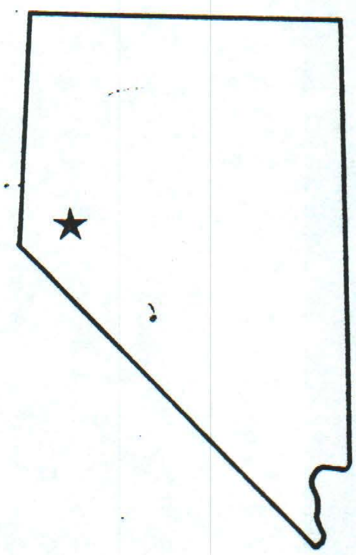
MINERAL RESOURCE EVALUATION OF THE PROPOSED MASTER LAND WITHDRAWAL AT NAVAL AIR STATION FALLON, CHURCHILL COUNTY, NEVADA



U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

BUREAU OF MINES
WESTERN FIELD OPERATIONS CENTER

MINERAL RESOURCE EVALUATION AND SOCIOECONOMIC STUDY OF THE PROPOSED MASTER LAND WITHDRAWAL AT NAVAL AIR STATION FALLON, CHURCHILL COUNTY, NEVADA CHURCHILL COUNTY, NEVADA

by

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and

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U.S. Bureau of Mines
Western Field Operations Center

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ABBREVIATIONS TABLE

MLW	Master Land Withdrawal
BLM	Bureau of Land Management
NBMG	Nevada Bureau of Mines and Geology
BOM	U.S. Bureau of Mines
Au	Gold
Ag	Silver
opt.	Troy ounces per ton (precious metals)
% per ton	% non-precious metal per short ton (2,000 pounds)
stu	short ton unit which is equal to 20 pounds (1%) per standard or short ton
NaCN	Sodium cyanide

1.0 Introduction

The proposed Master Land Withdrawal (MLW) is comprised of approximately 181,323 acres of federal (public) lands managed by the Bureau of Land Management (BLM). The United States recognizes that minerals are fundamental to the Nation's well-being and, as policy, strives to protect the availability of identified deposits and potentially significant mineral lands (National Materials and Minerals Policy, Research and Development Act of 1980; 30 U.S.C. 1601, 1605). Policy of the BLM is to encourage exploration for and development of the natural mineral resources it manages. Its objective is to manage exploration, development, and production activities in a timely manner while ensuring that those activities are integrated, using its "multiple use" concept, with the use, conservation, and protection of all other resources. The Navy also recognizes this fundamental importance of minerals and that mineral self-sufficiency of this nation is necessary to its mission.

1.1 Legal

Mineral commodities are classified by law into three distinct groups: Locatables, leasables, and salables. Locatable minerals are those minerals which, when found in valuable deposits, can be acquired under the General Mining Laws of 1872, as amended (17 Stat. 91; 30 U.S.C. 22 et seq.). Examples of locatable minerals occurring on public lands within the proposed MLW include, but are not limited to, those minerals containing gold, silver, tungsten, fluorite, copper, lead, and zinc. Uncommon varieties of limestone and other minerals, having unique and special values, are also locatables. Under the General Mining Law of 1872, U.S. citizens have a statutory right to explore vacant, unreserved public lands for these minerals. Upon discovery of a valuable deposit, citizens have a right to locate, mine, and remove the minerals. Prospecting and development that involve large disturbances of land are regulated by the BLM through regulations at Title 43, Code of Federal Regulations (CFR), part 3800. Mine and reclamation plans are reviewed and may contain stipulations or conditions that will avoid unnecessary or undue degradation of the public land or nonmineral resources.

