000 pounds of copper. During the second phase of operations an additional $4.5 million will be spent and a second SW-EW plant will be built to produce 35,000 pounds per day of cathode copper. Material for this phase will come from an 80-million-ton stockpile of vat-leach tailings that contain 0.2% copper. Calculated reserves are 400 million pounds of recoverable copper, 85% of which is already mined. Current life expectancy of the operation is 14 years and overall production costs for both phases of operation is expected to average about 57 cents per pound of produced copper.

Mineral County

The **Aurora mine**, controlled by **Nevada Goldfields Corp.**, produced 12,683 ounces of gold and 16,400 ounces of silver during fiscal year ending in June 1989. Direct operating costs were $233 per ounce of gold or gold equivalent produced. For the year, the mill processed in excess of 80,000 tons of ore having an average head grade of 0.174 ounces of gold per ton. The recovery rate was 93%. Most of the ore (96%) came from the Prospectus open pit. The Prospectus underground deposit was expected to greatly enhance 1989 gold production but failed to do so. Ore grade was as high as expected but the extent of the mineralization was less than expected. A large fault zone also hindered mining in this area but in places grades of 0.38 ounces gold per ton over widths of 13 feet were encountered. Drilling during the year in the area of the Juanita deposit confirmed additional open-pit ore in an offset extension of this deposit. Ore grades averaging 0.38 ounces gold over 10 feet, 0.17 ounces gold over 15 feet, 0.43 ounces gold over 20 feet, and 0.19 ounces gold over 30 feet were encountered. Production for fiscal year 1990 will come from the Prospectus open pit, the Prospectus underground mine, and the newly drilled Juanita offset.

The **Borealis mine**, owned by **Echo Bay Minerals Co.**, produced 89,000 ounces of gold and 37,000 ounces of silver in 1989. The Freedom Flats orebody was mined out by mid-year but mining continued at Northeast Ridge with some additional reserves being confirmed in the immediate area. Even so, known reserves were expected to be mined out by March 1990. Several small pits have been mined since 1981 on the 35,000-acre property. An exploration program is ongoing with minimal success. One area of interest is a sulfide zone lying beneath the Freedom Flats open pit. If economic, this material would require milling.

The **Candelaria mine**, owned and operated by **NERCO Minerals Co.**, poured its 20 millionth ounce of silver in February 1990. The mine came onstream in 1979 and was one of the first large-scale heap-leaching operations to recover silver in North America. NERCO acquired the mine from Occidental Petroleum Corp. in 1983 and has mined more than 20 million tons of ore since then. In 1989 the mine set a record by producing 4.36 million ounces of

silver and 13,800 ounces of gold. This was a 40% increase in silver and a 17.5% increase in gold production over 1988. Since acquiring the mine, NERCO has added 39.4 million ounces of silver and 140,000 ounces of gold to its recoverable reserves.

Kennecott Corp. (Division of **RTZ Corp.**) announced that construction began at its 51% owned **Denton-Rawhide** gold property (secs. 1-6,T13N,R31-32E) with production scheduled for mid-1990. **Kiewit Mining Group, Inc.** will earn a 49% net profit interest by providing construction and capital required to bring the property into production. For the first 5 years of the mine's projected 15-year life, gold production will be about 80,000 ounces per year and silver production will be about 315,000 ounces per year. Ore reserves are 29.4 million tons grading 0.040 ounces of gold and 0.368 ounces of silver per ton. Estimated costs to bring the property into production are $18.3 million.

Nye County

The **Bullfrog mine** owned and operated by **Bond International Gold, Inc.** (BIG) began operation in September 1989 and produced 50,000 ounces of gold and 41,000 ounces of silver by the end of the year. Cash production costs averaged 313 per ounce of gold produced. Yearly production is expected to be about 239,000 ounces of gold. At the time production began, proven and probable reserves were 18.6 million tons grading 0.097 ounces of gold per ton. Current life expectancy of the mine is 5 to 7 years. In November **LAC Minerals Ltd.** acquired 65% of BIG from **Dallhold Investments Pty. Ltd.** and **Bell Resources Ltd.** for $373.8 million. In December BIG announced a joint venture with **Sunshine Mining Co.** on 18,000 acres Sunshine controls adjacent to the Bullfrog mine. BIG will spend $2 million on exploration over 30 months to earn a 60% interest in the joint venture.

The **Mother Lode mine**, a joint venture of **U.S. Precious Metals** (40%), **GEXA Gold Corp.** (40%), and **Degerstrom** (20%), began production in November and produced 1,000 ounces of gold by year-end. Production is projected at 25,000 ounces of gold per year for the next two years. At the time of start-up, reserves were 4.9 million tons grading 0.054 ounces of gold per ton, 1.2 million tons of which is oxide ore and constitutes current production ore reserves. Approximately 2,000 feet southeast of the Mother Lode deposit is another mineralized zone called the **SNA** (Sunday Night Anomaly) deposit. Drill-indicated reserves here are 1.8 million tons grading 0.048 ounces of gold per ton. This deposit has not been fully delineated.

The **Paradise Peak mine**, owned and operated by **FMC Gold Co.**, produced 228,000 ounces of gold and 5.2 million ounces of silver in 1989. FMC is developing the **Ketchup Flat** deposit which lies southeast of the current mine area. It is expected to

Ward Mountain mine. *Alta Gold Co. photo.*

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be in production by the end of 1990. Announced proven and probable reserves at Ketchup Flat are 300,000 ounces of gold and 3.1 million ounces of silver.

The **Round Mountain mine** (Smoky Valley Common Operation) completed a two-year expansion program in 1989 which doubled its tonnage capacity and increased gold production to 386,227 ounces for the year. Silver production for the year was 211,297 ounces. A new zone of gold mineralization was discovered along the proposed southeast boundary of the open pit. Named "Masada," the zone has yet to be fully delineated but consists of free gold in unoxidized host rock.

Pershing County

Pershing Gold and **Black Rock Nevada Mines, Ltd.** have a 50-50 joint venture agreement to explore for gold on the 22,000 acre **Barrel Springs** property (~sec. 33,T34N,R29E). In 1989 ten holes, totaling approximately 3,500 feet, were drilled in the Constants Pit area. No ore-grade mineralization was found but all holes were anomalous in gold, silver, mercury, and antimony. Geologic mapping and prospecting were also carried out in the Red Canyon area of the property. Many jasperoid boulders were found and assays of samples collected from them had gold values up to 0.05 ounces per ton with average values running 0.015 ounces of gold per ton. Widespread placer gold was also found in alluvial material associated with Red Canyon. In December an airborne electromagnetic survey was completed over the property. It identified several anomalies, including a large anomaly in the Red Canyon area. This anomaly is interpreted to be associated with a large epithermal alteration system buried beneath pediment gravels. A 6,000-foot drill program is planned for 1990 to test this geophysical anomaly, as well as drilling in Number 7 Canyon, Tyree Site, and continued drilling in the Constants Pit area.

The **Rochester silver-gold mine**, owned and operated by **Coeur d'Alene Mines Corp.**, is Nevada's second largest primary heap-leach producer of silver. In 1989 the mine produced 4.6 million ounces of silver, down from the 5 million ounces produced in 1988. The mine also produced 76,000 ounces of gold, an increase over the 52,000 ounces produced in 1988. On an annual basis, about 6 million tons of ore are mined having a grade of 1.50 ounces of silver and 0.011 ounces of gold per ton. In the approximately three years that the mine has been in operation, it has yielded more than 10 million ounces of silver, 1.1 million ounces more than the district's entire recorded silver production from 1912 to 1966 (prior production life). Over the 13-year life of the present mine plan, Rochester is expected to yield about 60 million ounces of silver and about 765,000 ounces of gold. This will be more than seven times the total recorded silver production and more than nine times the total recorded gold production for the district (prior to the current mining operation).

Drilling on **Equinox Resources' Rosebud** property (~sec. 13,T34N,R29E) by **LAC Minerals** has intercepted interesting gold values. Some of these are:

Width (ft)	*Gold (oz/t)*	*Silver (oz/t)*
18	0.114	1.90
71	0.238	8.18
20	0.271	13.18
9	1.090	28.88
10	0.300	2.77
41	0.120	1.97
35	0.259	2.05
10	0.726	5.54

Mineralization is not oxidized and therefore not amenable to heap-leaching. LAC can earn a 51% interest in the property by spending $700,00 on exploration and by making cash payments. Drilling is ongoing.

Star Valley Gold Corp. acquired an option to earn a 60% interest in the **Tag mine/Wildcat** gold prospect (~sec. 20,T31N,R29E). In 1989 Star Valley was required to spend $100,000 and also fund 100% of project expenditures up to $1.5 million prior to the end of 1993. The property consists of 64 lode claims and 128 mill-site claims and has had some previous production from a number of underground workings developed on high-angle structures. Previous drilling, consisting of 33 holes totaling approximately 6,700 feet, encountered a number of mineralized zones and defined a mineral reserve of 1.5 million tons grading 0.043 ounces of gold per ton. Mineralization occurs in Tertiary volcanic rocks. Work is continuing.

Since 1986, the **Bunce** property (~sec. 6,T27N,R29E), controlled by **Noramex Minerals Inc.**, has undergone several stages of geochemical sampling, trenching, and drilling. In 1989 Noramex acquired additional land from Santa Fe Minerals and extended the mineralized gold zone an additional 1,600 feet. A resistivity anomaly is coincident with the mineralization and is interpreted to be caused by silicification associated with gold mineralization. Gold values of 50 ppb to 2,400 ppb from soil samples are also associated with this geophysical anomaly. Mineralized outcrops on the Santa Fe land contain up to 0.023 ounces of gold per ton. Combined strike length of the structure on the Bunce and Santa Fe ground is 2,600 feet. Detailed drilling has only been done on the Bunce property and covers only 500 feet of strike. A geologic, open-pit reserve of 600,000 tons grading 0.04 ounces of gold per ton has been outlined in this area. A new gold discovery, the **Santa Fe east zone**, was made during 1989. It lies 1,400 feet southeast of the Bunce deposit and rock samples collected from the zone have assayed up to 0.028 ounces of gold per ton. About mid-year **Annabel Gold Mines, Inc.** obtained an option to earn a 44% interest in the property by spending $200,000 on exploration by the end of September 1989 and underwriting 600,000 shares of Noramex at $0.55 per share.

Washoe County

The **Wind Mountain mine**, owned by **Amax Gold Inc.**, began commercial production in the second quarter of 1989 and by year-end had produced 30,900 ounces of gold and 335,000 ounces of silver. Direct cash costs to produce gold are given as $265 per ounce. The mine is a heap-leach operation and at start-up leach pads covered about 1.5 million square feet. The leach pad area was to be enlarged to 3 million square feet by early 1990.

White Pine County

The **Little Bald Mountain mine**, operated by **New Dynasty Mines, Inc.** (43% interest), began its third year as an underground mine utilizing heap-leach recovery methods. Approximately 78,000 tons of ore having a grade of 0.14 ounces of gold per ton were to be mined in 1989. Actual reported production amounted to 5,500 ounces of gold and 1,500 ounces of silver. The **Gator** deposit, located 10 miles to the south, was explored by 14,000 feet of rotary drilling. This work was done by the **WX Syndicate**, 43% owner of the Little Bald Mountain mine. Drill-indicated reserves amount to 617,000 tons grading 0.05 ounces of gold per ton.

The **Robinson** project, operated by **Alta Gold Co.**, produced 78,828 ounces of gold and 66,340 ounces of silver in 1989. Direct cash costs to produce an ounce of gold were around $177 per ounce. A new leach pad was placed in operation during the second quarter of the year and a third pad was being constructed at the **Ada** deposit. At the end of the year **Kennecott Corp.** (name revived after **RTZ Corp.** acquired **B.P.**'s international mineral assets) granted an option to the **Alta Bay** joint venture (60% Alta Gold, 40% **Echo Bay Mines, Ltd.**) to purchase the 14,000-acre property for $16.5 million.

The **Ward Mountain** zinc-copper-lead-silver mine (NE quarter,T14N,R63E), owned and operated by **Alta Gold Co.** (merger of **Silver King Mines** and **Pacific Silver Corp.**) began operations by mining and stockpiling ore during the second quarter of 1989. Alta leased the mill at the **Taylor mine** from NERCO Minerals to process the ore. Conversion of the mill to process 1,000 tons per day was projected to be completed by year-end. Estimated costs to convert the mill to handle the Ward Mountain ore was $1.5 to $2 million. Current proven and probable ore reserves are enough for 5 years of operation with a possible additional reserve for another 5 years of operation. Allowing for dilution, the grade of ore is: 6.1% zinc, 1.1% copper, 1.1% lead, and 2.4 ounces of silver per ton. The property has been undergoing development for the past 5 years.

USMX, Inc. and **Pegasus Gold, Inc.** (owners of the **Green Springs mine**) announced at the beginning of the year that they had signed a letter of intent to merge whereby Pegasus would acquire the remaining 65% of USMX which it does not already own. In 1989 the Green Springs mine produced 30,000 ounces of gold (compared to 12,974 ounces produced in 1988) and approximately 5,000 ounces of silver. Because of forward selling, the average realized selling price in 1989 was $440 per ounce of gold produced, compared to the average market price of $382 based on the London PM fix. Direct cash operating costs were approximately $220 per ounce of gold produced. The mine is projected to produce 15,000 to 20,000 ounces of gold in 1990 before the current ore reserves are mined out.

Bulk-Mineable Precious-Metal Deposits

by Harold F. Bonham, Jr. and Ronald H. Hess

Fortitude gold mine at Copper Canyon. *Battle Mountain Gold Co. photo.*

The information in this compilation was obtained from the Nevada Department of Minerals and from published reports, articles in mining newsletters, and company annual reports and press releases. The Nevada Department of Minerals supplied most of the 1989 production data for the large mines. Locations of most of these deposits are shown on NBMG Map 91.

Deposit name	Reserves/resources	Production	Host rock	Mineralization age
CHURCHILL COUNTY				
Bell Mountain	1989: *reserves*—30,000 oz Au, 125,000 oz Ag	no production	rhyolitic tuff	Miocene
Dixie Comstock	1989: 4 million tons, 0.047 oz Au/ton	1989: development	Tertiary rhyolite	
Fondaway Canyon	1988: 400,000 tons, 0.06 oz Au/ton	1989: 1,065 oz Au, 87 oz Ag	Triassic slate and phyllite	Cretaceous
ELKO COUNTY				
Big Springs (Sammy Creek)	1989: 1.55 million tons, 0.172 oz Au/ton	1987–88: ~106,000 oz Au 1989: 60,376 oz Au, 4.416 oz Ag	Mississippian to Permian overlap assemblage	Cretaceous or Tertiary
Bootstrap/ Capstone	1989: *geologic resource*—25 million tons, 0.039 oz Au/ton	1988–89: NGO	dacitic dikes, Paleozoic siltstone and laminated limestone/ chert	~37 Ma

NGO: Newmont Gold Operations (Bootstrap/Capstone, Blue Star, Genesis, and Gold Quarry mines) reported 895,500 oz Au produced in 1988 and 1,467,800 oz Au and 117,400 oz Ag produced in 1989.

continued

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BULK-MINEABLE PRECIOUS-METAL DEPOSITS (continued)

Deposit name	Reserves/resources	Production	Host rock	Mineralization age
ELKO COUNTY (continued)				
Burns Basin	Reserves and production included in Jerritt Canyon figures		Roberts Mountains and Hanson Creek Formations	Cretaceous or Tertiary
Dee	1990: 4.5 million tons, 0.059 oz Au/ton	1987–88: ~97,000 oz Au 1989: 44,500 oz Au, 45,000 oz Ag	Vinini Formation Devonian carbonates, dacitic dikes	Cretaceous or Tertiary
Emigrant Springs	1989: 11.5 million tons, 0.024 oz Au½Ton	exploration	lower Paleozoic sedimentary rocks	Cretaceous or early Tertiary
Hollister (Ivanhoe)	1989: *oxide*—18.4 million tons, 0.035 oz Au/ton; estimated mineral inventory 83.5 million tons, 0.034 oz Au/ton, with 52.8 million tons of oxide and 30.7 million tons of sulfide	pre-production, exploration	rhyolitic tuff, flows, volcaniclastic rocks	Miocene
Jerritt Canyon	1989: 21.6 million tons, 0.143 oz Au/ton mill ore; 6.5 million tons, 0.043 oz Au/ton leachable; new discovery south of current mine has a geologic resource of 21 million tons, 0.228 oz Au/ton	1981–88: ~2.0 million oz Au 1989: 296,927 oz Au	Hanson Creek and Roberts Mountains Formations	Cretaceous or Tertiary
Kinsley Mountain	1988: 2.6 million tons, 0.046 oz Au/ton	pre-production	upper Paleozoic carbonate rocks	Oligocene?
Rain	1989: *geologic resource*—22.6 million tons, 0.052 oz Au/ton	1988: 29,000 oz Au	Webb Formation	36–37 Ma
Saval Canyon	1988: 237,000 oz Au	evaluation	lower Paleozoic carbonate rocks	Cretaceous or Tertiary
Trout Creek	1988: 1.5 million tons, 0.04 Au/ton	1988: exploration	lower Paleozoic	Cretaceous or Tertiary
Tuscarora (Dexter)	1987: 2 million tons, 0.039 oz Au and 1.9 oz Ag/ton 1988: 1.8 million tons, 0.037 oz Au/ton, 0.74 oz Ag/ton	1896–1902: 29,940 oz Au, 28,543 oz Ag 1987: 5,000 oz Au, 70,000 oz Ag 1988: 14,000 oz Au, 60,000 oz Ag 1989: 13,932 oz Au, 13,026 oz Ag	Eocene rhyolitic ignimbrite and andesite	38 Ma
Winters Creek	1986: 1.4 million tons, 0.146 oz Au/ton	evaluation, exploration	lower Paleozoic carbonate rocks	Cretaceous or Tertiary
Wood Gulch	1988: 500,000 tons, 0.098 oz Au and 0.4 oz Ag/ton	1989: 19,810 oz Au, 31,122 oz Ag	lower Paleozoic sedimentary rocks, andesite-dacite dikes and sills	Cretaceous or Tertiary
Wright Window	1986: 1.3 million tons, 0.095 oz Au/ton	evaluation, exploration	lower Paleozoic carbonate rocks	Cretaceous or Tertiary
ESMERALDA COUNTY				
Boss	1987: 500,000 tons, 0.07 oz Au/ton	1989: W	Ordovician sedimentary rocks	Miocene?
Divide	1988: 500,000 tons, 0.04 oz Au and 0.40 oz Ag/ton	evaluation	Miocene silicic tuff	16 Ma
Goldfield	1983: 1.75 million tons, 0.087 oz Au/ton	1903–45: 4.19 million oz Au, 1.45 million oz Ag 1989: 1,987 oz Au, 200 oz Ag	andesite, rhyodacite, rhyolite	21 Ma
Hasbrouck	1986: 12.9 million tons, 0.0291 oz Au and 0.59 oz Ag/ton	exploration	Siebert Formation tuff and volcaniclastic rocks	16 Ma
Weepah	1986: 200,000 tons, 0.1 oz Au and 0.4 oz Ag/ton	1986–87: 58,000 oz Au 1988–89: idle	Wyman Formation	Cretaceous

W: withheld

NGO: Newmont Gold Operations (Bootstrap/Capstone, Blue Star, Genesis, and Gold Quarry mines) reported 895,500 oz Au produced in 1988 and 1,467,800 oz Au and 117,400 oz Ag produced in 1989.