Leasable minerals are those mineral commodities that may be acquired under the Mineral Leasing Act of 1920, as amended (41 Stat. 437, 30 U.S.C. 185, et seq). These minerals are subject to exploration and development under leases, permits, or licenses granted by the Secretary of the Interior. This authority is presently administered by the BLM, and implemented through regulations under Title 43, Code of Federal Regulations (CFR) at parts 3100 (oil and gas), 3400 (coal), and 3500 (solid leasable minerals other than coal and oil shale).1/ Geothermal resources are disposed of by the BLM through permit, lease, and license under the authority of the Geothermal Steam Act of 1970, as amended (84 Stat. 1566; 30 U.S.C. 1001-1025) and implementing regulations of 43

CFR 3200.

Salable minerals are common varieties of sand, stone, gravel, pumice, pumicite, cinders, and clay. All of these salables are of widespread occurrence within the proposed MLW. Through of relative low unit value, these materials often have high bulk commercial/industrial value and importance when located near markets, and take on even greater importance when other sources become unavailable due to depletion and lack of access. Salables are used chiefly for construction materials and road building. These minerals/rocks are disposed of by contract or permit under the authority of the Materials Act of July 31, 1947, as amended by the Act of July 23, 1955 (69 Stat. 367; 30 U.S.C. 601 et seq). Disposal of salable minerals from public lands administered by the BLM is totally at the discretion of the BLM and implemented under regulations of 43 CFR 3710.

At the time of this printing, the Department of the Navy has stated that mining and exploration can continue within the proposed MLW, subject to certain provisions. All Category A, B, and C lands would be opened to operation under the Mining Law of 1872, the Mineral Lands Leasing Act of 1920, as amended, the Mineral Leasing Act for Acquired Lands of 1947, the Geothermal Steam Act of 1970, or any one or more such Acts. Category D lands would not be opened to new exploration; however, access would be allowed to those persons with prior permitted claims (i.e., patented and unpatented claimholders) subject to advance approval of Commanding Officer, Naval Air Station, Fallon (CO NASF).

For locatable minerals, new mining claims would be located under the provisions of the mining laws subject to the land use controls for Categories A, B, and C. Mining operations would be regulated by the BLM with concurrence of CO NASF and would be subject to the land use controls. Access to and operations on new mining claims would be at the discretion of CO NASF and would not be guaranteed. Patents to new mining claims would convey title to locatable minerals only, together with the right to use so much of the surface as may be necessary for purposes incident to mining. Patents would contain a reservation to the United States for the land surface and nonlocatable minerals.

Mining claims with valid existing rights would be managed under existing laws and regulations. Reasonable access to valid existing mining claims in all categories of lands would be guaranteed,

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1/ There are no known mineral commodities within the MLW that fall under the Mineral Leasing Act of 1920.

subject to the conditions of current regulations. Operations would not be at the discretion of CO NASF. CO NASF would require that patented and unpatented claimholders in Category D land attend a briefing on the nature of the possible danger due to unexploded ordnance within these lands or could require additional precautionary measures. Patents to valid existing mining claims would convey title to both the surface and mineral estates. Patented mining claims, existing at the time of withdrawal, would be guaranteed reasonable access. Operations on these patented lands would be managed through existing state and local laws and regulations and would not be at the discretion of CO NASF.

For leasable minerals, applications for leases, permits, and licenses would be issued under the mineral leasing laws. BLM, with the concurrence of CO NASF, would issue leases, permits, and licenses subject to the land use controls for Categories A, B, and C. New leases would not be issued in Category D lands. The issuance of all leases, permits, and use authorizations would be subject to the advance approval of CO NASF.

For salable minerals, disposals of mineral materials would be made under the Material Sale Act and Rights-of-Way granted under the Federal Highways Act. BLM, with the concurrence of CO NASF, would issue permits, contracts, and grants, subject to the land use controls for Categories A, B, and C. New Developments of salable minerals would not be allowed on Category D lands. All use authorizations (permits, contracts, or grants) would be subject to the advance approval of CO NASF.