BULK-MINEABLE PRECIOUS-METAL DEPOSITS (continued)

Deposit name	Reserves/resources	Production	Host rock	Mineralization age
EUREKA COUNTY				
Blue Star	1987: 1.95 million tons, 0.066 oz Au/ton 1988: *geologic resource*—22.8 million tons, 0.029 oz Au/ton	1974–84: intermittent 1988–89: NGO	lower Paleozoic sandy siltstone and carbonate rocks, granodiorite	37.5 Ma
Bobcat	1988: *geologic resource*—17.6 million tons, 0.029 oz Au/ton		lower Paleozoic rocks	Cretaceous or Eocene
Buckhorn	1990: 700,000 tons, 0.05 oz Au/ton; *geologic resource*—200,350 oz Au	1988: 28,730 oz Au, 151,832 oz Ag 1989: 28,892 oz Au, 86,155 oz Ag	basaltic andesite, sinter, silicified sedimentary rocks	14.6 Ma
Bullion Monarch	1987: 1 million tons, 0.10 oz Au/ton	exploration, evaluation	lower Paleozoic sedimentary rocks	Tertiary or Mesozoic
Carlin	1989: *geologic resource*—20.8 million tons, 0.029 Au/ton	1965–84: 4.3 million oz Au 1988: 25,320 oz Au 1989: idle	Roberts Mountains Formation	~37 Ma
Genesis	1989: *geologic resource*—33.3 million tons, 0.045 oz Au/ton	1986: production commenced 1988–89: NGO	Ordovician-Devonian limestone, argillite chert	36–37 Ma
Gnome	1988: 2.7 million tons, 0.048 oz Au/ton	exploration	Paleozoic sedimentary rocks	Cretaceous or early Tertiary
Gold Bar	1988: 2.75 million tons, 0.10 oz Au/ton 1989: *geologic resource*—1.45 million oz Au	1987–88: 91,000 oz Au 1989: 66,000 oz Au	Devonian Nevada Formation	Eocene
Gold Pick	1988: 10 million tons, 0.06 oz Au/ton	exploration	Paleozoic sedimentary rocks	Eocene
Gold Quarry	1987: 197.8 million tons, 0.042 oz Au/ton 1988: *geologic resource*—503 million tons, 0.04 oz Au/ton	1985: 170,000 oz Au 1988–89: NGO	Ordovidian to Devonian chert, shale, siltstone, and impure carbonates, in part, Vinini Formation	30–38 Ma
Gold Ridge	1988: 4 million tons, 0.06 oz Au/ton	exploration, evaluation	Paleozoic sedimentary rocks	
Goldstone	1988: 1.7 million tons, 0.08 oz Au/ton	exploration, evaluation	Paleozoic sedimentary rocks	
Goldstrike (Betze, Post)	1988: 128.4 million tons, 0.095 oz Au/ton 1989: 18.4 million oz Au	1980–88: 440,000 oz Au 1989: 207,264 oz Au, 15,500 oz Ag	Ordovician to Devonian chert, shale, siltstone, and impure carbonates, in part, Vinini Formation	36–37 Ma
Horse Canyon	1984: 3.94 million tons, 0.055 oz Au/ton 1988: included in Gold Acres figures	1984: 40,000 oz Au 1988–89: included with Gold Acres	Vinini Formation, Wenban Limestone	34 Ma?
Lantern	1988: *geologic resource*—15.45 million tons, 0.028 oz Au/ton	exploration	lower Paleozoic sedimentary rocks	Cretaceous or early Tertiary
Maggie Creek	1988: *geologic resource*—303,000 tons, 0.092 oz Au/ton	1984: 1,250,000 tons 1986: intermittent production 1988: no production reported	Ordovician to Devonian siltstone, chert, sandstone, impure limestone	Cretaceous or early Tertiary
North Star	1989: *geologic resource*—6.9 milion tons, 0.052 oz Au/ton	1988: 4,250 oz Au	lower Paleozoic sedimentary rocks	Eocene or Oligocene
Pete	1988: *geologic resource*—15.7 million tons, 0.030 oz Au/ton	exploration	Roberts Mountains Formation	36–37 Ma
Post/Deep Post	Newmont Gold Co. holdings only— 1988: *geologic resource*—196 million tons, 0.062 oz Au/ton	1988: 4,930 oz Au	Vinini Formation lower Paleozoic carbonate rocks	36–37 Ma
Project Glister		1989: 8,450 oz Au, 23,519 oz Ag		
Ratto Canyon	1984: ~200,000 oz Au	exploration	Dunderberg Shale, Hamburg Dolomite	Oligocene
Tonkin Springs	1987: *oxide*—1.5 million tons, 0.05 oz Au/ton; *sulfide*—2.5 million tons, 0.09 oz Au/ton	1987: ~9,700 oz Au 1988: 565 oz Au 1989: 1,753 oz Au, 1,402 oz Ag	Vinini Formation, dacitic dikes	Oligocene?
Tusc	1988: *geologic resource*—15.8 million tons, 0.059 oz Au/ton	exploration	lower Paleozoic sedimentary rocks	Eocene or Oligocene
Windfall	3 million tons, 0.03 oz Au/ton	1908–16: 24,000 oz Au 1975–84: 90,000 oz Au 1988: 6,380 oz Au, 59 oz Ag	Hamburg Dolomite	Eocene or Oligocene

NGO: Newmont Gold Operations (Bootstrap/Capstone, Blue Star, Genesis, and Gold Quarry mines) reported 895,500 oz Au produced in 1988 and 1,467,800 oz Au and 117,400 oz Ag produced in 1989.

continued

BULK-MINEABLE PRECIOUS-METAL DEPOSITS (continued)

Deposit name	Reserves/resources	Production	Host rock	Mineralization age
HUMBOLDT COUNTY				
Adelaide Crown	1989: *south pit*—585,000 tons, 1.313 oz Ag and 0.043 oz Au/ton; *additional area*—165,000 tons, 0.015 oz Au/ton	pre-production	Preble Formation	Tertiary
Ashdown	1988: 1 million tons, 0.11 oz Au/ton	exploration	Mesozoic granitic rocks	Mesozoic
Chimney Creek	1988: *proven, probable*—26.9 million tons, 0.068 oz Au/ton; *inferred in south pit*—2.1 million oz Au 1989: *geologic resource*—4.6 million oz Au	1987–88: 300,000 oz Au 1989: 222,556 oz Au, 55,953 oz Ag	upper Paleozoic sedimentary rocks	~90 Ma
Crofoot	1988: 25 million tons, 0.025 oz Au/ton	1988: 60,000 oz Au 1989: 82,000 oz Au, 123,000 oz Ag (includes Lewis)	Camel conglomerate, rhyolite dikes	1–2 Ma
Getchell	1989: 8.1 million tons, 0.154 oz Au/ton mill grade and 1.43 million tons, 0.049 Au/ton heap-leach ore; *additional geologic resource*—5.7 million tons, 0.092 oz Au/ton sulfide and 2.6 million tons, 0.055 oz Au/ton oxide	1938–50, 1962–67: 788,875 oz Au 1987: ~15,000 oz Au 1988: ~20,000 oz Au 1989: 120,730 oz Au, 9.407 oz Ag	Comus and Preble Formations, granodiorite dikes, granodiorite	90 Ma
Lewis	1984: 10 million tons, 0.04 oz Au/ton 1987: 9 million tons, 0.032 oz Au/ton	1984: 3,500 tons/day 1987: ~8,800 oz Au 1988: 15,800 oz Au 1989: included with Crofoot	Camel conglomerate rhyolite dikes	1–2 Ma
Marigold	1990: 12.1 million tons, 0.055 oz Au/ton	1989: 16,000 oz Au, 484 oz Ag	Paleozoic chert, argillite, and carbonate	Tertiary?
Pinson	1989: 480,000 oz Au	1980:56,000 oz Au 1986–88: 189,864 oz Au 1989: 72,489 oz Au (includes Preble)	Comus Formation	90 Ma
Preble	1989: 624,000 tons, 0.052 oz Au/ton	1985: 17,000 oz Au 1987: 28,000 oz Au 1988: 18,828 oz Au 1989: included with Pinson	Preble Formation	90 Ma?
Rabbit Creek	1989: 4.1 million oz Au; *additional geologic resource*—1 million Au in refractory material	pre-production	Valmy Formation	Cretaceous?
Sleeper	1989: 1,975,000 oz Au	1986: 128,000 oz Au, 94,000 oz Ag 1987: 158,696 oz Au 1988: 230,410 oz Au 1989: 256,000 oz Au, 339,650 oz Ag	Miocene "latite" flows and dikes, silicic ash-flow tuff, Triassic slate and phyllite	5.9 Ma
Trout Creek	1989: 50,000 oz Au			
LANDER COUNTY				
Austin Gold Venture	1989: mined out	1986–88: 141,000 oz Au 1989: 50,000 oz Au	Antelope Valley Limestone	Cretaceous or Tertiary
Buffalo Valley	1988: 1.48 million tons, 0.05 oz Au/ton	1988: 9,238 oz Au 1989: 14,660 oz Au		Eocene?
Cortez	mined out	1968–82: 1.0 million oz Au	Roberts Mountains Formation	34 Ma
Fire Creek	1982: 350,000 tons, 0.06 oz Au/ton	1983–84: 767 oz Au	basaltic andesite	Miocene
Fortitude (Copper Canyon) (Battle Mtn.)	1989: *proven, probable*—6.7 million tons, 0.13 oz Au and 0.47 oz Ag/ton (includes Surprise and Labrador)	1986: 259,000 oz Au, 902,000 oz Ag 1987: 255,000 oz Au 1988: 243,000 oz Au, 675,000 oz Ag (includes production from Surprise) 1989: 254,507 oz Au, 301,272 oz Ag (includes Surprise)	Battle Formation, Antler Peak Limestone, Pumpernickel Formation	37 Ma
Gold Acres and Little Gold Acres	1987: 4.8 million tons, 0.105 oz Au/ton 1988: 5.4 million tons, 0.093 oz Au/ton	1942–84: 2.4 million tons, 0.13 oz Au/ton; 2 million tons, 0.041 oz Au/ton leached. *Little Gold Acres:* 800,000 tons, 0.124 oz Au/ton 1988: 42,322 oz Au (includes Horse Canyon) 1989: 39,993 oz Au, 12,234 oz Ag (includes Horse Canyon)	Roberts Mountains Formation, Wenban Limestone, Valmy Formation, quartz porphyry dikes	92.8–94 Ma and 36 Ma
Hilltop	1984: 10.5 million tons, 0.073 oz Au/ton	no production	Valmy Formation	Oligocene?

BULK-MINEABLE PRECIOUS-METAL DEPOSITS (continued)

Deposit name	Reserves/resources	Production	Host rock	Mineralization age
LANDER COUNTY (continued)				
McCoy/Cove	1989: *proven and probable reserves*—2.9 million oz Au, 128 million oz Ag	1986: 50,000 oz Au 1987: 200,000 oz Au, 5 million oz Ag 1988: 100,000 oz Au, 700,000 oz Ag 1989: 214,566 oz Au, 2,259,653 oz Ag	Panther Canyon Formation (conglomerate, sandstone), Augusta Mountain Formation (limestone), granodiorite	39.5 Ma
Robertson	1988: 11 million tons, 0.04 oz Au/ton	1989: 3,700 oz Au		
Surprise	1987: 225,000 oz Au 1988–89: production and reserves included in Fortitude figures	1987: 2,000 oz Au	skarn	37 Ma
Toiyabe	1988: 813,400 tons, 0.066 oz Au/ton	1988: 32,000 oz Au, 10,300 oz Ag 1989: W	lower Paleozoic calcareous siltstone	Eocene?
LINCOLN COUNTY				
Atlanta	1980: 1.1 million tons, 0.08 oz Au and 1.6 oz Ag/ton	1980: 88,000 oz Au, 1,710,000 oz Ag 1987–89: idle	Pogonip Group, Ely Springs and Laketown Dolomites, Oligocene silicic tuff, dacite dikes	early Miocene
Delamar	1988: 200,000 tons, 0.079 Au/ton	1988: exploration	Cambrian quartzite	Miocene
LYON COUNTY				
Fire Angel	1989: 2 million tons			
Talapoosa	1988: 2.5 million tons, 0.041 oz Au and 0.53 oz Ag/ton *oxide* 14.9 million tons, 0.03 oz Au and 0.49 oz Ag/ton *sulfide* 1989: *additional resources delineated*—2.7 million tons, 0.054 oz Au and 0.654 oz Ag/ton	pre-production	Kate Peak Formation	Miocene
MINERAL COUNTY				
Aurora mine	1989: 347,000 tons, 0.253 oz Au/ton	1989: 12,683 oz Au, 16,400 oz Au	andesite, rhyolite	10 Ma
Aurora Partnership	1983: 1.5 million tons, 0.129 oz Au 0.3 oz Ag/ton	1930s: 100,000 oz Au 1983: 10,000 oz Au 1988: 10,302 oz Au 1989: 27,825 oz Au, 26,000 oz Ag	andesite, rhyolite	10 Ma
Borealis	1988: 1.792 million tons, 0.046 oz Au/ton	1981–84: 170,000 oz Au 1986–88: 116,256 1989: 89,060 oz Au, 37,032 oz Ag	rhyolite flow dome, andesite flows, breccias, volcaniclastic rocks	5 Ma
Candelaria	1988: 24 million tons, 1.267 oz Ag and 0.011 oz Au/ton	1982: 1.7 million oz Ag, 9,000 oz Au 1987: total production was 10 million oz Ag as of June 1987 1988: 3.8 million oz Ag, 11,000 oz Au 1989: 4.36 million oz Ag, 13,800 oz Au	Candelaria Formation serpentinite, granitic dikes	Cretaceous
Denton-Rawhide	1989: *reserves*—29.4 million tons, 0.040 oz Au and 0.368 oz Ag/ton; *geologic resource*—59.3 million tons, 0.0274 oz Au and 0.298 oz Ag/ton	1989: W	rhyolite plugs, flows, tuffs, breccias	16 Ma
Mindora	1988: 1.04 million tons, 0.036 oz Au and 1.78 oz Ag/ton	1988: exploration		
Santa Fe	1990: 6.8 million tons, 0.035 oz Au and 0.241 oz Ag/ton	1989: 60,000 oz Au, 150,000 oz Ag	Luning Formation	Miocene
NYE COUNTY				
Bullfrog	1989: 18.6 million tons, 0.097 oz Au/ton	1989: 50,011 oz Au, 40,905 oz Ag	rhyolite ash-flow tuff	9.5 Ma
Cuervo (Sullivan)	1987: 10.2 million tons, 0.039 oz Au and 0.086 oz Ag/ton and 0.37% Cu 1988: *proven*—10.8 million tons, *probable*—2.7 million tons, 0.025 oz Au/ton	exploration	Mesozoic granodiorite	Mesozoic
Gold Bar	1987: 1.23 million tons Au ore	1989: W	silicic volcanic rocks	Miocene

W: withheld

continued

BULK-MINEABLE PRECIOUS-METAL DEPOSITS (continued)

Deposit name	Reserves/resources	Production	Host rock	Mineralization age
NYE COUNTY (continued)				
Ketchup Flat	1989: 300,000 oz Au, 3.1 million oz Ag	pre-production	Miocene volcanic rocks	Miocene
Manhattan	1988: 22.4 million tons, 0.021 oz Au/ton	1905–59: 500,000 oz Au 1983: 26,000–27,000 oz Au 1986: 3,000 tons/day 1987: 24,855 oz Au 1988: 4,752 oz Au 1989: 32,389 oz Au, 17,611 oz Ag	Gold Hill Formation	16 Ma
Montgomery Shoshone	1988: 3.1 million tons, 0.072 oz Au and 0.240 oz Ag/ton	1989: pre-production	rhyolitc ash-flow tuff	9.5 Ma
Mother Lode (includes Sunday Night Anomaly)	1989: *reserves, proven and probable*—4.9 million tons, 0.054 oz Au/ton, of which 1.8 million tons, 0.048 oz Au/ton are in the Sunday Night Anomaly	1989: 1,000 oz Au, 150 oz Ag	lower Paleozoic rocks, Tertiary dacite porphyry	14 Ma
Northumberland	1988: 12 million tons, 0.06 oz Au/ton	1939–42: 327,000 oz Au 1981–84: 950,000 tons/year 1988: 29,667 oz Au, 130,394 oz Ag 1989: W	Roberts Mountains and Hanson Creek Formations, granodiorite, tonalite, quartz porphyry dikes	85 Ma
Paradise Peak	1989: 5.22 million tons, 0.09 oz Au and 3.62 oz Ag/ton, mill ore; 11.52 million tons, 0.036 oz Au and 0.445 oz Ag/ton, leachable	1986–88: 560,000 oz Au, 8.5 million oz Ag 1989: 228,000 oz Au, 5.17 million oz Ag	rhyolite and andesite flows, ash-flow and air-fall tuffs	Miocene
Round Mountain (Smoky Valley)	1989: 271 million tons, 0.032 oz Au/ton	1977–84: 313,480 oz Au, 160,419 oz Ag 1984: 70,000 oz Au 1987: 190,600 oz Au 1988: 233,700 oz Au 1989: 386,227 oz Au, 211,297 oz Ag	rhyolite ignimbrite	25 Ma
Sterling	1989: 469,000 tons, 0.21 oz Au/ton	1983–88: 75,900 oz Au 1989: W	Wood Canyon and Bonanza King Formations	14 Ma
PERSHING COUNTY				
Bunce	1989: *geologic reserve*—600,000 tons, 0.04 oz Au/ton	exploration		
Florida Canyon	1988: 37 million tons, 0.023 oz Au/ton	1987–88: 109,300 oz Au 1989: 81,484 oz Au, 24,721 oz Ag	Grass Valley Formation	Cretaceous or Tertiary
Relief Canyon	1988: ~1.3 million tons, 0.03 oz Au/ton	1984: 24,500 oz Au 1987–88: 82,000 oz Au 1989: 30,266 oz Au, 32,835 oz Ag	Natchez Pass Limestone, Grass Valley Formation	Cretaceous
Rochester	1989: 94.5 million tons, 0.012 oz Au and 1.40 oz Ag/ton	1986–88: 13 million oz Ag, 122,400 oz Au 1989: 4.63 million oz Ag, 76,032 oz Au	Koipato Group, Weaver Rhyolite	Late Cretaceous
Standard	mined out	1932–51: 46,602 oz Au, 102,721 oz Ag	Natchez Pass Limestone, Grass Valley Formation	73 Ma
Tag-Wildcat	1989: 1.5 million tons, 0.043 oz Au/ton	1989: exploration	Tertiary volcanic rocks	Miocene
Trinity	1987: 1 million tons, 5.25 oz Ag/ton	1988: mining ended August 1988, heap-leaching continuing 1989: 718,714 oz Ag, 70 oz Au	rhyolite plugs	Miocene
Willard	1989: 3.61 million tons	1989: pre-production	Triassic siltstone	Cretaceous
STOREY COUNTY				
Flowery	1989: 1 million tons, 0.037 oz Au/ton	1988: 836 oz Au, 9,473 oz Ag 1989: W	Alta Formation	12 Ma
WASHOE COUNTY				
Western Hog Ranch	1988: *reserves, proven and probable*—5.5 million tons, 0.064 oz Au/ton; *geologic resource*—20.1 million tons, 0.029 oz Au/ton	1986: 50,000 oz Au 1988: 30,000 oz Au 1989: 25,000 oz Au, 4,000 oz Ag	rhyolite, explosion breccia, sinter	15–16 Ma
Wind Mountain	1988: 15 million tons, 0.021 oz Au and 0.42 oz Ag/ton	1989: 30,900 oz Au, 335,000 oz Ag	Tertiary sedimentary rocks	late Tertiary or Quaternary

W: withheld

BULK-MINEABLE PRECIOUS-METAL DEPOSITS (continued)

Deposit name	Reserves/resources	Production	Host rock	Mineralization age
WHITE PINE COUNTY				
Alligator Ridge	1989: 1 million tons, 0.064 oz Au/ton	1981–88: 560,000 oz Au, 70,000 oz Ag 1989: 54,057 oz Au, 10,188 oz Ag	Pilot Shale	Eocene
Bald Mountain (Top)	1989: 6.7 million tons, 0.069 oz Au/ton	1986: 50,000 oz Au 1988: 48,619 oz Au 1989: 55,112 oz Au	quartz porphyry, Cambrian shale and limestone	35–38 Ma
Casino/ Winrock	1989: **Casino**—804,000 tons, 0.054 oz Au/ton; **Winrock**—1.3 million tons, 0.037 oz Au/ton	1989: pre-production	late Paleozoic sedimentary rocks	Eocene
Easy Junior (Nighthawk Ridge)	1989: 5.68 million tons, 0.031 oz Au/ton	1989: W	Devonian and Mississippian rocks	Eocene
Golden Butte	1989: 4.23 million tons, 0.031 oz Au/ton	1989: 12,187 oz Au, 1,448 oz Ag	Chainman Shale	Cretaceous or Eocene
Green Springs	1988: 1.25 million tons, 0.06 oz Au/ton *additional possible resource*—500,000 tons, 0.036 Au/ton	1988: ~12,000 oz Au 1989: 30,000 oz Au, 5,000 oz Ag	Paleozoic sedimentary rocks	Eocene?
Illipah	1988: mined out	1987: ~25,000 oz Au/year 1988: 25,324 oz Au, mining ended 1989: 3,874 oz Au, heap-leached	Paleozoic sedimentary rocks	Eocene?
Little Bald Mtn.	1989: 200,000 tons, 0.13 oz Au/ton; *geologic resource*—260,000 tons, 0.127 oz Au/ton	1985–88: 21,700 oz Au 1989: 5,500 oz Au, 1,500 oz Ag	Antelope Valley Formation	Eocene
Mt. Hamilton	1988: 7.7 million tons, 0.05 oz Au and 0.5 oz Ag/ton	1988: pre-production	Dunderberg Shale	Cretaceous
Robinson	1989: 46.0 million tons, 0.019 oz/ton; *geologic resource*—1 million oz Au	1986: 48,000 oz Au, 96,000 oz Ag 1987: 50,207 oz Au 1988: 38,750 oz Au 1989: 78,828 oz Au, 66,340 oz Ag	Rib Hill Sandstone Riepe Spring Limestone	Cretaceous
Sunnyside	1988: 32,000 oz Au at 0.187 oz/ton gold equivalent			
Taylor	1980: 10 million tons, 3 oz Ag/ton	1980: 1,200 tons/day	Guilmette and Joana Limestones, rhyolite dikes	Eocene or Oligocene
White Pine	1988: 63,000 oz Au, 0.04 oz Au/ton	1989: 20,654 oz Au	Paleozoic sedimentary rocks	Oligocene?

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Industrial Minerals

by Stephen B. Castor

The total value of industrial minerals produced in Nevada in 1989 is estimated at $255 million, a substantial increase over 1988. Increases in production and dollar values of aggregate (sand, gravel, and crushed stone), clay, gypsum, lime, lithium carbonate, and silica in 1989 made up for decreases in fluorspar and magnesia. The most important Nevada industrial minerals produced in 1988, in order of estimated dollar value, were aggregate, diatomite, lithium carbonate, gypsum, cement, silica, clay, lime, barite, and magnesia. Data used for these estimates, and data reported for individual commodities below, were obtained from the U. S. Bureau of Mines, the Nevada Department of Minerals, the Mine Inspection Division of the Nevada Department of Industrial Relations, and individual producers of industrial minerals.

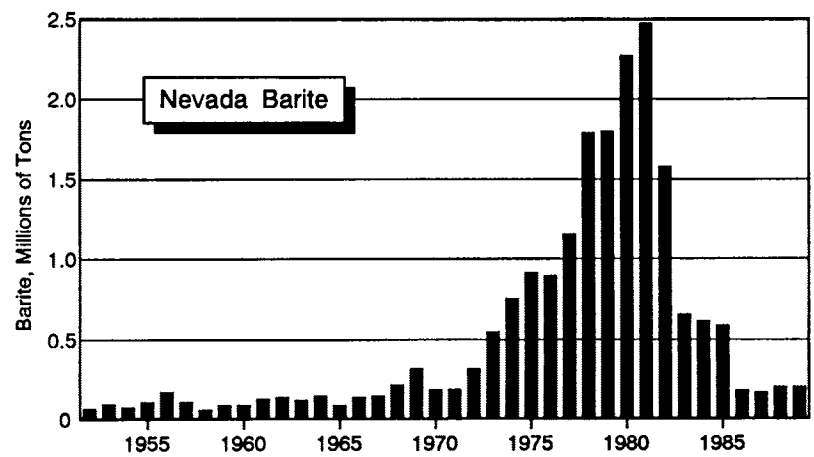
AGGREGATE (sand, gravel, and crushed stone). For 1989, Nevada's aggregate production is estimated at 20 million tons. The Las Vegas area accounted for more than half of this production even though some operations were closed between August 4 and November 10, 1989, due to concerns about impact on desert tortoise habitat. The booming Las Vegas construction industry spurred aggregate use despite substantial price increases.

Bonanza Materials, Inc., owned by **Gifford-Hill & Co.**, was the largest sand and gravel producer in Nevada in 1989 at more than 2 million tons. **Las Vegas Building Materials, Inc.**, which produced nearly as much as Bonanza in 1989, closed its Henderson sand and gravel operation at the end of the year and sold its ready mix plant to **Mitsubishi Corp.** In addition, Mitsubishi acquired the sand and gravel operations of **Nevada Ready Mix Corp.** and **Stocks Mill & Supply Co.** of Las Vegas. **CSR, Ltd.**, an Australian sugar company that has become the largest construction materials company in the world, is in the process of acquiring **WMK Transit Mix, Inc.**, an important Las Vegas aggregate, cement, and cement block producer, through its purchase of **ARC America**. Four other large producers in the Las Vegas area—**Las Vegas Paving Corp.**; **Wells Cargo, Inc.**; **Southern Nevada Paving**; and **Basic, Inc.**—produced more than 300,000 tons each in 1989. The Nevada Department of Industrial Relations reported 32 producers of aggregate for Clark County for 1989, up substantially from 24 producers reported for 1988.

The largest aggregate producer in the Reno-Sparks-Carson City area in 1989 was **Granite Construction Co.**, which produced a total of about 1 million tons of aggregate from its Patrick Pit east of Reno in Washoe County and its Gardnerville operation in Douglas County. The Patrick operation has sufficient reserves for only about a year's production, but further reserves in Storey County across the Truckee River from Patrick may be exploited by the company in the near future. In addition, the company is planning to begin production of high-quality crushed stone aggregate at a site on the north flank of Peavine Mountain northwest of Reno. Other large aggregate producers in the Reno-Sparks-Carson City area in 1989 were **Robert L. Helms Construction Co.**; **Paiute Pit Aggregates, Inc.**; **Sha-Neva, Inc.**; and **Eagle Valley Construction Co.**, each producing at least 300,000 tons.

Aggregate production in Nevada includes increasing amounts of lightweight aggregate that consists of cinders or crushed rhyolite. In the Reno-Sparks-Carson City area where lightweight accounts for more than 10% of the aggregate market, **Rilite Aggregate Co.**, **Naturalite Aggregate Corp.**, and **Allite Aggregate Co.** produce rhyolitic lightweight. In the Las Vegas area, where lightweight accounts for less than 2% of the aggregate market, **Southern Nevada Lightweight, Inc.** produces rhyolitic lightweight, and **Cind-R-Lite Co.** mines volcanic scoria from a cinder cone 100 miles north of Las Vegas for use in cement blocks.

BARITE. Nevada barite production in 1989 was 203,000 tons, about the same as in 1988. Production of barite in Nevada has fallen off precipitously



Annual production of barite in Nevada. Production figures are from the U.S. Bureau of Mines (1952–1987) and the Nevada Bureau of Mines and Geology (1988 and 1989).

since the early 1980s, with current production at less than 10% of the production peak in 1981.

Five Nevada barite producers were active in 1989. **N L Baroid, Inc.; M.I. Drilling Fluids; Milpark, Inc.;** and **Circle-A Construction** produced barite for use in drilling mud. Total shipments from these companies consisted of approximately equal amounts of milled product and crude barite. Production is anticipated to increase in 1990 because M. I. Drilling Fluids negotiated lower rail shipment costs in late 1989 and has contracted sales of at least 100,000 tons of crude barite in the Texas-Oklahoma market area.

Annual production of barite in Nevada. Production figures are from the U.S. Bureau of Mines (1952–1987) and the Nevada Bureau of Mines and Geology (1988 and 1989).

In 1989 the **Standard Magnesia Co.** mined barite in Nye County and upgraded it by flotation in Fallon and final processing in Bishop, California. The product is sold primarily to manufacturers of auto underbody paint in the upper Midwest. Although production accounts for less than 1% of Nevada's barite production in 1989, paint-grade barite brings a premium price. **Standard Industrial Minerals**, the parent company, plans to streamline barite production in 1990 by exercising more stringent grade control at the mine and eliminating the flotation step.

BORATES. In 1989, the **American Borate Co.** produced colemanite from mill tailings at its Amargosa Valley plant. The plant originally treated ore from nearby borate deposits in Death Valley, California, but Death Valley borate mining ceased in 1986. Because the colemanite was not mined in Nevada, borate was not included in the estimate of total value of Nevada industrial minerals.

CEMENT. The **Nevada Cement Co.** plant at Fernley, about 30 miles east of Reno, was the only producer of cement in Nevada in 1989. Annual production at this plant is about 400,000 tons. Raw materials are mined locally. Nevada Cement obtains Tertiary freshwater limestone from a deposit 5 miles south of Fernley and upgrades it, when necessary, with high-calcium marble mined 20 miles northwest of Fernley. Halloysite clay from a deposit 45 miles northwest and gypsum from 35 miles southwest of Fernley are both mined by **The Art Wilson Co.** for use by Nevada Cement.

Construction of the Las Vegas Cement, Inc. plant at Logandale in Clark County was not completed in 1989, and construction was not begun on a cement plant proposed by the **Great Star Cement Co.** northeast of Las Vegas.

CLAY. **IMV Division of Floridin Co.** is the largest producer of clay mineral products in Nevada. Production at this operation in Amargosa Valley, Nye County, increased about 30% over that in 1988. Organo-clad specialty clays accounted for less than 10% of production by weight, but made up about 70% of total revenues. The operation produces more than 20 different specialty and commodity clay products. Some organo-clad clay products sell at more than $2,500 per ton. In 1989, **Gulf Resources, Inc.**, sold IMV (Industrial Minerals Ventures) to Floridin's parent company, **U.S. Silica**, itself a twice-removed subsidiary of the giant **RTZ Corp.**

Vanderbilt Minerals Co. produced small but valuable amounts of montmorillonite used in pharmaceutical and cosmetic products from operations in Esmeralda, Nye, and Pershing Counties in 1989. The Nevada Department of Industrial Relations also reported montmorillonite mining by **Tuttle's Golden Minerals** from a deposit in Lyon County.

J. M. Huber Corp. of Georgia and **American Colloid Co.** of Illinois are attempting to develope separate hectorite clay deposits in the McDermitt caldera, Humboldt County. These developments have been encouraged by increased consumption and high prices for this lithium-bearing smectite valued for its ability to form thixotropic gel when added to aqueous solutions in small amounts.

IMV Division of Floridin Co. and **N L Baroid, Inc.** already produce hectorite products from deposits in California. IMV processes hectorite in its Nevada plant.

DIATOMITE. Diatomite continues to be Nevada's second most important industrial mineral in monetary terms. Nevada produced about 200,000 tons of diatomite in 1989. Diatomite is used in filtration, filler, and absorbent products. In general, diatomite market trends have been flat or slightly negative over the past few years because of inroads by perlite in filtration products and talc in fillers.

Eagle-Picher Industries, Inc., the largest Nevada producer, mines diatomite at three locations in northern Nevada. The company's largest operation is in Pershing County, where diatomaceous earth is mined from a diatomite-bearing sequence up to 200 feet thick and trucked 6 miles to a plant near Lovelock.

Three other companies mined diatomite in Nevada in 1989. **Grefco, Inc.** produced diatomite that is used mostly as fillers from a mine on the Esmeralda/Mineral county line. **C. R. Minerals** processed material mined near Hazen in a mill at Fernley. **Moltan Co.** produced diatomite cat litter and oil absorbent at its operation north of Fernley.

FLUORSPAR. The **Daisy mine**, the only producing fluorspar mine in the western U.S., was shut down in April 1989 by **J. Irving Crowell, Jr. and Son**. Consequently, 1989 fluorite production in Nevada was a fraction of that in 1988. The Crowell operation has been mining vein fluorite underground at the mine near Beatty more-or-less continuously since the 1920s, and is expected to reopen if the market improves.

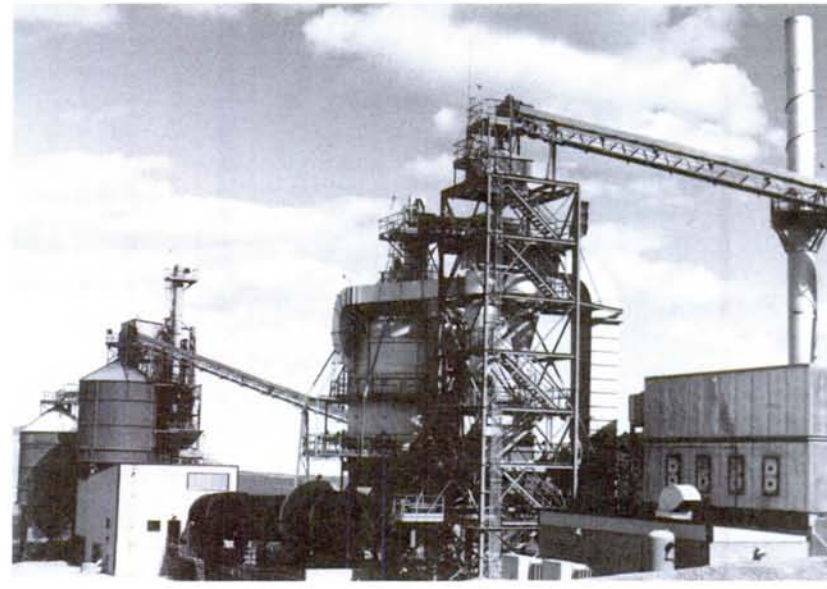
GARNET. A deposit of almandine garnet in the Mount Moriah area of White Pine County about 15 miles north of Baker was evaluated in 1988 by a Canadian company, but a drilling project planned for 1989 was abandoned because of environmental constraints. The area contains a placer garnet deposit that is derived from quartz-garnet-biotite-staurolite schist estimated to average less than 10%

garnet. Demand for garnet abrasives has been spurred by health rulings regarding other abrasive materials, particularly in California.

GYPSUM. Gypsum production in Nevada increased from about 1.5 million tons in 1988 to over 1.6 million tons in 1989. Gypsum mining in Nevada has shown steady growth through the 1980s owing to vigorous regional construction activity. Production of wallboard from gypsum is an important basic industry in Nevada, particularly in the Las Vegas area.

In 1989, **Pabco Gypsum** and **James Hardie Gypsum** were the two largest producers in the Las Vegas area, followed by the **Georgia Pacific Corp.** and **Nevada Gypsum and Mining.** Pabco's wallboard plant near Las Vegas has an annual capacity of 600 million square feet, and utilizes the bulk of the gypsum mined. Most of the James Hardie production also goes into the production of wallboard at the Blue Diamond plant, which has been in operation since 1941. The Georgia Pacific wallboard plant 15 miles northwest of Las Vegas began production in 1987 with annual capacity of 175 million square feet. According to the Nevada Department of Industrial Relations, the **White Grow Gypsum Co.** of Texas operated a gypsum mine 3 miles southwest of Logandale, but production figures are not available.

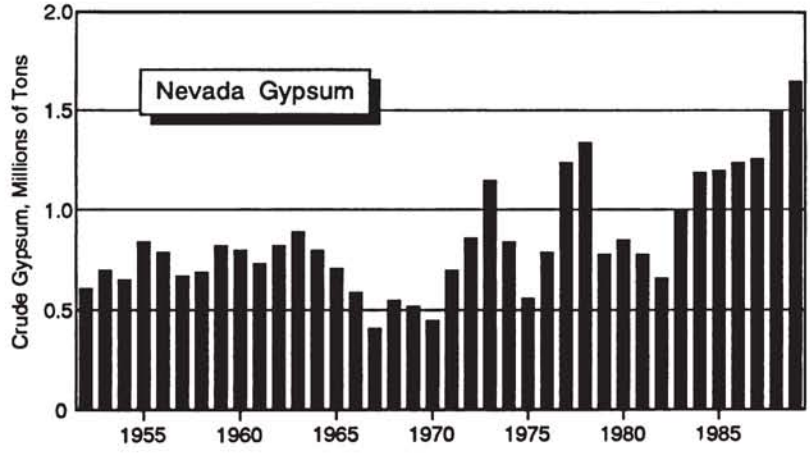
U.S. Gypsum Corp., the largest North American gypsum producer, mines gypsum in northern Pershing County and processes it at its wallboard plant at Empire in Washoe County. In 1989, U.S. Gypsum was the largest gypsum producer in Nevada. The privately owned **Art Wilson Co.**, which mines gypsum from the Adams mine near Carson City for sales to agricultural users and cement manufacturers, went public in 1989 as a subsidiary of **Homestead Minerals Corp.**



Continental Lime, Inc. mill at Pilot Peak near Wendover, Nevada. *S. B. Castor photo.*

LIME AND LIMESTONE. Nevada lime production has increased due to start-up of the **Continental Lime, Inc.** Pilot Peak high-calcium lime operation in late 1989 near Wendover in Elko County. In 1989 Continental utilized stockpiled material; limestone quarrying is slated to begin in the spring of 1990. In mid-1989, Continental Lime was acquired by **Graymont Ltd.**, a Canadian company.

Chemstar, Inc. is the most important Nevada lime producer. Regional construction remained strong in 1989, and Chemstar operations in Nevada, which rely partially on sales of construction lime, were operating at capacity by the end of the year. The company mines and processes both dolomite and high-calcium limestone at operations near Las Vegas. Dolomitic lime is used in glass and in construction products such as stucco, plaster, and mortar. High-calcium lime is used in construction, water treatment, and metallurgical processing.



Annual production of gypsum in Nevada. Production figures are from the U.S. Bureau of Mines (1952–1986), Nevada Bureau of Mines and Geology data (1987 and 1988), and Nevada Department of Minerals data (1989).

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Chemstar is actively exploring for a quality deposit of high-calcium limestone in northern Nevada to meet increasing lime needs of the gold mining industry in that area. In 1989, **Min-Ad, Inc.** and **Nutritional Additives Corp.**, both located near Winnemucca, produced relatively small amounts of dolomitic limestone for sale to agricultural users.

LITHIUM CARBONATE. The **Cyprus Minerals** production of lithium carbonate from brine at Silver Peak in Esmeralda County increased in 1989 relative to 1988. The company, which is the world's leading lithium producer, is expanding production capacity at a similar operation in Chile, which will lead to lower production rates at Silver Peak in the future.

MAGNESIA. Production at the **Basic, Inc.** magnesite mine and magnesia plant at Gabbs was down slightly in 1989 compared with 1988 owing to slower sales of dead-burned refractory magnesia. However, caustic magnesia sales were up slightly in 1989. The parent company, **C E Refractories, Inc.**, was purchased by **Asea Brown Boveri**, a European electronics company, which plans to sell off the C E mining operations.

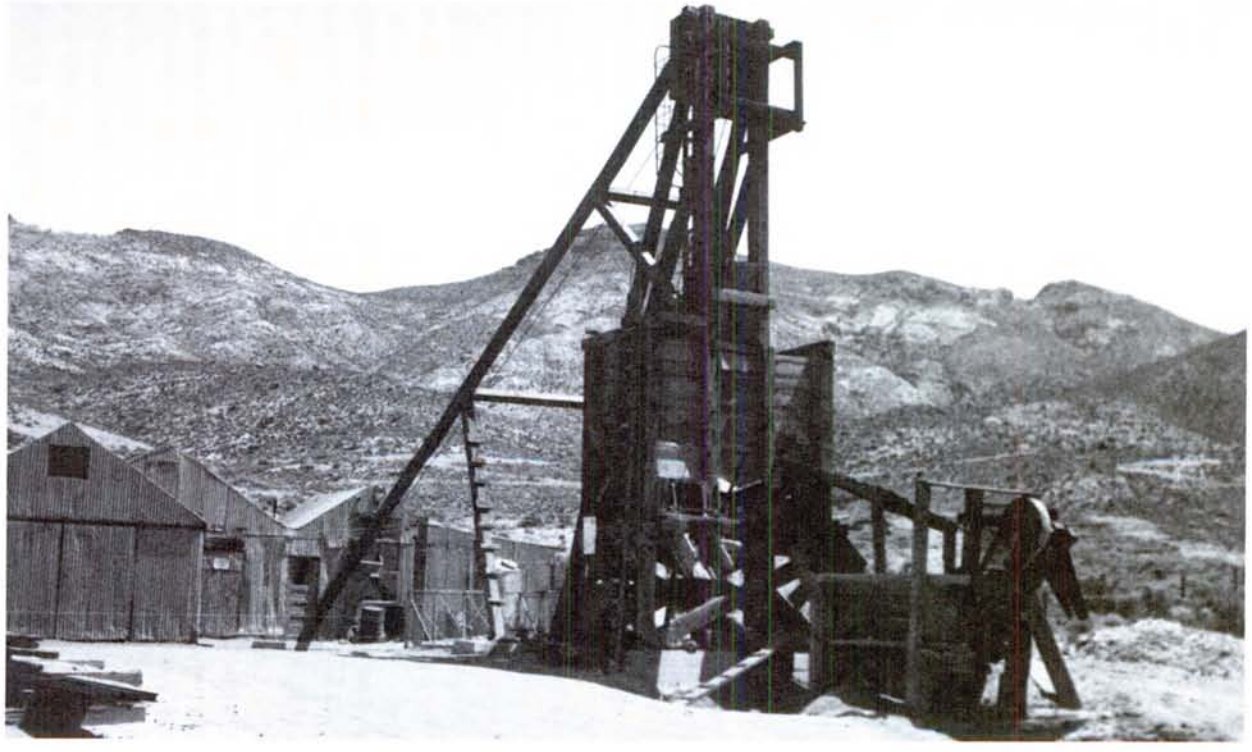
PERLITE. The **Wilkin Mining and Trucking Co.** mines perlite in Lincoln County and ships both crude perlite and expanded perlite. In 1989, a second furnace was added to the company's popping plant in Caliente leading to increased production of expanded perlite.

SALT. The **Huck Salt Co.**, which harvests salt from a dry lake near Fallon, increased production to 13,000 tons, about 30% over 1988.

SILICA. **Simplot Silica Products** at Overton produced about 706,000 tons of silica sand in 1989, an increase of 15% over 1988. Because Simplot's silica sand requires little beneficiation for use in plate glass, it competes strongly with other silica sources in the southern California market. The sand is mined from large reserves in the Cretaceous Baseline Sandstone. Development of similar sandstone in the same unit about 30 miles northeast of Las Vegas is being considered by a Canadian company.

WOLLASTONITE. In late 1989, **Sikaman Gold Resources, Ltd.**, a Toronto-based company, announced the discovery of a major deposit of wollastonite of potential filler grade in Nevada. The deposit, which is in the Gilbert mining district in Esmeralda County about 30 miles west of Tonopah, is said to contain substantial reserves of rock containing more than 50% wollastonite, and high-grade zones with more than 70%. Wollastonite, which has never been mined in Nevada, is in demand as a reinforcing filler and an asbestos substitute.

ZEOLITES. At its Ash Meadows plant in Nye County, **East West Minerals, Inc.** processed stockpiled clinoptilolite in 1989. Increased sales to aquaculture users overseas pushed production up by about 60% over that of 1988. East West's mordenite operation at Eastgate in Churchill County was idle in 1989. **Steelhead Minerals, Inc.** was evaluating two Nevada zeolite deposits in Mineral County in 1989.



J. Irving Crowell, Jr. and Son's Daisy fluorite mine near Beatty, Nevada. *S. B. Castor photo.*

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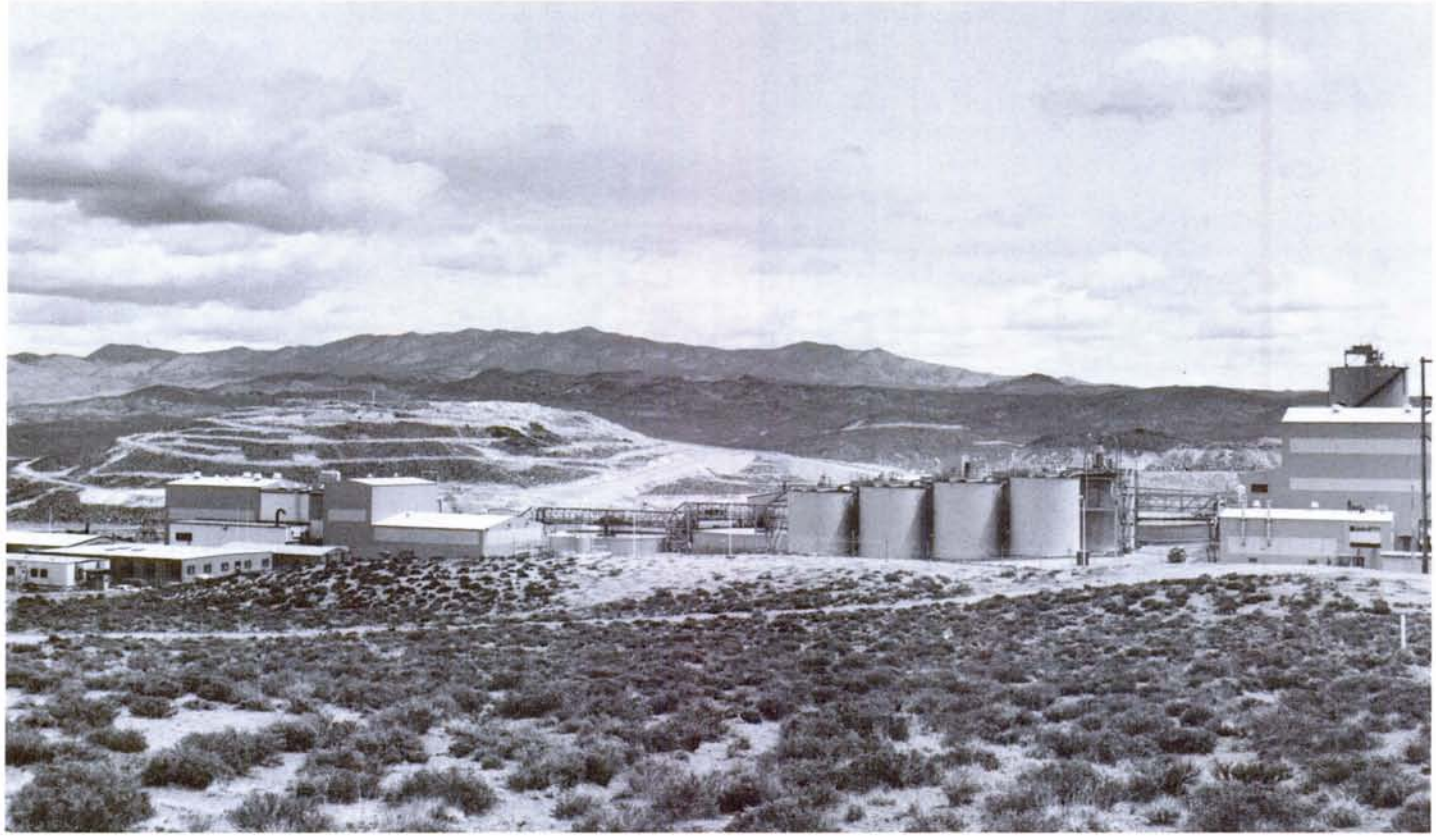
Directory of Mining and Milling Operations

by Keryl L. Fleming



Paradise Peak mine and mill, Nye County. *FMC photo.*

Compiled from information supplied by the Nevada Division of Mine Inspection, Nevada Department of Minerals, and U.S. Mine Safety and Health Administration. Does not include sand and gravel operations.