1.2 Purpose of Study

Prior to withdrawal of more than 5,000 acres of public land from mineral entry, section 204 (c) of the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1714) requires that a mineral report be prepared. The report is to include information on the geology, known mineral deposits, past and present mineral production, mineral interests in the area, an evaluation of future mineral potential, and present and potential market demands. The purpose of a minerals study is to assess the resource potential of known mineral deposits and to report potential for the presence of yet unidentified mineral deposits within the withdrawal area. Also considered were mines or well mineralized areas immediately adjacent to the proposed MLW which might be affected by Navy activities.

1.3 Mechanism of the Study

Mineral knowledge of the study area and past exploration within the study area have largely been influenced by deposit types (models) found to exist in those mining districts that border the proposed MLW. Examples of mineral commodities known to exist near the study area in significant quantities and identified within the study area are gold, silver, tungsten, lead, copper, zinc, fluorite, and diatomite.

A preliminary mineral potential appraisal of the study area was undertaken in 1987 by the Nevada Bureau of Mines and Geology (NBMG). This preliminary appraisal appropriately addresses the proposed MLW in the context of its regional geologic setting. The appraisal included library research on the regional geology and mineralization and past and present mining activity using available published information.

An inventory and classification of known mineral interest were also prepared as part of the same contract. Sources of information used in compiling the inventory are many. Mineral holdings determined to be within the proposed withdrawal area were visited. Not all claim/land holders within the proposed MLW were contacted. However, those who were contacted were most helpful in providing data concerning their holdings. Rock or mineral samples were taken of mineral occurrences, and mapping and sampling of known mineral development workings was performed.

Because the NBMG study only addressed the location of mineral properties, the Bureau of Mines (BOM) was requested to complete an economic assessment of the study area. This assessment addressed all significant commodities known to occur in the proposed MLW; determined, short of exploration, the actual number, type, size, and distribution of major, non-producing deposits; and studied the markets. Using mining and milling operations currently active in the region as examples, an appropriate mine/mill design was constructed for each deposit. The regional socioeconomic effects which would be generated by these mining operations in the MLW, if they were to come on line, were estimated from detailed analyses of the capital and operating costs of the operations using a model of the Churchill County economy.

After pairing mine/mill models with the ore deposits models, the socioeconomic effects (employment, taxes, cash flow, etc.) that mining activities would generate were estimated.

The information contained within the sections on minerals generally reflects the combined results of the NBMG and BOM field studies.

2.0 Mining History

2.1 General

The first recorded mineral discovery in Churchill County, Nevada, was by Asa L. Kenyon in 1855 when he discovered deposits of soda near what is now Soda Lake, east and north of Fallon. Although the county was literally overrun by prospectors in the 1860s, there were no major discoveries until nearly 50 years later. It was the production of soda and salt that were of importance at this time as these minerals were needed to reduce (treat) the silver ores from the famous Comstock. Three mining districts, all of which are in or adjacent to the proposed MLW [Silver Hill, Mountain Wells (La Plata), and Clan Alpine] came into existence in the 1860s, but production was limited. (Vanderburg, 1940)

A mining revival took place in Nevada starting in 1901 with the discovery of the gold-silver ores at Tonapah (Nye and Esmeralda Counties) followed by discoveries at Goldfield (Esmeralda County) that caused prospectors again to reinvestigate ground in Churchill County. During this period, the silver-gold deposits of Fairview (1905) and Wonder (1906) were discovered.

The first discovery in the Fairview mining district occurred in July, 1905, when some high-grade silver-gold float on the lower elevations of Fairview Peak was located (Shamberger, 1973, p. 2). A prospector rush began in 1906 which lead to the discovery of the district's richest mine, the Nevada Hills. This mine was the major producer, producing bullion valued at more than $3 million between 1906 and 1917. Precious metal production from the district probably exceeded $4 million through 1920. The primary producing mines lie outside the proposed MLW but many fringe prospects and mining claims (patented and unpatented) overlap the proposed MLW on the east side of Range B-17.

As Fairview began to develop into a producing mining camp, news of a strike about 18 miles north of the camp spread. This was the Wonder District. The rush to the Wonder District began on May 31, 1906; the majority of the people came from the new camp at Fairview (Shamberger, 1974). Numerous claims were staked and at least five townsites were laid out.