EX = exploration, HL = heap leach, ML = mill, OP = open-pit mine, OS = other surface, PL = placer, UG = underground mine.

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
CHURCHILL COUNTY							
Fondaway mine	Tenneco Minerals	S1,3,T22N,R33E	gold silver	OP,HL	cyanide	29	Gary L. Beahm, Mine Manager P.O. Box 1017 Fallon, NV 89406
	Dynatec Mining, *contractor*	S1,T22N,R33E		UG	drifting		Ray Willis P.O. Box 1617 Fallon, NV 89406
	J.D. Welsh and Associates, *contractor*	S1,T22N,R33E		ML	leaching		Lon Armstrong, Vice President 5301 Longley Lane Reno, Nv 89408-0860
	RAMCO, Inc., *contractor*	S1,T22N,R33E		ML	leaching		Gene Ranstrom, Owner 5301 Longley Lane Reno, NV 89511
Huck Salt	Elmer and John Huckaby	S12,T16N,R31E	salt	OP	solar evaporation	3	Elmer Huckaby, Owner 895 Harrigan Road Fallon, NV 89406
Moltan mine	Moltan Co.	S28,29,32,33, T23N,R27E	diatomaceous earth	OP,ML	drying calcining grinding	23	Dallas Herreld P.O. Box 860 Fernley, NV 89408-0860

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DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
CLARK COUNTY							
Apex plant	Chemstar, Inc.	S26,T18S,R63E	limestone lime	OP	crushing sizing	38	Art Reber P.O. Box 3598 North Las Vegas, NV 89036
Dolomite plant	Chemstar, Inc.	S18,T22S,R63E	dolomitic lime	ML	calcining	31	Dave Johnson, Vice President 2551 North Green Valley Parkway, Suite 201-B Henderson, NV 89015
Georgia-Pacific quarry	Georgia Pacific Corp.	S10,11,14-16, T16S,R66E	gypsum	OP	single bench crushing	75	Dean Wassenberg P.O. Box 30006 North Las Vegas, NV 89030
Golden Dawn's mine	Snowbird Resources	S2,T29S,R63E	gold	OP,ML	single bench gravity concentration	3	M. R. Vandergrift, President 3355 Spring Mountain Road Las Vegas, NV 89102
Henderson quarry	Whiting Brothers, Inc.	S34,35,T21S,R62E	landscape rock	OP	screening	7	Mark C. Whiting 6418 E. Vegas Valley Drive Las Vegas, NV 89122
James Hardie Gypsum	James Hardie Gypsum, Inc.	S20,29-31,32, T21S,R59E; S5,T22S,R59E S24-26,T21S,R58E	gypsum	OP	grinding calcining	117	William M. Rogers HCR 89033, Box 2900 Las Vegas, NV 89124
Money pit	Southern Nevada Liteweight	S9,16,T25S,R61E	rhyolite	OP	crushing screening	25	Spencer Apple 4675 Wynn Road Las Vegas, NV 89103
Nevada Gypsum mine	Nevada Gypsum & Mining	S27,33,34, T28S,R63E	gypsum	OP,ML	drilling blasting crushing	9	Richard Thornton 928 S. Valley View Las Vegas, NV 89107
PABCO Gypsum-Apex	Pacific Coast Building Products, Inc.	S7,8,17,18, T20S,R64E	gypsum	OP	wash plant	98	Stanley L. Asbell 1973 N. Nellis Boulevard #328 Las Vegas, NV 89115
Simplot Silica Products #3 pit & mill	Simplot Industries	S30,T16S,R68E	silica sand	OP,ML	flotation multiple bench drying screening	43	Jack A. Olson P.O. Box 308 Overton, NV 89040
Sloan quarry	Chemstar, Inc.	S13,T23S,R60E	dolomitic limestone	OP	crushing sizing	15	Earl Gillian Star Route 70, Box 2300 Las Vegas, NV 89124
Wallboard plant	Georgia Pacific, Inc.	S24,T18S,R63E	gypsum	ML	calcining	11	Jean Wassenberg, Manager P.O. Box 30006 North Las Vegas, NV 89030
White-Grow Gypsum Co.	GKB Nevada Holdings, Inc.	S30,T15S,R67E	gypsum	OP,ML	single bench crushing screening	6	Jerry Morrison, General Manager 300 Crescent Court, Suite 1300 Dallas, TX 75201
DOUGLAS COUNTY							
Buckskin leach plant	Sonora Mining Corp.	S13,T13N,R23E	gold silver	HL	cyanide	33	George Newell P.O. Box 546 Yerington, NV 89447
ELKO COUNTY							
Big Ledge mine	Circle A Construction	S26,T42N,R61E	barite	OP	multiple bench	3	James Madsen, Superintendent Star Route Jackpot, NV 89825
	Dale Aslett, *contractor*	S26,T40N,R57E		OP	stockpile crush		Dale Aslett, Owner P.O. Box 105 Jackpot, NV 89825

continued

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
ELKO COUNTY (continued)							
Big Springs joint venture	Freeport-McMoRan Gold Co.	S1-3,11,12, T42N,R53E	gold silver	OP,HL	cyanide fluid-bed roasting	124	D. Scott Barr Mountain City Star Route Elko, NV 89801
	Gibbons & Reed Co., *contractor*	S11,12,T42N,R53E		OP	multiple bench		C. David Baer, Project Manager 1111 Brickyard Road Salt Lake City, UT 84130
	Lang Drilling, *contractor*	S10,T42N,R53E		EX	rotary drilling		Jim Collard, Project Manager 439 West Commercial Elko, NV 89801
	The Industrial Co. of Steamboat Springs, *contractor*	S11,12,T42N,R53E		OP	construction		Stan Palmer, Superintendent Rural Route 42144 Elko, NV 89801
Dee gold mine	Rayrock Mines, Inc.	S34,T37N,R49E	gold silver	OP,HL, ML	cyanide	100	David S. Cook, General Shop Manager P.O. Box 1193 Elko, NV 89801
Jerritt Canyon joint venture	Freeport-McMoRan Gold Co.	S33,T41N,R53E	gold	OP,ML, HL	cyanide grinding fluid bed roasting	491	Cecil L. Kinard II Mountain City Star Route Elko, NV 89801
	Blatzer Construction Co., *contractor*	S33,T41N,R53E		ML,HL			John Blatzer, President P.O. Box 4460 Medford, OR 97501
	George Delong Construction, *contractor*	S16,T40N,R53E		EX	exploration, rotary drilling		833 East 4th Street Winnemucca, NV 89445
	Hackworth Drilling, *contractor*	S21,T40N,R53E		EX	exploration, rotary drilling		Royce Hackworth, President 850 West Main Street Elko, NV 89801
	Idaho Resources, Inc., *contractor*	S34,35,T41N,R53E		ML,HL			Mark Cook, Superintendent P.O. Box 84340 Vancouver, WA 98684-0340
	The Industrial Co. of Steamboat Springs, *contractor*	S33,T41N,R53E		OP	multiple bench		Doug Green, Construction Manager Rural Route 4213 & Freeport Road Elko, NV 89801
	Transystems, Inc., *contractor*	S33,T41N,R53E		OP	multiple bench		J. Michael Rice, President P.O. Box 399 Black Eagle, MT 59414
Pilot Peak lime plant	Continental Lime, Inc.	S14,T34N,R68E	lime	OP	multiple bench roasting grinding rotary kiln	16	Norman Tupper P.O. Box 2520 Wendover, NV 89883
	Ferenco Industrial, Inc., *agent*	S13,14,T34N,R68E		OP	single bench crushing		Kelly Windover, Project Manager P.O. Box 2520 Wendover, NV 89883
	Plateau Electrical, *contractor*	S14,T34N,R68E		OP	multiple bench crushing dryer		Wayne Tripp, Superintendent P.O. Box 10 Wendover, UT 84083
	Wollam Construction Co., *contractor*	S13,14,T34N,R68E		OP	single bench crushing		Guy Wollam, President 8671 S. Pebble Hills Drive Sandy, UT 84094
Rossi mine	N. L. Industries, Baroid Division	S15,21,22, T37N,R49E	barite gold	OP,ML	multiple bench crushing gravity concentration	12	August V. Castelli, Manager P.O. Box 231 Battle Mountain, NV 89820
	John Davis Trucking Co., *contractor*	S15,21,22, T37N,R49E		OP	multiple bench		John N. Davis, Owner 165 West Front Street Battle Mountain, NV 89820
	Target Construction, Inc., *contractor*	S15,22,26, T37N,R49E		OP	multiple bench		Kevin Fegert, Owner 333 Holcomb Avenue, Suite 100 Reno, NV 89502

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
ELKO COUNTY (continued)							
Tuscarora gold mine	Horizon Gold Shares, Inc.	S2,3,T39N,R51E	gold silver	OP,HL	cyanide	48	Bob Jones P.O. Box 37 Tuscarora, NV 89834
	RAMCO, Inc., *contractor*	S3,T39N,R51E		OP	crushing		Gene Ranstrom, President/Owner P.O. Box 37 Tuscarora, NV 89834
Wood Gulch	Homestake Mining Co.	S23-26,T44N,R53E	gold silver	OP,HL	cyanide	22	Don R. Rolfe, Project Manager P.O. Box 277 Mountain City, NV 89831
	Seubert Excavating, *contractor*	S23-26,T44N,R53E		OP	crushing		J.P. Seubert and George Seubert, Owners c/o Chambers Motel P.O. Box 177 Mountain City, NV 83522
	Welsh Construction Co., *contractor*	S23-26,T44N,R53E		OP,HL	multiple bench		Joe Shea, Construction Superintendent P.O. Box 1236 Winnemucca, NV 89445
ESMERALDA COUNTY							
Basalt mine & mill	Grefco, Inc.	S29,T2N,R34E	diatomaceous earth	OP,ML	grinding	12	Robert A. Poelvoorde, Plant Manager P.O. Box 288 Mina, NV 89422
Blanco mine	Vanderbilt Minerals Corp.	S22,T1N,R37E	clay	OP	grinding bagging	6	Jerry W. Lease 2320 Viking Road Las Vegas, NV 89109
Boss mine	EBCO Enterprises	S4,5,T02N,R38.5E; S19,30-33, T03N,R39E	gold silver	OP,HL	cyanide	2	Jack T. Watterson, General Manager P.O. Box 3719 Tonopah, NV 89049
Goldfield operation	Red Rock Mining (USA), Inc.	S25,35,T02S,R42E	gold	OP,HL	cyanide	77	John Webster P.O. Box 160 Goldfield, NV 89013
McLean mine	Kinkaid Exploration and Mining Co. II	S15,T4N,R38E	gold silver	OP,ML, HL	single bench cyanide	1	William Pautler, Manager P.O. Box 1531 Tonopah, NV 89049
Silver Peak	Zephyr Resources, Inc.	S1,2,T3S,R38E	gold silver	OP,ML		52	Rory Tibbals P.O. Box 768 Silverpeak, NV 89047
	Parsons Construction Co., *contractor*	S6,T2S,R39E		OP	multiple bench		Elton Parson, Owner P.O. Box 2658 Silverpeak, NV 89047
Silver Peak Operations	Cyprus Foote Mineral Co.	S22,T2S,R39E	lithium carbonate	OS	evaporation precipitation	74	P. J. Seaman State Road 265 Silverpeak, NV 89047
EUREKA COUNTY							
Barrick Goldstrike mine	Barrick Goldstrike Mine, Inc.	S12,20,29,30, T36N,R50E; S23-26,T36N,R49E	gold silver	OP,ML, HL	cyanide milling	1,232	John T. McDonough P.O. Box 29 Elko, NV 89801
	J. S. Redpath Corp., *contractor*	S23,T36N,R49E		UG	exploration development		Scott McIntosh, General Manager P.O. Box 3094 Elko, NV 89801
	Liggett Industries, Inc., *contractor*	S30,T36N,R50E		OP			Wayne M. Liggett, President 7003 W. Banff Peoria, AZ 85345
	Ledcor Construction, Inc., *contractor*	S26,T36N,R49E		OP	multiple bench		George Hoar, Vice President P.O. Box 2808 Elko, NV 89801
	United Drilling Inc., *subcontractor*	S26,T36N,R49E		OP	construction		Al Volking, President
	Western States Energy, *subcontractor*	S26,T36N,R49E		OP	multiple bench		Vern Long, President P.O. Box 1386 Elko, NV 89801

continued

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
EUREKA COUNTY (continued)							
Buckhorn mine	Cominco American Resources Inc.	S30,31,T27N,R49E	gold silver	OP,HL	cyanide multiple bench Merrill Crowe	80	Warren R. Hood P.O. Box 847 Carlin, NV 89822
	A & K Earth Movers, Inc., *contractor*	S30,31,T26N,R45E		OP,HL	multiple bench cyanidation		K. Bart Hiatt, Vice President P.O. Box 1059 Fallon, NV 89406
Gold Bar mine	Atlas Gold Mining, Inc.	S26,27,T22N,R49E	gold	OP,ML, HL	multiple bench crushing grinding cyanidation	150	Andrew H. Scrymgeour, General Manager P.O. Box 282 Eureka, NV 89316
	CEC Construction Co., *contractor*	S26,27,T22N,R49E		OP	multiple bench		Phil Rothstein, President P.O. Box 784 Eureka, NV 89316
	Selland Construction Co., *contractor*	S26,27,T22N,R49E		OP	multiple bench		Brad Selland, President 1285 S. Wenatchee Wenatchee, WA 99223
Newmont Gold operations	Newmont Gold Co.	T31N-36N, R49E-53E	gold silver	OP,ML, HL	carbon-in-leach carbon-in-pulp cyanide	2,175	T. Peter Philip, President P.O. Box 669 Carlin, NV 89822-0669
	Bechtel Construction, Inc., *contractor*	S31,T31N,R53E		OP,ML	construction		R. C. Isaacson, Construction Manager P.O. Box 340 Carlin, NV 89822
	O'Keefe Drilling, *contractor*	S6,T37N,R50E		EX	rotary drilling		Robert E. Chamberlin, General Foreman P.O. Box 3810 Butte, MT 59710
	Coats Drilling Co., *contractor*	S30,T36N,R50E		OP	exploration		Otto Schmitke 3051 North Deer Run Road Carson City, NV 89701
	Scott Co., *contractor*	S4,8,15,29,35, T33-36N,R50-51E		OP	cyanidation		Wayne W. Liggett, President 1919 Market Street Oakland, CA 94103
	Corbesco, Inc., *contractor*	S4,8,15,29,35, T33-36N,R50-51E		OP	cyanidation		Cliff Cutrell, Jr., Vice President P.O. Box 1138 Carlin, NV 89822
	Ezcar and Desruisseaux Const., Inc., *contractor*	S4,8,15,29,35, T33-36N,R50-51E		OP	cyanidation		Jim Richardson 455 Franklin Sparks, NV 89431
	Jarvis B. Webb, *contractor*	S4,8,15,29,35, T33-36E,R50-51E		OP	cyanidation		Jim Richardson P.O. Box 460 Carlin, NV 89822
	Johnson Controls, Inc., *contractor*	S1,2,3,T33N,R51E; S35,36,T34N,R51E		OP	multiple bench		James H. Keyes, President P.O. Box 520 Carlin, NV 89822
	Liggett Industries, Inc., *contractor*	T33N-36N, R50E-51E		OP			Wayne M. Liggett, President 7003 W. Banff Peoria, AZ 85345
Project Glister	USSRAM Exploration Company	S9-11,14-16,21-23, 27,28,T19N,R53E	gold silver	OP,HL	cyanide carbon adsorption	12	Ron Palmer P.O. Box 693 Eureka, NV 89316
	Charles Joseph Trucking, Inc., *contractor*	S22,T19N,R53E		OP,HL			Wayne Joseph, President P.O. Box 437 Eureka, NV 89316

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
EUREKA COUNTY (continued)							
Tonkin Springs gold mine	U.S. Gold Corp.	S2-6,T23.5N,R49E	gold silver	OP,ML, HL	bio-oxidation cyanide	92	William B. Williams P.O. Box 671 Elko, NV 89801
	G and R Builders, Inc., *contractor*	S2,3,T23N,R49E		OP,HL	multiple bench cyanidation		James G. Loggains, President P.O. Box 2825 Elko, NV 89801
	Martel Construction, Inc., *contractor*	S2,3,T23N,R49E		OP,HL	multiple bench cyanidation		William Martel, President P.O. Box 308 Battle Mountain, NV 89771
	Merit Consultants Ltd., *contractor*	S2,3,T23N,R49E		OP	construction		Tony Mochinski, Owner/President P.O. Box 671 Elko, NV 89801
	Rocky Mountain Fab. and Eng., *contractor*	S2,3,T23N,R49E		OP,HL	multiple bench cyanidation		Jim Jones, President P.O. Box 671 Elko, NV 89801
	Selland Construction Co., *contractor*	S2,3,T23N, R48.5E		OP	construction		Brad Selland, President P.O. Box 1236 Winnemucca, NV 89445
	Weyher Brothers Co.	S2,3,T23N,R49E		OP,HL	multiple bench, cyanidation		Alex Montoya, Superintendent 1 Ricci Road Dayton, NV 89403
HUMBOLDT COUNTY							
Bonanza opal mine	Lloyd H. Olds	S13,T45N,R25E	precious opal	OP	single bench	3	P.O. Box 13 Denio, NV 89404
Chimney Creek mine	Gold Fields Operating Co.	S5-8,T39N,R43E	gold silver	OP,ML, HL	grinding cyanide	219	Jim H. Gourdie, Manager P.O. Box 69 Golconda, NV 89414
	Lang Exploratory Drilling, *contractor*	S5,T39N,R43E			exploration rotary drilling		Alan Lang, Zone Manager 2286 West 1500 South Salt Lake City, UT 84104
Crofoot mine	Hycroft Resources & Development, Inc.	S24?,T35N,R29E; S19,20?,T35N,R30E	gold silver	OP,HL	crushing cyanide	190	Roger Leonard P.O. Drawer M Winnemucca, NV 89445
Getchell mine	FirstMiss Gold Inc.	S3,4,T38N,R42E; S33,T39N,R42E	gold silver	OP,ML, HL	multiple bench fluid-bed roasting cyanide	250	Q. Allen Neal P.O. Box 220 Golconda, NV 89414
	Brown & Root USA, Inc., *contractor*	S3,4,T38N,R42E; S32-34,T39N,R42E		OP	multiple bench		Larry Kuhlman, Project Manager P.O. Box 1560 Winnemucca, NV 89445
	Gilbert Western Corp., *contractor*	S22,T39N,R42E		OP	bench		Tait Johnson, President P.O. Box 2217 Winnemucca, NV 89445
	Stebbins Engineering & Manufacturing Co., *contractor*	S3,4,T38N,R42E; S32-34,T39N,R42E		OP	construction		A. I. Calligaris, President, CEO P.O. Box 129 Golconda, NV 89414
	The Industrial Co., *contractor*	S3,4,T38N,R42E; S32-34,T39N,R42E		OP	multiple bench		Ken Dean, Project Superintendent P.O. Box 1880 Winnemucca, NV 89445
Gold Run mine	Marlon H. Thompson	S28,T34N,R40E	gold	OP,ML	single bench gravity concentration	3	Marlon H. Thompson, Owner/Operator 422 West Haskill Box 8 Winnemucca, NV 89445

continued

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
HUMBOLDT COUNTY (continued)							
Golden Sands project	Bronco Minerals, Inc.	S25,26,30, 31,36,T37N,R31E	gold	OP,ML	single bench gravity concentration	10	Donald Holder, President P.O. Box 1885 Winnemucca, NV 89445
	Micon, Inc., *contractor*	S25,26,30, 31,36,T37N,R31E	gold	OP,ML	single bench gravity concentration		John Rice and Gene Pridemore, Managers P.O. Box 1940 Winnemucca, NV 89445
Hectorine mill	J.M. Huber Corp.	S24,T45N,R34E	hectorite clay	OP,ML	single bench sizing	6	David Durham, Senior Research Scientist 4500 Jungo Road Winnemucca, NV 89445
MIN-AD mine and mill	MIN-AD, Inc.	S25,T36N,R37E; S28,T35N,R38E	limestone	OP	grinding	16	Charles Evans, Mill Superintendent 4210 W. Jungo Road Winnemucca, NV 89445
Marigold mine	Rayrock Mines, Inc.	S8,9,17-19, T33N,R43E	gold silver	OP,ML, HL	grinding multiple bench cyanide	151	Art Schwandt, General Manager P.O. Box 9 Valmy, NV 89438
	Engineered Structures, Inc., *contractor*	S8,T33N,R43E		OP,ML, HL	multiple bench		Art Schwandt, General Manager P.O. Box 1608 Winnemucca, NV 89445
	Hunewill Construction Co., *contractor*	S8,T39N,R43E		OP,ML	mill construction		Harvey Hunewill, President 315 Artist View Yerington, NV 89444
	Lambert Construction Co., Inc., *contractor*	S8,T39N,R43E		OP,ML	plant construction		Victor Lambert, President 900 East 4th Street Winnemucca, NV 89445
	The Industrial Co., *contractor*	S8,T39N,R43E		ML	plant construction		Ken Finnegan, Project Superintendent P.O. Box 388 Valmy, NV 89438
McDermitt mine	McDermitt Mine Placer Dome US, Inc.	S27,28,33,34, T47N,R37E	mercury	OP,ML	flotation retorting	21	Randy Powell P.O. Box 497 McDermitt, NV 89421
Pinson mine	Pinson Mining Co.	S28,29,32,33, T38N,R42E	gold	OP,ML, HL	cyanide grinding	138	H. D. Harper P.O. Box 192 Winnemucca, NV 89445
Rabbit Creek mine	Rabbit Creek Mining, Inc.	S19,29,31, T39N,R43E	gold silver	OP,HL	carbon-in-leach multiple bench	210	Michael L. Surratt, Project Manager P.O. Box 552 Winnemucca, NV 89445
	Gilbert Western Corp., *contractor*	S19,T39N,R43E		OP	multiple bench		Tait Johnson, President P.O. Box 2217 Winnemucca, NV 89445
	The Industrial Co., *contractor*	S19,T39N,R43E		OP	plant construction		Ken Dean, Project Superintendent P.O. Box 1880 Winnemucca, NV 89445
Rainbow Ridge opal mine	Rainbow Ridge Opal Mines, Inc.	S6,7,22,23, T45N,R26E	precious opal	OP,UG	multiple bench	1	G. Keith Hodson, Owner P.O. Box 97 Denio, NV 89404
Royal Peacock opal mine	Royal Peacock Opal Mines, Inc.	S19,20,T45N,R26E	precious opal	OP	hand digging	1	Walter Wilson 10 Virgin Valley Road P.O. Box 55 Denio, NV 89404
Sleeper mine	Nevada Gold Mining, Inc.	S16,17,20,21, T40N,R35E	gold silver	OP,ML, HL	multiple bench cyanide gravity grinding	210	Thomas E. Irwin, Manager P.O. Box 1820 Winnemucca, NV 89445
	The Industrial Co. of Steamboat Springs, *contractor*	S16,17,20,21, T40N,R35E		ML	construction		Ray Dix, Project Manager P.O. Box 366 Winnemucca, NV 89445

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
LANDER COUNTY							
Argenta mine and mill	Milpark Drilling Fluids	S13,24,T32N,R46E	barite	OP	gravity grinding	34	Keith S. Olson P.O. Box 277 Battle Mountain, NV 89820
Austin gold venture	Westgold Expl. & Mining Co.	S27,36,T18N,R43E	gold	UG,OP, ML	multiple bench flotation cyanide	94	Robert A. Prescott, Project Manager P.O. Box 502 Austin, NV 89310
	American Mine Services, Inc., *contractor*	S25,26,36, T18N,R43E		UG	drifting		John C. Folinsbee P.O. Box 59 Austin, NV 89310
Battle Mountain grinding plant	M-I Drilling Fluids Co.	S18,T32N,R45E	barite	ML	gravity grinding	15	Garry Thielen P.O. Box 370 Battle Mountain, NV 89820
Buffalo Valley mine	Horizon Gold Shares, Inc.	S33,34,T32N,R42E	gold	OP,HL	cyanidation	42	John E. Watson, President P.O. Box 358 Valmy, NV 89438
	Ranstrom Construction, Inc., *contractor*	S33,34,T32N,R42E		ML	crushing screening		Larry Lundy, Superintendent P.O. Box 15395 Boise, ID 89642
Cortez gold mines	Placer Dome U.S., Inc.	S13,21,24, T27N,R47E; S36,T28N,R46E	gold silver	OP,ML, HL	cyanide grinding	180	Alvin. L. Crandell Cortez, NV 89821
	Engineered Structures, Inc., *contractor*	S13,28,T28N,R47E		OP	multiple bench		Jim Eckardt, President 723 E. Karcher Road Nampa, ID 83651
Elder Creek mine	Alta Gold Co.	S12,13,T28N,R45E; S7,18,T28N,R46E	gold silver	OP,HL	multiple bench	60	Robert C. Hedlund P.O. Box 1413 Battle Mountain, NV 89820
	S M & S Nielsen Exploration, *contractor*	S12,13,T28N,R45E		OP,HL	multiple bench		Steve and Dianne Nielsen, Owners P.O. Box 310 Battle Mountain, NV 89820
Fortitude complex	Battle Mountain Gold Co.	S21,22,T31N,R43E; S28,T32N,R44E	gold silver	OP,HL	cyanide flotation gravity grinding	367	R. H. DePaoli, Operations Manager P.O. Box 1627 Battle Mountain, NV 89820
Kingston mine and mill	Nevada Goldfields, Inc.	S27,T16N,R43E; S5,6,T15N,R44E	gold silver	UG,ML	carbon-in-leach cyanide grinding	12	Joe Kircher Kingston Box 119 Austin, NV 89310
McCoy/Cove mine	Echo Bay Minerals Co.	S1,2,11,T28N,R42E; S36,T28N,R43E	gold silver	OP,ML, UG,HL	cyanide grinding	511	David C. Naccarati, Manager P.O. Box 1658 Battle Mountain, NV 89820
	Davy McKee Corp., *contractor*	S2,T28N,R42E		ML	plant construction		Tom Turk, Project Manager P.O. Box 400 Battle Mountain, NV 89820
	Dynatec Mining Corp., *contractor*	S1,2,11,T28N,R42E		UG	drifting		Alan R. Walsh, President 12567 West Cedar Drive, Suite 100 Lakewood, CO 80228
	Neilsons, Inc., *subcontractor*	S2,T28N,R42E		ML	plant construction		Clyde Rule, Project Manager P.O. Box 385 Battle Mountain, NV 89820
	Plateau Electrical Contractors, Inc., *subcontractor*	S2,T28N,R42E		ML	plant construction		Tom A. Martinez, President P.O. Box 836 Battle Mountain, NV 89820
	Western Central Concrete, Inc., *contractor*	S2,T28N,R42E		OP,ML	mill construction		Del Cornella, Manager P.O. Box 409 Winnemucca, NV 89445
Robertson mine	Coral Resources, Inc.	S12,13,24,25, T28N,R46E; S3-10,16-21, T28N,R47E	gold silver	OP,HL	cyanide multiple bench	3	David C. Arnold P.O. Box 796 Battle Mountain, NV 89820
	Vaughn Construction, *contractor*	S8,T28N,R47E		OP,HL	multiple bench		Otis Vaughn, President P.O. Box 679 Fernley, NV 89408
Toiyabe mine	Inland Gold & Silver Corp.	S5,6,T25N,R47E; S31,32,T26N,R47E	gold silver	OP,HL	cyanide	13	Dallas Pulley P.O. Box 29 Crescent Valley, NV 89821

continued

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
LINCOLN COUNTY							
Delamor-Mackie perlite mine	Wilkin Mining & Trucking Co.	S7,T4S,R67E; S33,34,T4S,R62E	perlite	UG,ML	room pillar crushing expansion	3	Joseph D. Wilkin, Owner P.O. Box 472 Panaca, NV 89042
LYON COUNTY							
Basalite	Basalite	S16,T17N,R22E	aggregate	OP	crushing screening	10	Henry Williams 2600 Boeing Way Carson City, NV 89706
Copper Tek mine	Copper Tek Corp.	S16,T13N,R25E	copper	OP,HL		40	M. Henry Shipes 102 Burch Drive Yerington, NV 89447
Dayton Sand & Gravel, Inc.	Dayton Sand & Gravel, Inc.	S23,T16N,R21E	sand & gravel gold	OP,ML	gravity crushing multiple bench screening	17	Robert O. Foster P.O. Box 193 Dayton, NV 89403
Gold Bug placer	Gold Bug Mining, Inc.	S21,T16N,R21E	gold silver	PL	gravity modified vat leach	12	Robert W. Craig 13-B Affonso Drive K-27 Carson City, NV 89706
Haywood Santiago leach facility	Oliver Hills Mining Co., Inc.	S18,T16N,R21E	gold silver	OP,HL	cyanide	11	Scott Jolcover P.O. Box 1298 Carson City, NV 89702
Hazen pit - Clark	Eagle-Picher Minerals, Inc.	S8,17,T18N,R25E	diatomite	OP	crushing drying calcining	2	Thomas A. Buchanan P.O. Box 10480 Reno, NV 89510
Limestone mine	Nevada Cement Co.	S4,6,19,25, T19N,R25E	limestone	OP	multiple bench	10	David Dalton, President P.O. Box 840 Fernley, NV 89408
Moundhouse Adams mine	Art Wilson Co.	S25,T16N,R20E	gypsum/ anhydrite	OP,ML	grinding	20	Art Wilson P.O. Box 1160 Carson City, NV 89702
Nevada Cement Company	Nevada Cement Co.	S31,32,33, T20N,R25E; S2,3,10,11,36, T20N,R24E	limestone clay cement	OP	rotary kiln	156	D.L. Dalton P.O. Box 840 Fernley, NV 89408
Section 8 mine	CR Minerals Corp.	S8,17,T19N,R26E S11,T20N,R24E	diatomaceous earth	OP,ML	grinding	7	Chris Harris 100 Front Street Fernley, NV 89408
Six Mile Canyon mine and mill	Gold Bug joint ventures	S31,T17N,R22E	gold silver	OP,ML	single bench leaching	4	Pete Haggart, President P.O. Box 333 Dayton, NV 89403
	Graham Equipment Co., *contractor*	S31,T17N,R22E		OP	development		Virgil Graham, Owner 1690 Industrial Way Sparks, NV 89431
Tuttle mine	Tuttle's Golden Minerals	S20,21,29, T7N,R27E	montmorillonite	OP	single bench screening	2	James B. Tuttle, Owner P.O. Box 519 Hawthorne, NV 89415
MINERAL COUNTY							
Aurora mine	Nevada Goldfields, Inc.	S17,18,T05N,R28E	gold silver	OP,UG, ML	multiple bench	40	Rick Dye, Project Manager P.O. Box 3070 Hawthorne, NV 89415
Aurora Partnership	Minerex Resources, Ltd.	S17,T5N,R28E	gold silver	OP,HL	multiple bench cyanide	73	J. Burt P.O. Box 1628 Hawthorne, NV 89415
	Lost Dutchman Construction, Inc., *contractor*	S17,T5N,R28E		OP,ML	multiple bench crushing		J. R. Barkley, President P.O. Box 129 Hawthorne, NV 89415

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
MINERAL COUNTY (continued)							
Borealis mine	Echo Bay Minerals Co.	S17,18,T6N,R29E	gold silver	OP,HL	cyanide	42	Greg Earle P.O. Box 2310 Hawthorne, NV 89415
	Lost Dutchman Construction, Inc. *contractor*	S16,17,T6N,R29E		OP	multiple bench		J. R. Barkley, President P.O. Box 1538 Hawthorne, NV 89415
Candelaria mine	NERCO Metals, Inc.	S32-34,T4N,R35E; S3-5,T3N,R35E	silver gold	OP,HL	cyanide	198	Ralph L. Van Arsdale P.O. Box 1240 Hawthorne, NV 89415
	J. Wise Corp., *contractor*	S3,4,T3N,R35E; S33,T4N,R35E		OP	drilling		W. L. Weisenburger, Secretary/Treasurer P.O. Box 2290 Hawthorne, NV 89415
	T-4 Drilling Co., *contractor*	S3,4,T3N,R35E; S33,T4N,R35E		OP	drilling		Stephen R. Schlatter, Owner P.O. Box 188 Hawthorne, NV 89415
Denton-Rawhide mine	Kennecott Rawhide Mining Co.	S4,5,8,16,17, T13N,R32E	gold silver	OP,HL	development	97	Mian M. Naseem P.O. Box 2070 Fallon, NV 89406
	Denny Frook Construction, *subcontractor*	S8,T13N,R32E		OP	construction		Denny Frook, Owner 1455 Deming Way #11 Sparks, NV 89431
	Kiewit Mining Group, Inc., *contractor*	S3,10,15,18, T13N,R32E		OP	development		Steve Anderson, Project Manager P.O. Box 1647 Fallon, NV 89406
	Reno Sparks Ready Mix, Inc., *contractor*	S8,9,T13N,R32E		OP	construction		Darol D. Cline, President P.O. Box 1325 Sparks, NV 89432
Mina gold mine	Pischel Mining Co.	S20,T9N,R17E	gold	OP,UG	development	2	Harold Pischel, Mine Manager P.O. Box 436 Mina, NV 89422
Santa Fe mine	Corona Gold Inc.	S6,T8N,R35E; S36,T9N,R34E; S31,T9N,R35E	gold silver	OP,HL	multiple bench cyanide	103	Gregory A. Lang, Resident Manager P.O. Box 3220 Hawthorne, NV 89415
	Brown & Root USA, Inc., *contractor*	S31,T9N,R35E		OP	multiple bench		Dean Domsten, Project Manager P.O. Box 3220 Hawthorne, NV 89425-2570
Spot deposit	N. A. Degerstrom, Inc.	S11,T7N,R36E	gold silver	OP,HL	cyanide	3	Floyd L. Miller, Manager P.O. Box 185 Mina, NV 89422
NYE COUNTY							
Ash Meadows plant	East West Minerals, Inc.	S1,T18S,R51E	zeolite	ML	screening drying bagging	4	Valerie Shelton State Route 15 P.O. Box 7006 Amargosa Valley, NV 89020
Basic Inc.	AB & B	S26,34,T12N,R36E	magnesite	OP,ML	calcining dead burning sizing separation	95	Don Pressey, Works Manager P.O. Box 177 Gabbs, NV 89409
Bullfrog mine	Bond Gold Bullfrog, Inc.	S15,T12S,R46E	gold silver	OP,HL	multiple bench cyanide grinding	280	Jack Bingham, Project Manager P.O. Box 519 Beatty, NV 89003
	Industrial Contractors Corp., *contractor*	S15,T12S,R46E		OP	multiple bench		Iradj Azimi P.O. Box 909 Beatty, NV 89003
	The Industrial Co. of Steamboat Springs, *contractor*	S15,T12S,R46E		OP	construction		Robert Dusbabek, Construction Manager P.O. Box 100 Beatty, NV 89003

continued

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
NYE COUNTY (continued)							
Cinder Cone pit	Cind-R-Lite Co.	S28,T14S,R49E	cinder	OP	gravity	4	E.L. Selman 3333 Cinder Lane Las Vegas, NV 89103
Crowell Daisy mine	J. Irving Crowell & Son	S14,15,22,23, T12S,R47E	fluorspar	UG	crushing	2	Jack I. Crowell P.O. Box 96 Beatty, NV 89003
Cyprus Tonopah mine	Cyprus Tonopah Mining Corp.	S5-8,T5N,R42E	molybdenum copper	OP	grinding flotation	275	W. A. Gibson, Vice President/General Manager P.O. Box 1569 Tonopah, NV 89049
Gold Bar mine	Angst, Inc.	S36,T11S,R45E	gold silver	OP,HL	cyanide	42	Britt T. Johnson P.O. Box 1030 Beatty, NV 89003
Industrial Mineral Ventures	Floridin Co.	S29,T17S,R49E	clay	OP	grinding drying	72	Joseph Wujcik, Plant Manager Star Route 15 Box 549 Amargosa Vly, NV 89020
Lathrop mill	American Borate Co.	S36,T17S,R49E	calcium borate	ML	flotation calcination	26	Darrell Cypert Star Route 15 Box 610 Amargosa Valley, NV 89020
Manhattan mine & mill	Round Mountain Gold Corp.	S19,20,29,30, T8N,R44E	gold silver	OP,HL	gravity flotation cyanide leach crush/grind	74	Andre Douchane, Project Manager P.O. Box 56 Manhattan, NV 89022
	W.E. Vining, *contractor*	S20,T8N,R44E		OP	multiple bench		W.E. Vining, Owner P.O. Box 2499 Carson City, NV 89702
Mother Lode mine	N. A. Degerstrom, Inc.	S7,8,T12S,R48E	gold silver	OP,ML, HL	multiple bench	46	William G. Stotts, Mine Manager P.O. Box 40 Beatty, NV 89003
New Discovery mine	Vanderbilt Minerals Corp.	S13-24,T12S,R46E; S18,19,T12S,R47E	clay	UG,ML	grinding bagging	7	Jerry W. Lease P.O. Box 399 Beatty, NV 89003
Northumberland mine	Western States Minerals Corp.	S24,T13N,R45E	gold silver	OP,HL	cyanide	50	Gaylen Cropper P.O. Box 109 Kingston Village Austin, NV 89310
P & S barite mine	The Standard Magnesia Co.	S11,14,15, T13N,R45E;	barite	OP	multiple bench	3	Sergio M. Jaramillo P.O. Box 10477 Reno, NV 89510
Paradise Peak mine	FMC Gold Co.	S7,12,13,24, T10N,R36E; S3-22,T10N,R35E	gold silver mercury	OP,ML, HL	grinding cyanide Merrill Crowe retorting	219	E. Woody Wayland, General Manager P.O. Box 145 Gabbs, NV 89409
Smoky Valley Common Operation	Round Mountain Gold Corp.	S19,20,29,30, T10N,R44E; S12,24,25,36, T10N,R43E	gold silver	OP,HL, ML	cyanide	690	Andre J. Douchane P.O. Box 480 Round Mountain, NV 89045
	Gibbons & Reed Co., *contractor*	S19,T10N,R44E		ML	construction		Jack Huff, Superintendent P.O. Box 369 Round Mountain, NV 89045
	J.S. Redpath Corp., *contractor*	S19,T10N,R44E		UG	development		Bruce McKinstry, Senior Manager for Contracting P.O. Box 480 Round Mountain, NV 89045
	Patrick Harrison Mining Corp., *contractor*	S19,T10N,R44E		UG	exploration decline development		Larry Twerdun, Superintendent P.O. Box 2020 Round Mountain, NV 89045
	The Industrial Co. of Steamboat Springs, *contractor*	S19,T10N,R44E		ML	construction		Cal Brown, Project Superintendent P.O. Box 449 Round Mountain, NV 89045
	Utah Construction & Development, *contractor*	S19,T10N,R44E		ML	construction		Lloyd Grenshaw, Construction Superintendent P.O. Box 230 Round Mountain, NV 89045

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
NYE COUNTY (continued)							
Sterling mine	Saga Exploration Co.	S6,T13S,R48E	gold silver	UG,ML, HL	drifting cyanide	35	Greg Austin, President P.O. Box 6479 Reno, NV 89513
Summit project	Zephyr Resources, Inc.	S31,T12N,R40E	gold silver	OP	single bench	1	Rory Tibbals P.O. Box 768 Silverpeak, NV
	J. D. Welsh and Associates	S31,T12N,R40E		OP	single bench		Murray N. Hutchison, General Manager P.O. Box 1236 Winnemucca, NV 89445
PERSHING COUNTY							
Buff mine	Vanderbilt Minerals Corp.	S2,T27N,R32E	clay	OP	grinding bagging	6	Jerry W. Lease 2320 Viking Road Las Vegas, NV 89109
Colado operations	Eagle-Picher Minerals, Inc.	S7,T28N,R29E; S6,T27N,R32E	diatomite	OP,ML	crushing drying classification grinding calcining	105	Jack P. Richards Drawer "A" Lovelock, NV 89419
Dusty mine	Dusty Mining Co.	S24,T32N,R31E; S20,30,T32N,R32E	gold	OP	gravity flotation	8	L. Edward Speir P.O. Box 1149 Lovelock, NV 89419
Florida Canyon mine	Florida Canyon Mining, Inc.	S1-3,10-12,37,38, T31N,R33E	gold silver	OP,HL	cyanide	93	John Leahy P.O. Box 330 Imlay, NV 89418
	N. A. Degerstrom, Inc., *contractor*	S2,T31N,R33E		OP	multiple bench		James J. Wolfe, Superintendent P.O. Box 1150 Lovelock, NV 89419
Relief Canyon mine	Florida Canyon Mining, Inc.	S18,T27N,R34E	gold silver	OP,HL	cyanide	14	John Leahy, General Manager P.O. Box 1150 Lovelock, NV 89419
	Morrison-Knudsen Co., Inc., *contractor*	S16,T27N,R34E		OP	multiple bench		John O'Laughlin, Project Manager P.O. Box H Lovelock, NV 89419
	N. A. Degerstrom, Inc., *contractor*	S16,T27N,R34E		ML	crushing		Robert Wallin, Area Manager P.O. Box 1150 Lovelock, NV 89419
Rochester mine	Coeur-Rochester, Inc.	S15,16,21,22, T28N,R34E	silver gold	OP,HL	cyanide	289	Robert Martinez, Project Manager P.O. Box 1057 Lovelock, NV 89419
Sexton mine and mill	W. Glen Sexton	S5,8,T34N,R38E	dolomite/ limestone	OP	grinding	4	W. Glen Sexton East 4th Street Winnemucca, NV 89445
Trinity silver mine	U.S. Borax & Chemical Corp.	S9,T29N,R30E	silver gold	OP	cyanide merrill crowe	7	Richard C. Jensen, Resident Manager Drawer L Lovelock, NV 89419
Willard Gold mine & mill	Western States Minerals	S35,36,T28N,R32E	gold silver	OP,HL, ML	cyanide multiple bench	58	Thomas Wood, mine manager P.O. Box K Lovelock, NV 89419
STOREY COUNTY							
Clark operations (mine & mill)	Eagle-Picher Minerals, Inc.	S28,33,34, T20N,R23E; S35,T20N,R22E	diatomite	OP,ML	crushing drying calcining	50	Thomas A. Buchanan P.O. Box 10480 Reno, NV 89510
Flowery mine	American Eagle/ Miramar	S22,23,24,26,27, T17N,R22E	gold silver	OP,HL	cyanide	35	324 South Wells Avenue Reno, NV 89502
Gooseberry mine & mill	Asamera Minerals (U.S.), Inc.	S25,T19N,R22E	silver gold	UG,ML, HL	flotation cyanide	38	Rick Karlson, Mine Manager 6121 Lakeside Drive Suite 130 Reno, NV 89511
	Selland Construction, Inc., *contractor*	S25,T19N,R22E		OP,ML	single bench		Norman J. Stevens, Operations Manager P.O. Box 2464 Elko, NV 89801