Discoveries were made within an area of approximately four by six miles, and only one, the Nevada Wonder on Wonder Mountain, would have sizable production. It is estimated that this mine produced nearly $6 million in gold and silver before 1920.

Prospecting and mining activities in the La Plata District began in the late 1860s. This activity died out quickly as the mines were short lived. The district became dormant until prospecting and some mining began again in the early 1900s. In the 1970s, and the 1980s, prospecting activity for tungsten, molybdenum, and precious metals was very active.

Prospecting and mining activities in the Chalk Mountain, the Sand Springs, the Holy Cross, and the Camp Gregory districts has been intermittent since the early 1900s.

2.2 Mineral Production

It is estimated that the value of mineral production within Churchill County exceeds $40 million since 1875. The best production years were from 1906-1919 when the mining districts of Fairview and Wonder were in their heydays and from 1978-1987 when the nonmetallics, diatomite and sand and gravel, were produced in large quantities. (Table 2-2)

TABLE 2-2
Gross Value Estimate of Mineral Production,
Churchill County Nevada

Years	Gross Value Estimate
1875-1940	$ 12,246,000
1941-1967	$ 10,394,000
1968-1977	$ 6,630,000
1978-1988	$ 11,971,000

(Source: Univ. of Nevada Bulletin 4, U.S.B.M. Yearbooks)

There has been a greater production value produced from nonmetallics than from metallics. Diatomite, sand and gravel, and salt were the major non-metallics produced; silver and gold lead the metallics.

2.3 Mineral Land Status within Churchill County

There have been numerous land withdrawals from mineral entry within Churchill County. Of the county's 3.1 million acres, 52 percent of the county is unavailable for mineral entry, fig. 2-1. Most of these unavailaable lands have been reserved by the Department of the Interior (Fish and Wildlife Service, Bureau of Reclamation, or BLM Wilderness Study Areas), or the Department of the Navy or are private. Moderately restricted lands are not numerous and probably comprise less than 5 percent of the public domain within the county.

Tables 2-3.1, 2-3.2, and 2-3.3 illustrate the current claim and lease status in the MLW.

LEGEND

AVAILABILITY OF FEDERAL LAND

Federal lands shown other than available for mineral exploration and development are subject to (1) moderate or slight restrictions on surface occupancy, or special stipulations for protection of other resources values, or (2) severe restrictions, such as compliance with 42 CFR 3802 regulations protecting wilderness study areas; withdrawals, or segregations, closing the lands to mineral entry. Determination of these categories of availability status is described more fully in the report text.

AVAILABLE: Lands where energy and mineral resource development is routinely initiated by private industry. The managing agencies' practices do not discourage or preclude mineral exploration and/or development.

SLIGHTLY TO MODERATELY RESTRICTED: Lands where the practical effects of legal constraints or agency management practices may discourage private industry from initiating mineral exploration and/or development.

SEVERELY RESTRICTED TO UNAVAILABLE: Lands that are closed to operation of some or all of the mineral laws, or areas where the practical effects of legal constraints or management practices greatly discourage private industry from initiating exploration and/or development.

KNOWN MINERAL DEPOSIT AREAS[1]

This map shows areas (KMDAs) of mineral value in Nevada based on production, identified resources, mineral occurrences, and geologic terranes favorable for deposits. These areas outline mining districts with their boundaries modified to accommodate the data. They include most of the state's metal production, with the exclusion of nonmetallic, construction, and industrial minerals.

HIGH VALUE KMDA-An area of mineral deposits having cumulative production *12* and/or identified resources for commodities of interest with a total value of 1 million dollars or more.

MODERATE VALUE KMDA-An area of mineral deposits having a cumulative production and/or identified resources for commodities of interest less than 1 million dollars.