continued

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

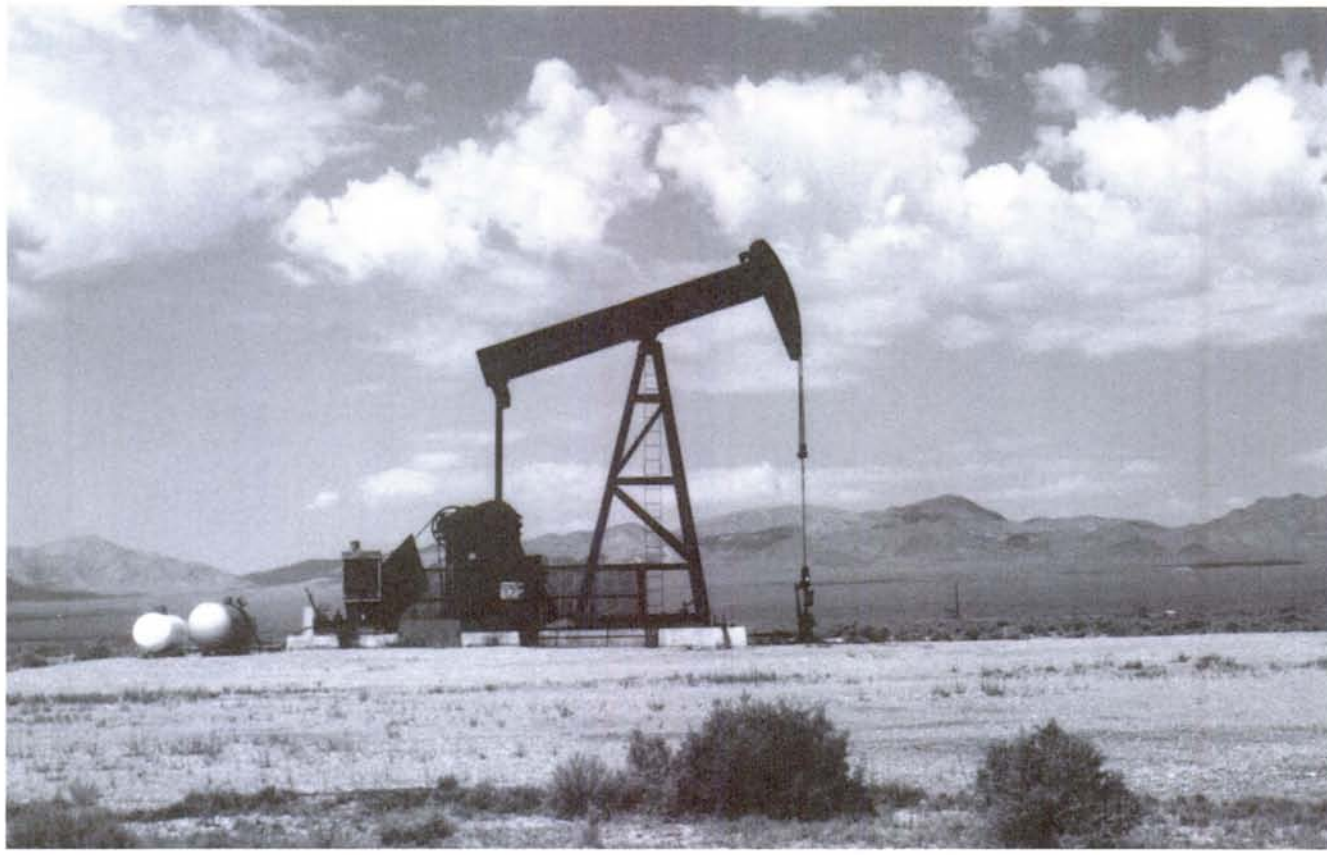
Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
STOREY COUNTY (continued)							
Lucerne mine	Oliver Hill Mining Co., Inc.	S8,T16N,R21E	gold silver	OP	multiple bench	4	Scott Jolcover, President P.O. Box 1298 Carson City, NV 89702
Washington Hill Quarry	All-lite Aggregate	S34,T19N,R21E	aggregate	OP,ML	multiple bench crushing	11	Norman L. Dianda, Partner P.O. Box 10865 Reno, NV 89510
WASHOE COUNTY							
Clay mine	Art Wilson Co.	S13,T27N,R19E	clay	OP	single bench	4	Art Wilson, Operator P.O. Box 1160 Carson City, NV 89702
Empire mine & mill	United States Gypsum Co.	S36,T31N,R24E; S36,T31N,R23E	gypsum	OP	grinding calcination	130	Michael D. Phillips P.O. Box 130 Empire, NV 89405
Rilite Aggregate	Rilite Aggregate Co.	S23,T18N,R20E	aggregate	OP	grinding crushing	12	Bruno Benna P.O. Box 11767 Reno, NV 89511
Western Hog Ranch mine	Western Mining Corp. USA	S24,T38N,R22E	gold silver	OP,HL, ML	cyanide	81	C. A. Moore, Resident Manager P.O. Box 9 Gerlach, NV 89412
	Ledcor Construction, Inc., *contractor*	S24,T38N,R22E		OP,ML	multiple bench crushing screening		Don Hall, Project Supervisor P.O. Box 138 Gerlach, NV 89412
Wind Mountain mine	Wind Mountain Mining, Inc.	S33,34,T30N,R23E	gold silver	OP,HL	cyanide	125	Andrew F. Pooler, General Manager P.O. Box 160 Empire, NV 89405
WHITE PINE COUNTY							
Alligator Ridge mine	Kennecott	S22-26,35,36, T22N,R57E	gold silver mercury	OP,ML, HL	CIL circuit cyanide	137	J. A. Coates P.O. Box 149 Ely, NV 89301
Bald Mountain mine	Placer Dome U.S., Inc.	S24,T24N,R56E; T24N,R57E	gold	OP,HL	multiple bench cyanide	155	D. G. Bailey P.O. Box 2706 Elko, NV 89801
	Pollocks Drilling, *contractor*	S16,17,18, T24N,R57E		EX	rotary drilling		Oren Pollock, Owner P.O. Box 123 Ely, NV 89301
Easy Junior mine	Alta Gold Co.	S9,T18N,R55E	gold	OP,HL	carbon-in-leach	80	Mike Iannacchione, Project Manager P.O. Box 120 Ely, NV 89301
Golden Butte mine	Alta Gold Co.	S2,3,T23N,R61E	gold silver	OP,HL	development cyanide multiple bench	63	Joseph A. Pescio, Mine Superintendent P.O. Box 324 East Ely, NV 89315
Golden Eagle mine	Terra Mining & Processing, Inc.	S26,T14N,R67E	gold	OP,ML	single bench gravity	5	Don Shaffer, Superintendent 842 Avenue "F" Ely, NV 89301
Green Springs mine	USMX, Inc.	S28,T15N,R57E	gold silver	OP,HL	multiple bench cyanide carbon absorption	59	Jim Kentopp P.O. Box 809 Ely, NV 89301
	Lost Dutchman Construction, Inc., *contractor*	S28,T15N,R57E		OP	multiple bench		Kim Gash, Superintendent P.O. Box 328 Ely, NV 89301
Illipah mine	Alta Gold Co.	S9,17,T18N,R58E	gold	OP,HL	cyanide carbon in leach	10	Mike Iannacchione P.O. Box 120 Ely, NV 89301
	W. E. Vining Co., *contractor*	S4,T18N,R58E		OP	multiple bench		W. E. Vining, President P.O. Box 2499 Carson City, NV 89702

DIRECTORY OF MINING AND MILLING OPERATIONS (continued)

Mine/plant name	Operator	Location	Commodity	Type	Process/ activity	Employees	Address
WHITE PINE COUNTY (continued)							
Little Bald Mountain mine	New Dynasty Mines (US), Inc.	S26,27,T24N,R57E	gold silver	OP,UG, HL	cyanide	19	Ronald D. Damele P.O. Box 314 Eureka, NV 89316
Robinson project	Alta Gold Co.	S10,11,15, T16N,R62E	gold silver	OP,ML, HL	CIL mill cyanide	359	Gary Cummings P.O. Box 324 Ely, NV 89301
	Dan S. Halstead & Son, *contractor*	S11,T16N,R62E		OP	single bench		Dan Halstead, owner State Route 2, Box 21 Ely, NV 89301
Taylor mill	Alta Gold Co.	S3,4,8-10,15, T14N,R65E	silver lead zinc copper	ML	flotation	80	Hy Ekelenburg, Vice President P.O. Box 382 Ruth, NV 89319
Ward Mountain mine	Alta Gold Co.	S11,T14N,R63E	silver lead zinc copper	UG	development stoping	94	Charles E. Nuanez P.O. Box 324 East Ely, NV 89315
White Pine gold mine	U.S. Gold Corp.	S1,T24N,R57E; S6,T24N,R58E; S36,T25N,R57E; S31,T25N,R58E	gold silver	OP,HL	cyanide carbon recovery	12	Joseph Young P.O. Box 305 Ely, NV 89301
	Gilbert Western Corp., *contractor*	S36,T25N,R57E		OP,HL			Val Hanni, Project Superintendent P.O. Box 908 Ely, NV 89301

Oil and Gas

by Becky Weimer Purkey



Chadco, Inc. Zuspann No. 24-3, Trap Spring Field, Nye County. *Nevada Department of Minerals photo.*

EXPLORATION

Oil and gas exploration activity remained strong in Nevada in 1989, a record year for number of successful new producers. Eight new wells, with a total drilled depth of 33,758 feet, began producing in 1989, and three more wells, totaling 14,711 feet, were drilled in 1989 but did not begin production until 1990. Fourteen dry holes, totaling 93,730 feet, were drilled, plugged, and abandoned; three other wells were temporarily abandoned; and one well was shut-in. Drilling of two wells was in progress at the end of 1989. On the average, three drilling rigs were active at any given time in Nevada throughout 1989.

All of the new producing wells are located on federal land. Six development contracts were in effect with the Bureau of Land Management in Nevada during fiscal year 1989, the same number as in fiscal year 1988. There were 7,748,238 acres under 2,910 federal oil and gas leases in fiscal year 1989. This was a quarter million acres less than in fiscal year 1988. (For more information on federal leases and development contracts see NBMG Special Publication MI-1988, p. 50-51.)

Three deep wells were drilled in 1989. The deepest well drilled was **True Oil Co.**'s **True-Bird Federal No. 31-23** (NW¼NE¼ sec. 23, T7N,R56E) in Railroad Valley, Nye County. Total depth was 11,912 feet. Intermittent gas shows and dead oil stains were reported from 8,530 to 8,760 feet in a Paleozoic limestone (Joana and Ely Limestones?) slide block. Traces of dead oil were again reported at intermittent intervals from 10,890 to 11,912 feet in unweathered Paleozoic dolomite. This well is 2½ miles west of the Bacon Flat field, which is producing from the Devonian Guilmette Formation at 5,330 feet, and 4 miles west of the Grant Canyon field, which is producing about 6,380 barrels of oil per day, also from the Guilmette Formation.

Mobil Oil Co. drilled the **Tommy Knocker Unit No. T61X-33G** (NE¼NW¼NE¼ sec. 33, T23N,R59E)

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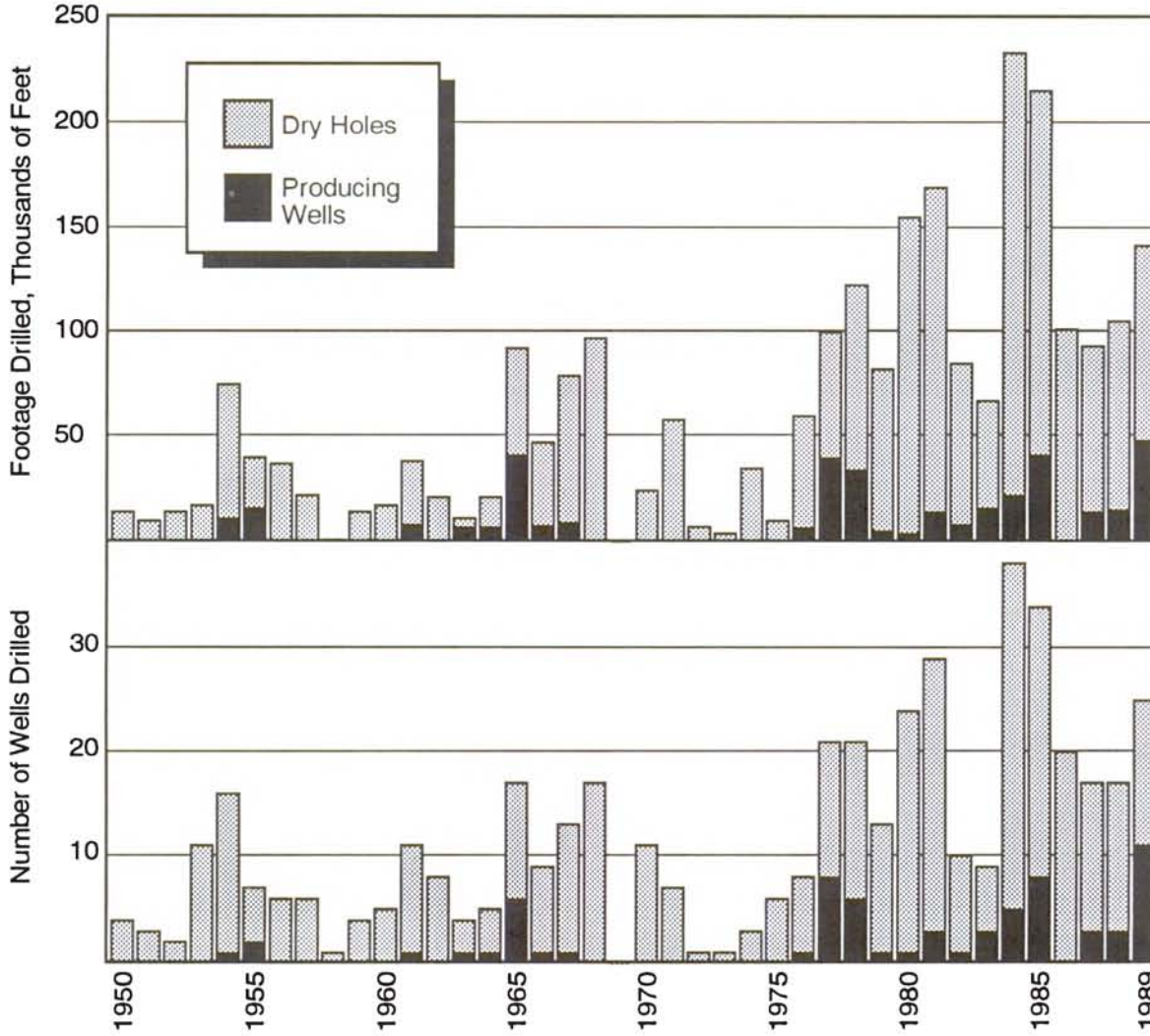
OIL WELL DRILLING ACTIVITY IN NEVADA IN 1989

Company	Well	Permit no.	Depth (feet)	Status (as of 31 Dec 89)
CHURCHILL COUNTY				
Terry F. Haskin	Reis Federal No. 1	561	W	TA
CLARK COUNTY				
Ruby Drilling Co.	Federal No. 1-20A	508	3,000	P&A
Ruby Drilling Co.	Federal No. 1-20B	527	895	P&A
ELKO COUNTY				
Exxon Corp.	Rattlesnake Unit No. 1	552	8,843	P&A
EUREKA COUNTY				
The Gary-Williams Co.	N. Koben Valley Fed. No. 13-10	526	W	TA
The Gary-Williams Co.	Lone Mountain No. 15-1	531	W	TA
Texaco, Inc.	TPI S.D. Bucy No. 1	541	10,579	P&A
The Gary-Williams Co.	Three Bar Unit Fed. No. 25-A	556	7,221	Drilled
The Gary-Williams Co.	Twin Springs Fed. No. 10-6	557	8,031	P&A
NYE COUNTY				
J. R. Bacon Drilling, Inc.	Munson Ranch No. 14-33	513	3,810	Producing
Makoil, Inc.	Munson Ranch No. 14-44	528	4,358	Producing
True Oil Co.	True-Bird Fed. No. 31-23	529	11,912	P&A
True Oil Co.	Shields Fed. No. 23-4	530	9,100	P&A
David M. Evans	Blind Spring No. 1	535	4,154	P&A
David M. Evans	Taylor Fed. No. 2	536	4,625	Producing
Makoil, Inc.	Munson Ranch No. 13-12	537	W	Shut-in
Makoil, Inc.	Munson Ranch No. 14-41	538	3,680	Producing
Apache Corp.	Kate Spring No. 12-2	544	4,594	Producing
Exxon Corp.	Wildhorse Unit No. 1	545	5,084	P&A
Exxon Corp.	Cottonwood Unit No. 1	546	4,319	P&A
J. R. Bacon Drilling, Inc.	Munson Ranch No. 13-45	547	4,319	Producing
J. R. Bacon Drilling, Inc.	Munson Ranch No. 13-46	548	4,353	Producing
J. R. Bacon Drilling, Inc.	Munson Ranch No. 14-48	549	W	Drilling
J. R. Bacon Drilling, Inc.	Munson Ranch No. 14-49	550	4,019	Producing
OHB, Inc.	Hanks No. 1401	555	3,502	P&A
Makoil, Inc.	Munson Ranch No. 12-32	559	3,002	Drilled
Western General, Inc.	Kate Spring Fed. No. 1-A	560	4,488	Drilled
Apache Corp.	Dry Lake Unit No. 1	563	W	Drilling
WHITE PINE COUNTY				
Mobil Oil Corp.	Tommy Knocker Unit No. T61X-33G	540	11,630	P&A
G-W Resources Operating Co.	Moorman Ranch Unit No. 1	551	5,272	P&A
	and redrill No. 1-A[1]		3,909	P&A
Remkin Corp.	Remkin Federal No. 1	558	3,500	P&A
		TOTAL[2]	142,199	

W: Depth information withheld in accordance with company requests and Nevada regulations.
TA: Temporarily abandoned.
P&A: Plugged and abandoned.
Drilled: Drilling finished but production not begun in 1989.
Drilling: Drilling not finished in 1989.
[1]No. 1 well was plugged back to 1,200 feet and directionally drilled to 5,109 feet around fish.
[2]Does not include temporarily abandoned or shut-in wells or wells still being drilled at the end of 1989.



Dry holes and producing wells drilled in Nevada, 1950–1989.

to a total depth of 11,630 feet in White Pine County. Oil zones were reported from 4,470 to 4,540 feet in the Pennsylvanian Ely Limestone. Intermittent traces of oil were found from 4,900 to 9,700 feet in the Ely and Guilmette Formations.

Texaco, Inc. drilled the third deepest well, the **TPI S.D. Bucy No. 1** (NW¼SE¼ sec. 6, T27N,R52E), to a depth of 10,579 feet in Eureka County, ¾ mile north-northwest of the Blackburn field. Oil stains were found from 6,210 to 6,230 feet, from 7,740 to 7,820 feet, at 8,090 feet, and from 8,410 to 8,560 feet in Miocene volcanic rocks; from 8,755 to 9,770 feet and from 10,000 to 10,410 feet in the Mississippian Chainman Shale; and from 10,410 to 10,445 feet in Devonian rocks.

Other shows in Eureka County include two wells drilled by **The Gary-Williams Co.** The **Twin Springs Federal No. 10-6** well (SE¼NW¼ sec. 10, T18N,R50E) encountered oil-stained rock and traces of asphalt at numerous intervals from 5,479 to 8,031 feet (total depth) in Tertiary volcanics and Ordovician Hanson Creek Formation(?), Eureka Quartzite(?), and Antelope Valley Limestone(?). The **Three Bar Unit Federal No. 25-A** well (center NE¼ sec. 25, T28N,R51E) was drilled to a total depth of 7,221 feet. In early 1990, the well reportedly was tested on a 16/64-inch choke flowing approximately 50 barrels of oil daily with a flowing tubing pressure of 210 pounds per square inch. Perforations are in the Miocene Humboldt Formation (Petroleum Information, 2-26-90, p. 1). Additional zones will be tested, and Gary-Williams is requesting permits to drill additional wells in the area. The Three Bar No. 25-A is 3 miles north-northwest of the Blackburn field, a Pine Valley reservoir that produces oil from the Oligocene Indian Well, Mississippian Chainman, and Devonian Nevada Formations.

In White Pine County, **G-W Resources Operating Co.** reported oil stains in its **Moorman Ranch Unit No. 1** well (NW¼NE¼NE¼ sec. 16, T16N,R59E) at two intervals in the Pennsylvanian Ely Limestone (from 1,140 to 1,330 feet and 3,220 to 3,380 feet), and at three intervals in the Mississippian Chainman Shale (from 3,710 to 3,740 feet, 4,190 to 4,290 feet, and 4,950 to 5,200 feet).

True Oil Co. reported dead oil stains and oil shows at various intervals in the Eocene Sheep Pass Formation from 7,127 to 7,500 feet in its **Shields Federal**

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No. 23-4 well (NE¼SW¼ sec. 4, T7N,R57E) in Railroad Valley. Total depth was reached at 9,100 feet in the Devonian Guilmette Formation.

Makoil, Inc. may have two more producing wells in the Trap Spring field. A possible production zone at 3,880 feet has been tested in the **Munson Ranch No. 13-12** well (SW¼NW¼ sec. 13, T9N,R56E). The well is currently shut-in, but Makoil plans to redrill and deepen the well. The **Munson Ranch No. 12-32** (SW¼NE¼ sec. 12, T9N,R56E) well flowed 103 barrels of 26.8° gravity oil per hour during tests on January 7, 1990. Makoil plans to produce 1,500 barrels per day from a zone 2,982 to 3,002 feet (total depth) in the Tertiary Garrett Ranch volcanics.

Another probable producer in the Kate Spring field in Railroad Valley is the **Western General, Inc. Kate Spring Federal No. 1-A** (NW¼SW¼ sec. 2, T8N,R57E) well. Oil and gas zones occur from 4,371 to 4,488 feet in the Pennsylvanian Ely Limestone. The production zone will be from 4,438 to 4,488 feet for the 10.5° gravity crude (Petroleum Information, 2-26-90). Blue gas was flared for about 3 hours prior to flow tests in early January 1990 (Petroleum Information, 1-5-90). The No. 1-A, located ¼ mile north-northwest of the Kate Spring No. 1 well, will be put into production only when the No. 1 is shut-in. Western General, Inc. took over operation of the Kate Spring No. 1 from Marathon in May 1989 and reworked the well to bring it from shut-in status to production of from 4,000 to 11,000 barrels per month since July 1989.

NEW PRODUCERS

Of Nevada's eight new producing wells, six are located in the Trap Spring field in Railroad Valley. They came into production from July through September of 1989. Only one dry hole was drilled in the Trap Spring field in 1989.

The **Makoil, Inc. Munson Ranch No. 14-41** well (NE¼NE¼ sec. 14, T9N,R56E) was drilled to a depth of 3,680 feet, and is producing 27° gravity oil from 3,638 feet to total depth in the Garrett Ranch volcanics. Another new Makoil producer is the **Munson Ranch No. 14-44** (SE¼SE¼ sec. 14, T9N,R56E) which is also producing 27° gravity oil from the Garrett Ranch volcanics from a zone from approximately 3,685 feet to total depth at 4,358 feet.

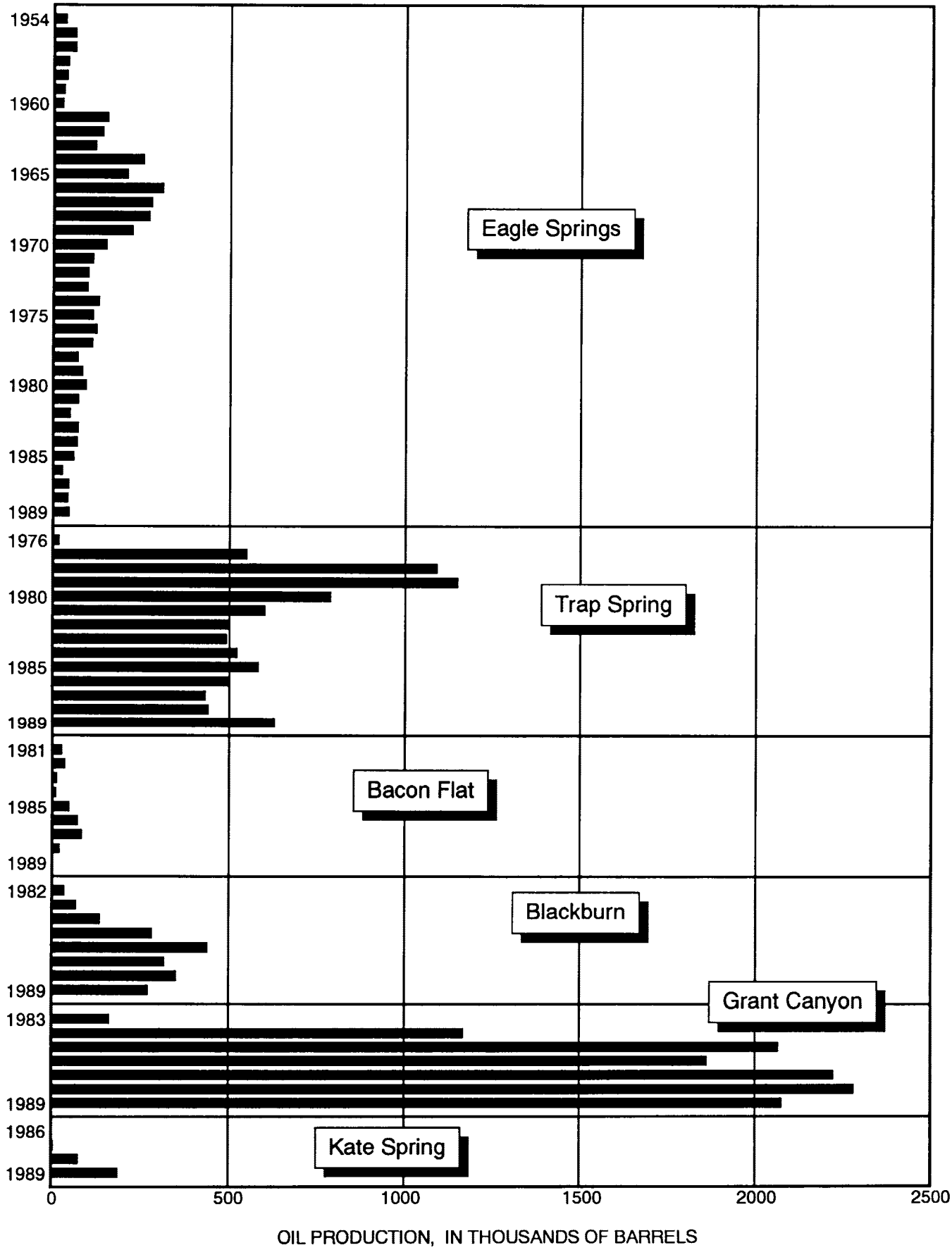
J.R. Bacon brought four new producing wells on line this year in the Trap Spring field. The **Munson Ranch No. 13-45** (NW¼SW¼ sec. 13, T9N,R56E) reported oil zones at 4,070 to 4,090 feet in the Tertiary Windous Butte volcanic rocks, and at 4,159 to 4,175 feet and 4,216 to 4,319 feet in Tertiary Pritchards Station ignimbrite. The **Munson Ranch No. 14-33** (NW¼SE¼ sec. 14, T9N,R56E), originally permitted by Marathon Oil Co., reported gas and oil zones from 3,715 to 3,810 feet (total depth). Production is from Pritchards Station ignimbrite. Oil zones for the **Munson Ranch No. 14-49** well (NE¼SE¼ sec. 14, T9N,R56E) were reported at 3,827 to 3,858 and at 3,910 to 3,910.6 feet in Pritchards Station ignimbrite. Total depth was 4,019 feet. Finally, J.R. Bacon's **Munson Ranch No.**

FEDERAL OIL AND GAS LEASES IN EFFECT IN FISCAL YEARS 1988 AND 1989[1]

County	NUMBER OF LEASES						ACREAGE					
	Competitive		Noncompetitive		Simultaneous		Competitive		Noncompetitive		Simultaneous[2]	
	FY88	FY89	FY88	FY89	FY88	FY89	FY88	FY89	FY88	FY89	FY88	FY89
Carson City	0	0	0	0	0	0	0	0	0	0	0	0
Churchill	0	0	10	15	12	3	0	0	21,207	27,379	20,701	3,148
Clark	0	0	55	26	54	30	0	0	86,666	23,751	58,827	27,069
Douglas	0	0	0	0	0	0	0	0	0	0	0	0
Elko	14	33	172	179	204	172	26,982	48,663	407,212	457,971	533,295	472,022
Esmeralda	0	0	1	0	0	0	0	0	1,287	0	0	0
Eureka	30	80	248	223	225	202	58,807	137,387	853,313	779,915	771,080	754,494
Humboldt	0	0	10	5	0	0	0	0	6,541	3,239	0	0
Lander	0	0	11	7	8	5	0	0	37,833	13,181	29,541	26,737
Lincoln	12	17	187	139	121	98	23,631	30,671	481,619	398,019	388,605	318,033
Lyon	0	0	0	0	0	0	0	0	0	0	0	0
Mineral	0	0	0	0	0	0	0	0	0	0	0	0
Nye	81	128	332	316	639	514	92,614	158,463	861,596	851,525	1,179,532	1,085,833
Pershing	0	0	11	10	1	0	0	0	18,665	18,025	6,402	0
Storey	0	0	0	0	0	0	0	0	0	0	0	0
Washoe	0	0	1	0	0	0	0	0	1,040	0	0	0
White Pine	53	102	226	281	465	397	100,229	179,977	604,782	709,883	1,330,461	1,222,853
TOTAL	190	288	1,264	1,201	1,729	1,421	302,263	555,161	3,381,761	3,282,888	4,318,444	3,910,189

[1]Data from the U.S. Bureau of Land Management FY88 = Oct. 1987–Sept. 1988; FY89 = Oct. 1988–Sept. 1989

[2]The simultaneous leasing program has terminated due to the Dec. 22, 1987 amendment of the 1920 Mineral Leasing Act. These leases were issued under this now expired program.



Production of Nevada's major oil fields; production of Tomera Ranch and North Willow Creek is too small to show in this figure.

PRODUCTION OF NEVADA'S OIL FIELDS[1]
(barrels)

Period	Eagle Springs (1954)[2]	Trap Spring (1976)	Currant (1979)	Bacon Flat (1981)	Blackburn (1982)	Grant Canyon (1983)	Kate Spring (1986)	Tomera Ranch (1987)	N. Willow Creek (1988)	Total	Change
Thru 1982	3,580,374	4,694,630	635	64,414	34,933	–	–	–	–	8,374,986	
1983	71,786	492,759	6	13,795	67,600	163,189	–	–	–	809,135	31%
1984	69,673	522,830	0	10,855	135,541	1,168,711	–	–	–	1,907,610	136%
1985	58,807	582,822	0	47,942	284,013	2,065,747	–	–	–	3,039,331	59%
1986	28,408	498,996	0	72,643	441,163	1,862,784	1,521	–	–	2,905,515	-4%
1987	45,821	432,690	0	84,156	318,553	2,221,642	5,494	1,032	–	3,109,388	7%
1988	43,451	441,832	0	20,855	351,582	2,280,323	75,725	5,221	9,457	3,228,446	4%
1989	47,272	629,281	0	0	272,119	2,076,272	188,408	225	4,036	3,217,613	-0.3%
TOTAL	3,945,592	8,295,840	641	314,660	1,905,504	11,838,668	271,148	6,478	13,493	26,592,024	

[1]Compiled from Producers' Monthly Reports filed with the Nevada Dept. of Minerals.
[2]Field discovery date.

13-46 well (NE¼SW¼ sec. 13, T9N,R56E) drilled through oil zones at 4,129 to 4,216 feet in the Windous Butte volcanic rocks, and again at 4,277 to 4,353 feet (total depth) in Pritchards Station ignimbrite.

Of the three wells drilled in the Kate Spring field in Railroad Valley in 1989, two became producers that year. **David M. Evans** drilled the **Taylor No. 2** well (SE¼NE¼ sec. 3, T8N,R57E) as a north offset to the Taylor No. 1 discovery. Gas and oil zones were recorded from 4,478 to 4,625 feet (total depth) in Devonian Guilmette dolomite, and the new well is producing from perforations at 4,519 to 4,533 feet. From 85 to 500 barrels of oil per day were pumped during initial production tests. Production began in August, and 22,798 barrels were produced by the end of 1989.

The second producer drilled in the Kate Spring field in 1989 was **Apache Corp.**'s **Kate Spring No. 12-2** (NW¼NW¼ sec. 2, T8N,R57E), a northeast offset to the Evans Taylor No. 2 well. Oil zones were reported at 4,070 to 4,390 feet, at 4,431 to 4,450 feet in siltstone, and at 4,450 to 4,550 feet in Paleozoic dolomite. When completed, the well flowed 1,560 barrels of 10° gravity oil per day from perforations in the Devonian Guilmette between 4,452 and 4,492 feet. This production rate makes the No. 12-2 the largest producer in the field. Production began in August 1989.

OIL AND GAS PRODUCTION

The total net oil production in Nevada in 1989 was 3,217,613 barrels from eight fields, according to the Producers' Monthly Reports filed with the Nevada Department of Minerals. The five fields in Railroad Valley in Nye County produced 91% of the oil; the rest came from three fields in Pine Valley in Eureka County.

The **Grant Canyon No. 3** well, located in SW¼SW¼ sec. 16, T7N,R57E, continues to be the most prolific onshore, free-flowing vertical well in the contiguous United States, capable of producing 4,100 barrels of 26° gravity oil per day from the Devonian Guilmette Formation.

The average net wellhead price for Nevada crude was $12.34/barrel in 1989 (John Snow, Bureau of Land Management). Nevada crude oil is transported by tank trucks to: the Petro Source Refining Corp.'s 8,000-barrel/day refinery and asphalt storage plant at Currant in Railroad Valley; the Petro Source Refining Partners asphalt storage facility and refinery (used only a few days a month for refining) at Tonopah; the Petro Source Refinery in Salt Lake City, Utah; or Crysen Refining, Inc. at Woods Cross, Utah (presently refining only Pine Valley crude oil). The Anschutz Corp. built a crude oil loading facility at Carlin, Nevada for transferring oil from truck to rail cars on the Southern Pacific Railroad.

In addition to Western General, Inc. buying out the Kate Spring No. 1 well from Marathon, two other producers changed owners in 1989. J.R. Bacon Drilling took over operation of Marathon's Munson Ranch No. 13-1 well in the Trap Spring field, and Petroleum Corp. of Nevada took over operation of Amoco's wells (Nos. 3, 10, 14, and 16) in the Blackburn field in Pine Valley.

In the Kate Spring field, gas production was officially recorded for the first time in Nevada during November and December 1989. Apache Corp. produced 6,961 thousand cubic feet (MCF) from the No. 12-2 well, David M. Evans produced 1,552 MCF from the Taylor Nos. 1 and 2 wells, and Western General produced 2,050 MCF from the Kate Spring No. 1. None of the gas is being sold. All gas is being used on the lease sites, and any excess is being flared.

CLOSURES

Despite the eight new producing wells completed in 1989, annual production decreased 0.3%

because of the shutting-in of several producing wells in the Trap Spring, Bacon Flat, Eagle Springs, Grant Canyon, and Tomera Ranch fields.

Of the 64 Nevada wells capable of producing, 18 were shut-in for 6 months or more during 1989. Several companies continued to suspend production on their leases (currently approved through May 31, 1990) in Railroad Valley and Pine Valley. Under a 1986 policy authorized by the Mineral Leasing Act of 1920, any oil and gas leaseholder with wells on federal land may opt to suspend production temporarily, rather than prematurely abandon the lease because of low domestic oil prices. This policy is meant to conserve domestic oil and gas reserves and provide for the collection of royalties and taxes on these leases in the future.

In the Trap Spring field, **Makoil, Inc.** suspended production on the Zuspann Nos. 24-1 and 24-3, the Munson Ranch No. 14-34, and the J.N. Federal No. 1 for all of 1989. **Apache Corp.** suspended production on the Nos. 1, 1-R, and 4 for the entire year. Production on the Nos. 17 and 19 was suspended for 7 and 5 months in 1989, respectively.

Apache Corp. also suspended production all year on the only producer in the Bacon Flat field, the Bacon Flat No. 1, and the Grant Canyon No. 1 in the Grant Canyon field.

In the Eagle Springs field, **John A. Lyddon** suspended production on its four wells (Nos. 1-35, 15-35, 35-35, and 62-35) all year. **Draycutt Corp.** continued suspension for the year on the Nos. 2, 4, and 34.

Foreland Corp. shut-in the S.P. Land Co. No. 1-5 well in the Tomera Ranch field in Pine Valley for 10 months in 1989.

U.S. OIL PRODUCTION AND CONSUMPTION

Domestic crude oil production in 1989 recorded the sharpest annual decline in history, according to the American Petroleum Institute. Crude oil production in the U.S. averaged 7,587,000 barrels per day in 1989, 6.8% less than the 1988 average of 8,140,000 barrels per day. Alaska's upward trend in production during the past ten years slowed down in 1989 and there was a large reduction in production in the lower 48 states. Production in the lower 48 states is projected to decline at an annual rate of 3% through 1993, according to the American Petroleum Institute (Petroleum Information, 1-26-90, p. 3).

Domestic crude oil reserves have declined at a fairly steady rate since 1973. The latest report on the subject, entitled "Estimates of Undiscovered Conventional Oil and Gas Resources in the United States—A Part of the Nation's Energy Endowment," was released by the U.S. Geological Survey and the Minerals Management Service this year. According to this report, known oil reserves are equal to about 9 times current annual domestic production and known gas reserves are equal to about 13 times current annual production.

Oil companies are accelerating their shift away from the U.S. in their worldwide oil and gas exploration and production spending, according to James D. Crandell and Carol Y. Lau of Salomon Brothers in their *Survey and Analysis of 1989 Worldwide Oil and Gas E & P Expenditures* (June 1989). In the fourth quarter of 1989, Petroleum Information conducted a survey of the oil and gas industry's drilling and production-related plans for 1990. Almost 200 oil and gas exploration and production companies responded. Three-fourths of the major companies indicated that they would emphasize international offshore prospects, while independents listed domestic targets as their top priority.

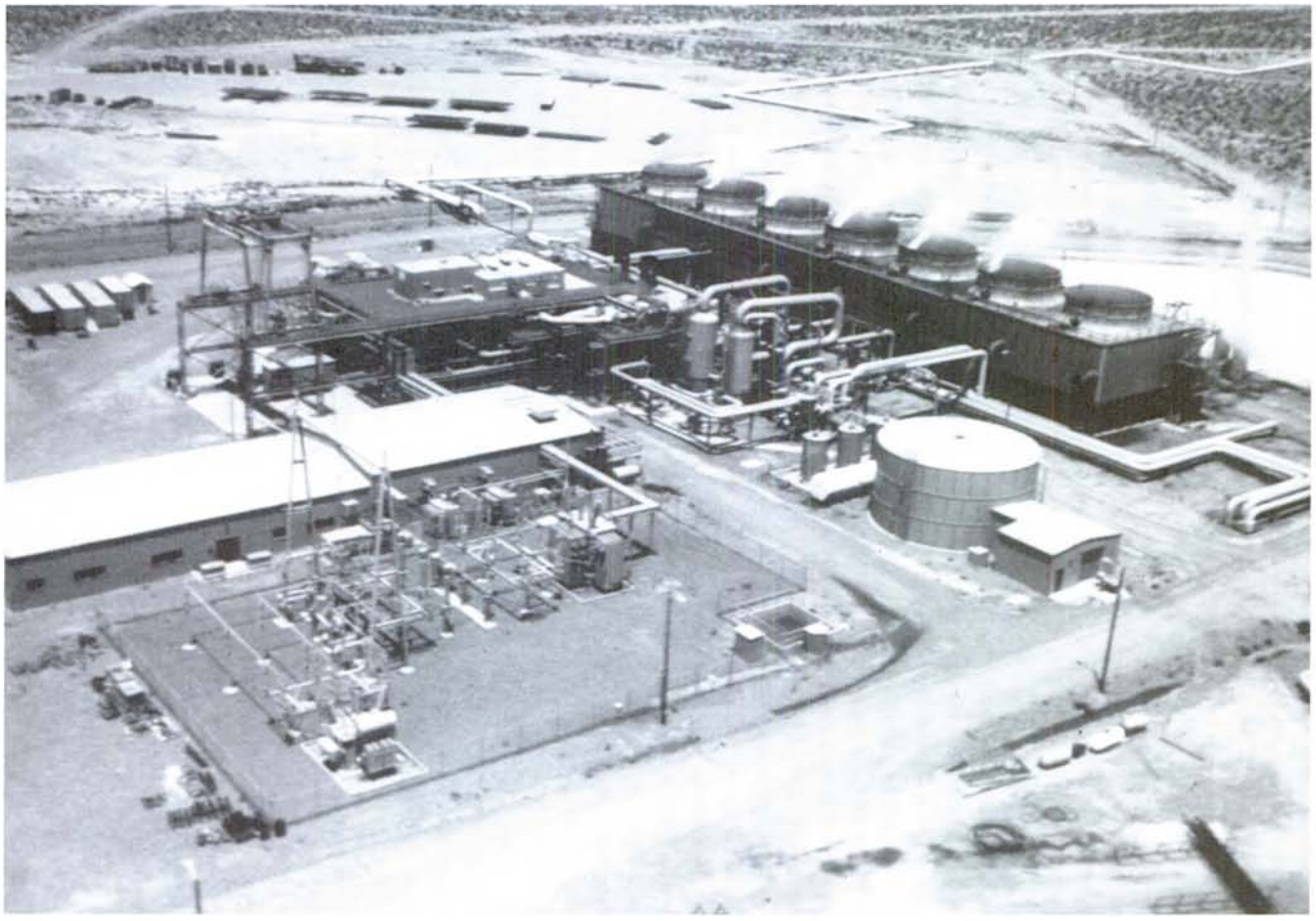
In 1989, petroleum imports were the highest in 10 years. Imports of crude oil and petroleum products have risen nearly 54% over the past three years, according to the American Petroleum Institute. About half of this rise in imports is due to greater U.S. consumption and half to lower domestic crude oil production (Petroleum Information, 12-1-90, p. 3). Total imports (crude oil plus petroleum products) averaged 7,952,000 barrels per day in 1989, up 8.2% from the 1988 average of 7,350,000 barrels per day. Forty-six percent of the total petroleum products delivered in the U.S. in 1989 were imports (the all-time record of 48% was reached in 1977) (Petroleum Information, 1-26-90, p. 3).

Worldwide demand for petroleum is up—world energy consumption will likely rise 50% to 75% between 1985 and 2020 (Oil and Gas Journal, v. 87, no. 39, p.8)—and OPEC keeps raising its production ceiling to fill the gap. John B. Gustavson, president of the Denver-based international consulting firm Gustavson Associates, predicts the "the driving economic forces will continue to be the combination of U.S. demand and the abundance of [OPEC] oversupply. The U.S. domestic oil industry will continue to be influenced more by OPEC's supply ability than U.S. demand." (AAPG Explorer, v. 11, no. 1).

The Nevada Department of Minerals is gratefully acknowledged for its help in compiling the information in this section.

Geothermal Energy

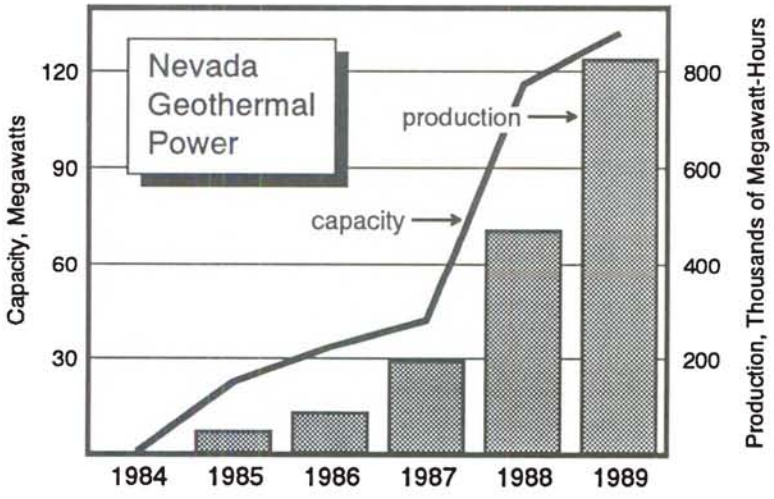
by Ronald H. Hess and Larry J. Garside



Oxbow Geothermal's power plant in Dixie Valley, Churchill County. *Photo by Dick Benoit, Oxbow Geothermal Corp.*

Twenty-six geothermal well permits were issued by the Nevada Department of Minerals during 1989: four industrial class (power generation), two commercial class (commercial use other than power generation), eight domestic class (household uses), ten injection wells, one observation well, and one permit for a series of thermal gradient wells. Fifteen geothermal wells are reported to have been drilled during 1989 for a total footage drilled of 48,599 feet. Six of the wells drilled were industrial class with a total footage drilled of approximately 24,000 feet.

As of March 15, 1990, there were 160 noncompetitive and 51 competitive federal geothermal leases totaling 361,388 acres, a decrease of 19,345 acres since 1988. Federal leases generated $449,783 in rental fees (State Office, U.S. Bureau of Land Management).



Capacity and annual production of Nevada geothermal power plants, 1984–1989. The first plant was completed in 1984 with an initial capacity of 600 kilowatts.

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GEOTHERMAL WELLS DRILLED IN NEVADA—1989

Area	Company	Well name	Proposed depth (ft)	Location	Type
Churchill County					
Dixie Valley	Oxbow Geothermal Corp.	Well #"7" 82-7	10,000	NE¼ NE¼ S7,T24N,R37E	Industrial class
Dixie Valley	Oxbow Geothermal Corp.	Well #"5" 25-5		NW¼ SW¼ S5,T24N,R37E	Injection well
Dixie Valley	Oxbow Geothermal Corp.	Well #"7" 63-7	9,000	NW¼ NE¼ S7,T24N,R37E	Industrial class
Stillwater	AMOR IV Corp.	Lawrence #24-7		SW¼ NW¼ S7,T19N,R31E	Injection well
Stillwater	AMOR IV Corp.	Vierra #13A-6	1,600	SW¼ NW¼ S6,T19N,R31E	Industrial class
Stillwater	AMOR IV Corp.	Vierra 13-6	3,000	SW¼ NW¼ S6,T19N,R31E	Industrial class
Stillwater	AMOR IV Corp.	Well #"1" 81A	3,000	NE¼ NE¼ S1,T19N,R30E	Injection well
Stillwater	AMOR IV Corp.	Well #"1" 84-1 (relief well)	3,000	SE¼ NE¼ S1,T19N,R30E	Industrial class
Stillwater	AMOR IV Corp.	Well #"31" 17-31	3,000	SW¼ SW¼ S31,T20N,R31E	Injection well
Stillwater	AMOR IV Corp.	Well #"31" 25-31	3,000	NW¼ SW¼ S31,T20N,R31E	Injection well
Stillwater	AMOR IV Corp.	Well #"6" 12-6	3,000	NW¼ NW¼ S6,T19N,R31E	Industrial class
Stillwater	AMOR IV Corp.	Well #"6" 14-6 (blow out)	3,000	SW¼ NW¼ S6,T19N,R31E	Injection well
Washoe County					
Moana	Nevada Properties	Well #4	750	NE¼ NE¼ SW¼ S24,T19N,R19E	Injection well
San Emidio	AMOR II Corp.	Slim Hole C	1,000	SW¼ NE¼ S21,T29N,R23E	Observation well
Steamboat Springs	Yankee/Caithness Joint Venture	Well #"5" ST 13-5	2,500	SW¼ NW¼ S5,T17N,R20E	Observation well

The total geothermal electrical production from federal and fee lands in Nevada in 1989 was 827,391 megawatt-hours with an approximate sales value of $72,790,000. Existing gross geothermal production capacity in Nevada is 130.8 megawatts. Geothermal energy production from federal lands in Nevada totaled 700,000 megawatt-hours in 1989; the net sales value of this production was $66,000,000. Federal production royalties totaled $1,700,000. By regulation, half of all funds collected by the Bureau of Land Management from federal geothermal leases and production royalties are returned to the State. In 1989 geothermal lease returns ($224,891) and royalty returns ($850,000) to Nevada totaled $1,074,891.

The Geothermal Steam Act of 1970 was amended by Congress in 1988 to remove bona fide sales of geothermal steam as a requirement for geothermal lease extensions and to provide for lease extensions by the Secretary of the Interior if certain conditions are met. To qualify, a geothermal developer must be making a diligent effort to develop and produce from the lease. This amendment also prohibits the issuance of a geothermal lease in a National Park if significant adverse effects are likely. Interim regulations required to implement this legislation were issued in 1989 by the U.S. Bureau of Land Management (Geo-Heat Center, Fall 1989).

Nevada's geothermal industry continued to grow and prosper in 1989. Nevada has over 400 megawatts of known geothermal resources in excess of that currently utilized. Approximately 100 megawatts is scheduled to be brought on line over the next 4 years. Although geothermal development is expected to remain slow nationally, due to reduced tax credits and stable conventional energy supplies, Nevada's geothermal industry should continue to develop and prosper into the foreseeable future.

Churchill County

The **Oxbow Geothermal Corp. Dixie Valley** plant averaged 96.2% of operating capacity during 1989. At year-end the plant was producing 56.5 megawatts net as measured at the point in California where their power line connects to the Southern California Edison Co. grid. The energy produced is purchased by Southern California Edison under a standard offer no. 4 contract. Oxbow's drilling activity during 1989 included the completion of two new production wells and a new injection well. They plan to drill another injection well in the near future (oral commun., Dick Benoit).

The **Fallon Naval Air Station** is moving ahead on development of a proposed $160 million, 80-megawatt geothermal plant. The plant is expected to come on line in 1992 and the resource should remain in production for at least 40 years. The Navy plans to use about 8 megawatts for base operations and sell the rest to a local utility company (Reno Gazette-Journal, July 21, 1989).

The **Ormat Energy Systems, Inc., Stillwater Geothermal I** plant came on line in April 1989. Total project cost was $36 million. Construction funds were provided by Bankers Trust Company and the Bank of Nova Scotia. Chrysler Corp. and Constellation Development, Inc., comprise the lessors partnership while the long-term financing is provided by Prudential Power Funding Associates. The air-cooled

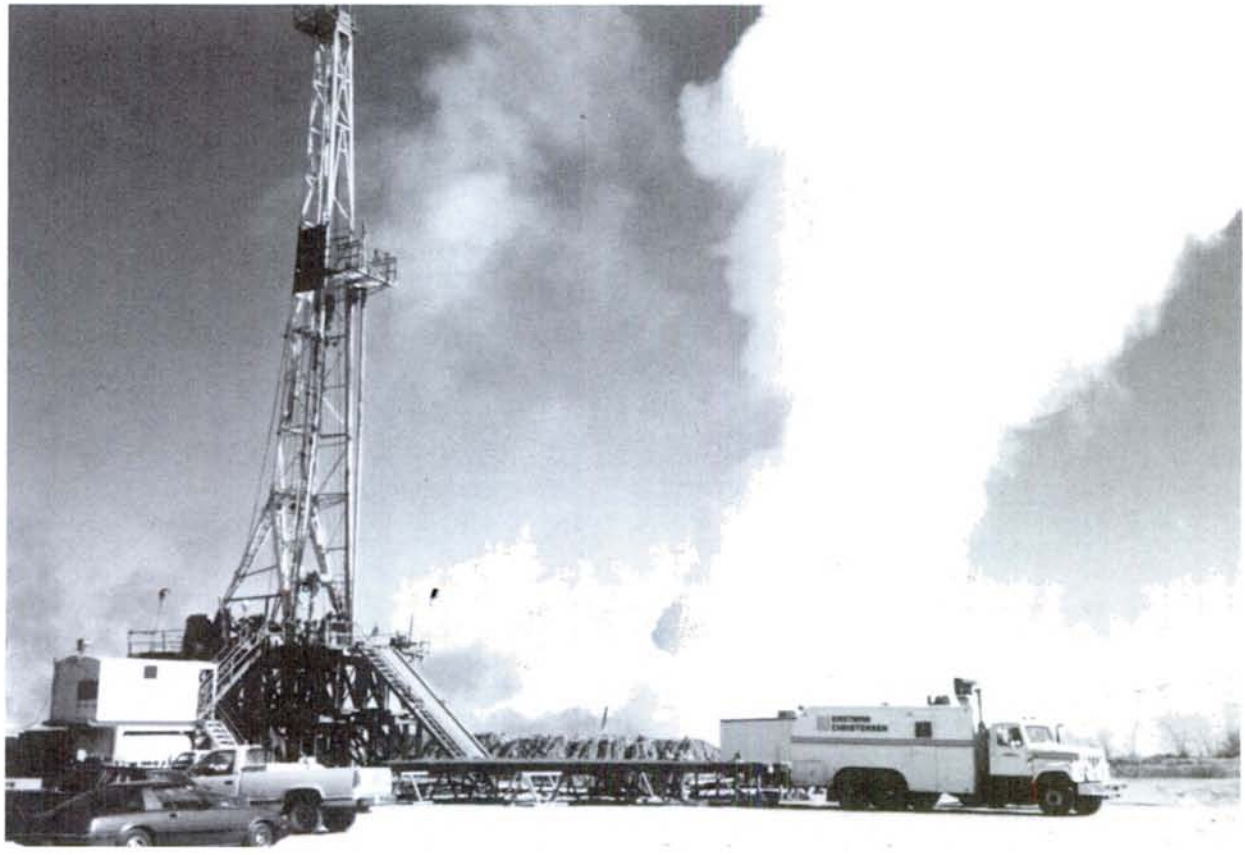
plant consists of 14 Ormat Energy Converters that have a combined gross generating capacity of 13 megawatts. The plant utilizes a liquid-dominated geothermal source, from four production wells, ranging in temperature from 310° to 340°F. This is currently the largest air-cooled binary geothermal power plant in the country. The plant operates on a closed system, all geothermal liquids are reinjected (Ormat Fact Sheet, 1989; Geo-Heat Center, Fall 1989).

An underground blowout occurred during the drilling of the AMOR IV Corp. No. "6" 14-6 well. This well was originally permitted to be completed as a production well for the Stillwater Geothermal I plant. The blowout destroyed the drilling derrick but some of the other drilling equipment was salvaged. A relief well, the No. "1" 84-1, had to be drilled to control the estimated 5,000-gallon-per-minute flow rate of the blowout well. The No. "1" well intercepted the No. "6" well at about 800 feet and was successfully used to control the flow of the blowout well. Both wells have been plugged and abandoned. Major efforts were made to minimize the surface impacts of the geothermal fluids flowing from the blowout well. For the most part, these efforts seem to have been successful (Nevada Section, Geothermal Resources Council Newsletter, March 1989; oral commun., Dick Whiting, Nevada Department of Minerals).

Ormat Energy Systems' wholly owned subsidiary **AMOR IX Corp.** has filed an application requesting approval to construct the **Soda Lake Geothermal No. 2** plant. This plant will have a net operating capacity of 13 megawatts. Ormat has been awarded a 13-megawatt long-term power purchase agreement from Sierra Pacific Power Co. The agreement calls for commercial power production at Soda Lake No. 2 to begin in December 1990. According to Ormat, revenues from the project, in its first 10 years of operation, are expected to exceed $50 million (Ormat Project information sheet, 1990; Geothermal Hot Line, December 1989). The existing Soda Lake plant has a gross capacity of 3.6 megawatts.

Elko County

The Elko County Court House is now being heated with geothermal energy. The geothermal system utilizes a heat exchanger and radiators, and cost the county $230,000, which included piping to the courthouse, repiping within the courthouse, engineering fees, and individual room radiators. The savings produced by the use of geothermal heat instead of natural gas is estimated to be $5,000 per year. The December 1988 heating bill using the old system was $2,082, while the December 1989 bill was only $830. The system was designed by Chilton Engineering and installed by Chester Plumbing and



Relief well rig on site at the Stillwater geothermal field following blowout during drilling of a production well in 1989. Site of blowout well in background. *Photo by Dick Whiting, Nevada Department of Minerals.*

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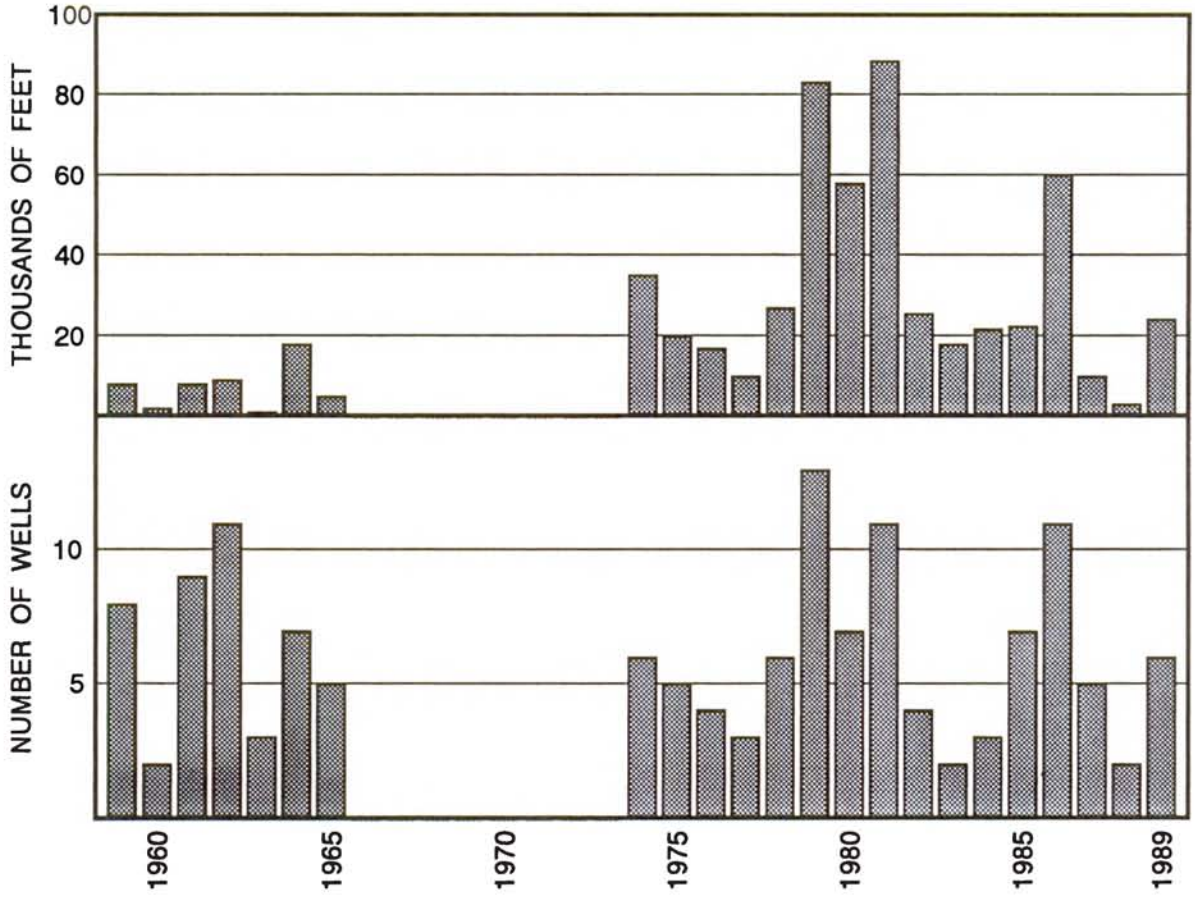

Industrial-class (power generating) geothermal wells drilled in Nevada, 1959–1989.

Heating. The 170°F geothermal fluid is provided by **Elko Heat Co.** (Geothermal Resources Council Bulletin, February 1990).

Washoe County

The **Ormat Energy Systems, Inc. Empire** plant consists of four Ormat Energy Converter Modules with a gross output of 4.8 megawatts. The geothermal fluids used in the production process range from 265° to 278°F. (Ormat Fact Sheet, 1989).

The **Peppermill Hotel/Casino in Reno** (Moana geothermal area) has three geothermal production wells that produce fluids at 127°. It is estimated that the use of this geothermal resource reduces the hotel/casino's conventional space heating costs by 33%. On September 1, 1988 the Peppermill was ordered by the Nevada Department of Environmental Protection to stop producing geothermal fluids until a reinjection program could be instituted to replace the existing practice of surface disposal. The Peppermill drilled an injection well to 2,050 feet but artesian pressure at that depth prohibited reinjection. The well was deepened to 3,300 feet and can now accept reinjected geothermal water at 1,100 gallons per minute, allowing the Peppermill to resume using the geothermal resource (Geo-Heat Center, Fall 1989; Geo-Heat Center, Winter 1990; oral commun., Glen McCormick, Chief Engineer, Peppermill Hotel/Casino).

The Peppermill Hotel/Casino is planning to begin a major expansion in late 1990. Part of this expansion will be improvements that allow for a much higher utilization rate of the existing geothermal production capacity. No new wells are planned at this time.

Yankee/Caithness Power submitted permit requests to install new binary generation equipment at their **Steamboat** plant that will increase plant capacity by 6 to 8 megawatts. Current gross capacity is 12.5 megawatts, generated from three production wells. The increased production will be obtained by utilizing the new equipment to extract additional energy from the geothermal fluid after it is flashed at the existing plant. In the past, nearby residents have complained about the sulfur smell and the possibility of health problems related to hydrogen sulfide emissions from the plant. It is believed that the reinjection plan that will be implemented as part of the expansion will eliminate any future hydrogen sulfide emissions (oral commun., Ted De Long, Caithness General Manager; Reno Gazette-Journal, October 18, 1989).

The **Ormat Energy Systems, Inc., Steamboat** plant originally consisted of seven Ormat Energy Converters with a gross capacity of 7 megawatts. In 1988 two additional Ormat Energy Converters were

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installed, increasing the plant's gross capacity to 9.8 megawatts. The plant uses a closed air-cooling system and injects 100% of the geothermal fluids used in the generating process. This helps insure that the plant will operate with a minimum possible impact on the environment. The plant is designed for automatic operation and has a current availability factor of 90% (Ormat Fact Sheet, 1989; Geothermal Hot-line, December 1988).

The **Washoe County District Board of Health** adopted regulations in April to control air pollution emissions (specifically hydrogen sulfide) from geothermal facilities. The regulations set certain limits for hydrogen sulfide emission levels on geothermal wells and power production facilities; the levels vary with distance from the nearest residential dwelling. Bills were introduced into the Nevada Legislature that would have reserved this type of regulation to the State, but they were not passed.

Residents of **Gerlach** hope to have a new geothermal spa completed in 1990 near the site of the well-known hot springs. Local residents raised funds from local donations, and volunteer labor is expected to reduce the final cost as well. Funds also were obtained from the Robert Z. Hawkins Foundation and Washoe County's park fund (Reno Gazette-Journal, July 17, 1989), but completion of the project depends on obtaining additional funds. Long-range planning also is underway to geothermally heat a clinic, a post office, a community center, and a school.

DIRECTORY OF GEOTHERMAL POWER PLANTS

Plant name (year on line)	Gross capacity (MW)	Location	Operator	Address	Remarks
Beowawe (1985)	16	S13,T31N,R47E	Chevron Resources	Jim DeGraffenreid P.O. Box 6 Beowawe, NV 89821	Production from two wells—one at 8,300 feet, the other at 9,600 feet. Maximum bottom-hole temperature 410°F.
Desert Peak (1985)	10.5	S21,T22N,R27E	Chevron Resources	Von Maynard, Superintendent P.O. Box 2627 Sparks, NV 89432-2627	Resource temperature 400°F Well-head temperature 330°F
Dixie Valley (1988)	60	S7,T24N,R37E S33,T25N,R37E	Oxbow	Don Wells, Plant Manager 200 South Virginia St., Suite 450 Reno, NV 89501	Estimated 30 to 60 year reservoir reserve with a 200+ MW production capacity. Now producing from six wells.
Empire (1987)	3.6	S21,T29N,R23E	Ormat/AMOR II	Monte Morrison, Operations Coordinator 610 East Glendale Avenue Sparks, NV 89431	Producing from a liquid-dominated geothermal source at 265° to 278°F.
Soda Lake (1987)	3.6	S33,T20N,R28E	Ormat/AMOR III	Monte Morrison, Operations Coordinator 610 East Glendale Avenue Sparks, NV 89431	Producing from a liquid-dominated geothermal source at 365°F.
Steamboat (1986)	9.8	S29,T18N,R20E	Ormat/Far West	Monte Morrison, Operations Coordinator 610 East Glendale Avenue Sparks, NV 89431	Three production wells provide 340°F fluid to one plant. Owned by Far West.
Stillwater (1989)	13.0	S1,T19N,R30E S6,T19N,R31E	Ormat/AMOR IV	Monte Morrison, Operations Coordinator 610 East Glendale Avenue Sparks, NV 89431	Producing from a liquid-dominated geothermal source at 310° to 340°F.
Wabuska (1984)	1.8	S15,16,T15N, R25E	Tad's	Grace Townsend Caldwell, Plant Manager 10 Julian Lane Yerington, NV 89447	Plant operates on geothermal fluids at 224°F from 350-foot depth.
Yankee/Caithness (1988)	12.5	S5,6,T17N,R19E	Yankee/Caithness	Ted De Long, General Manager P.O. Box 18160 Reno, NV 89511	Producing from three wells.
TOTAL	130.8				

Power from the Beowawe and Dixie Valley plant is purchased by Southern California Edison Co.; power from the other plants is purchased by Sierra Pacific Power Co.
Sources: MI-1988; Operators, 1990; and NBMG files.

For additional information on Nevada's mineral resources and mineral industries see the following NBMG publications:

Statewide Commodity Bulletins

Barite (B98)
Fluorspar (B93)
Gypsum (B103)
Montmorillonite, bentonite, and fuller's earth (B76)
Oil and gas (B104)
Radioactive minerals (B81)
Talcose minerals (B84)
Thermal waters (B91)
Tungsten (B105)
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Special Publications

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Economic impacts of Nevada's mineral industry—1988 update (L-9)
Nevada ore and concentrate buyers, custom mills, and smelters available to mine operators (L-7)
Major mines of Nevada 1989 (SP10)

NBMG maintains an open-file office with the following information available to the public:

NBMG, USGS, BLM, USBM, and DOE open-file reports on Nevada geology and mineral resources
petroleum and geothermal exploration and production
mining district records and maps
mineral resources and reserves
mineral resource assessments
core and cuttings library
mining claim data
wilderness study area reports
general geologic studies
indexes and ordering information for maps, air photos, and remote sensing imagery

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The Nevada Bureau of Mines and Geology (NBMG) is part of the Mackay School of Mines at the University of Nevada, Reno and is the state geological survey. NBMG scientists conduct research and publish reports on mineral resources and various aspects of general, environmental, and engineering geology.

Current activities in mineral resources and general geology include detailed geologic mapping and stratigraphic studies in Nevada, comparative studies of bulk mineable precious-metal deposits, geochemical investigations of mining districts, resource assessments, igneous petrologic studies, hydrothermal experiments, research on the origin of hydrothermal platinum-group-element occurrences, and examination of the origin and distribution of borate deposits in Nevada.

Environmental, engineering, and urban geology projects include investigations of earthquake hazards and related aspects of neotectonics, examination of issues involved in siting nuclear and hazardous wastes, mapping of geomorphic features, radon hazard studies, studies of landslide hazards, and investigation of land subsidence in Las Vegas Valley.

Geologic information activities include creating and updating databases on mining districts, active mines and prospects, and geothermal and petroleum exploration and production; implementation and development of statewide geographic information systems; and maintenance of core and cuttings facilities, rock and mineral collections for research, aerial photographic imagery and maps, and extensive files on Nevada geology and resources.

NBMG cooperates with numerous state and federal agencies in providing geologic and resource information and in conducting research. Research results are published as NBMG bulletins, reports, maps, and special publications as well as in federal publications and scientific journals. In addition to addressing the needs for geologic information by conducting research, publishing reports and maps, and creating computer databases, staff members assist the public, industry, and government agencies by answering specific questions regarding Nevada geology and resources and by providing some chemical and mineralogical analyses.

Individuals interested in Nevada geology are encouraged to visit or write NBMG or call (702) 784-6691. NBMG offices are located in the west wing of the Scrugham Engineering-Mines Building on the University of Nevada, Reno campus. When visiting NBMG by car please stop at the information booth just inside the Center Street entrance on the south end of the campus. The attendant will issue you a temporary parking permit and give you directions to parking areas and the NBMG offices. Address mail to: Director/State Geologist, Nevada Bureau of Mines and Geology/178, University of Nevada, Reno, NV 89557-0088. A publication list will be sent upon request.

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