[1] Italic numbers associated with KMDAs refer to mineral producing areas listed below:

102 - Holy Cross District
103 - Sand Springs District
106 - Wonder District
107 - Chalk Mountain District
108 - Fairview District

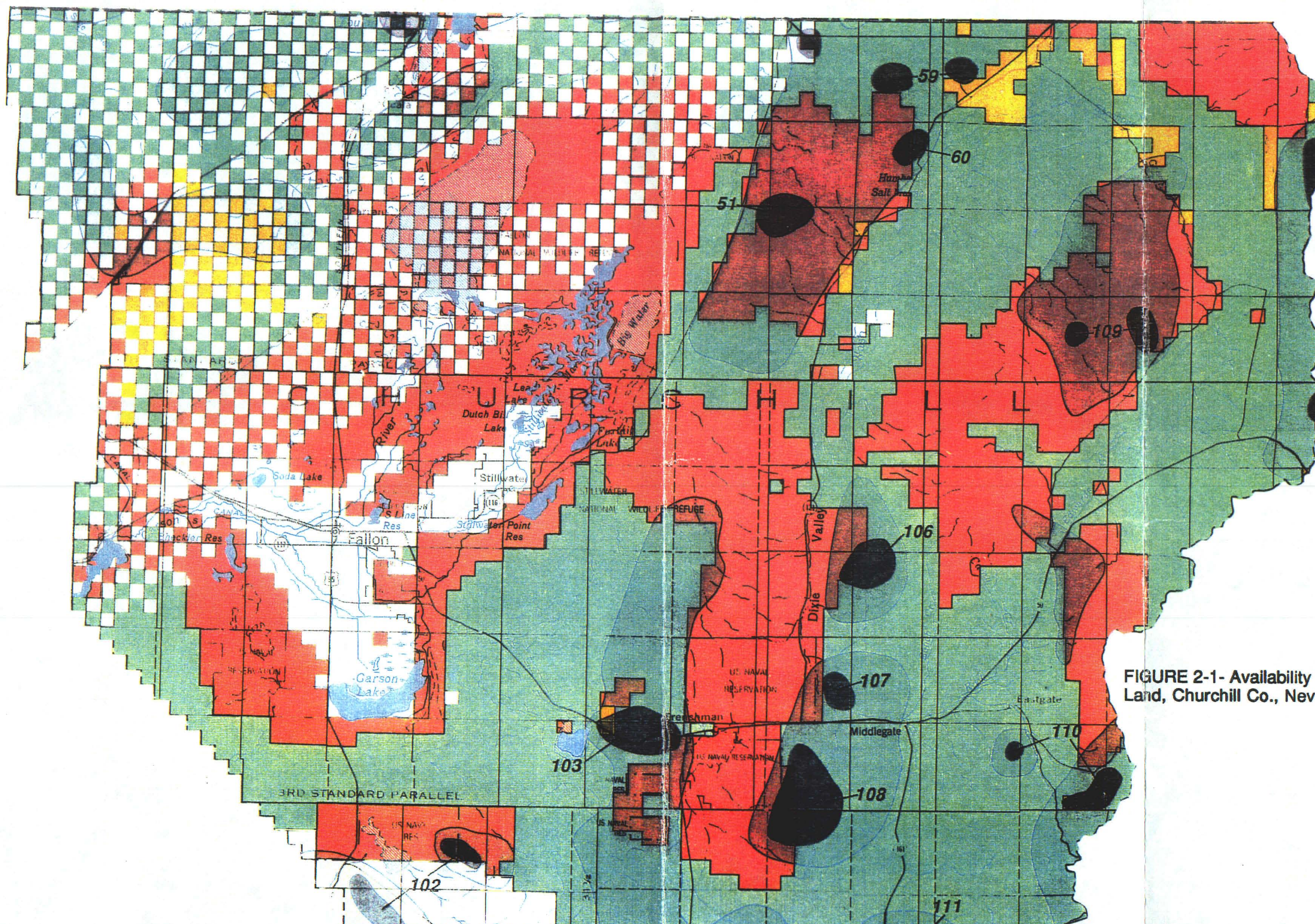
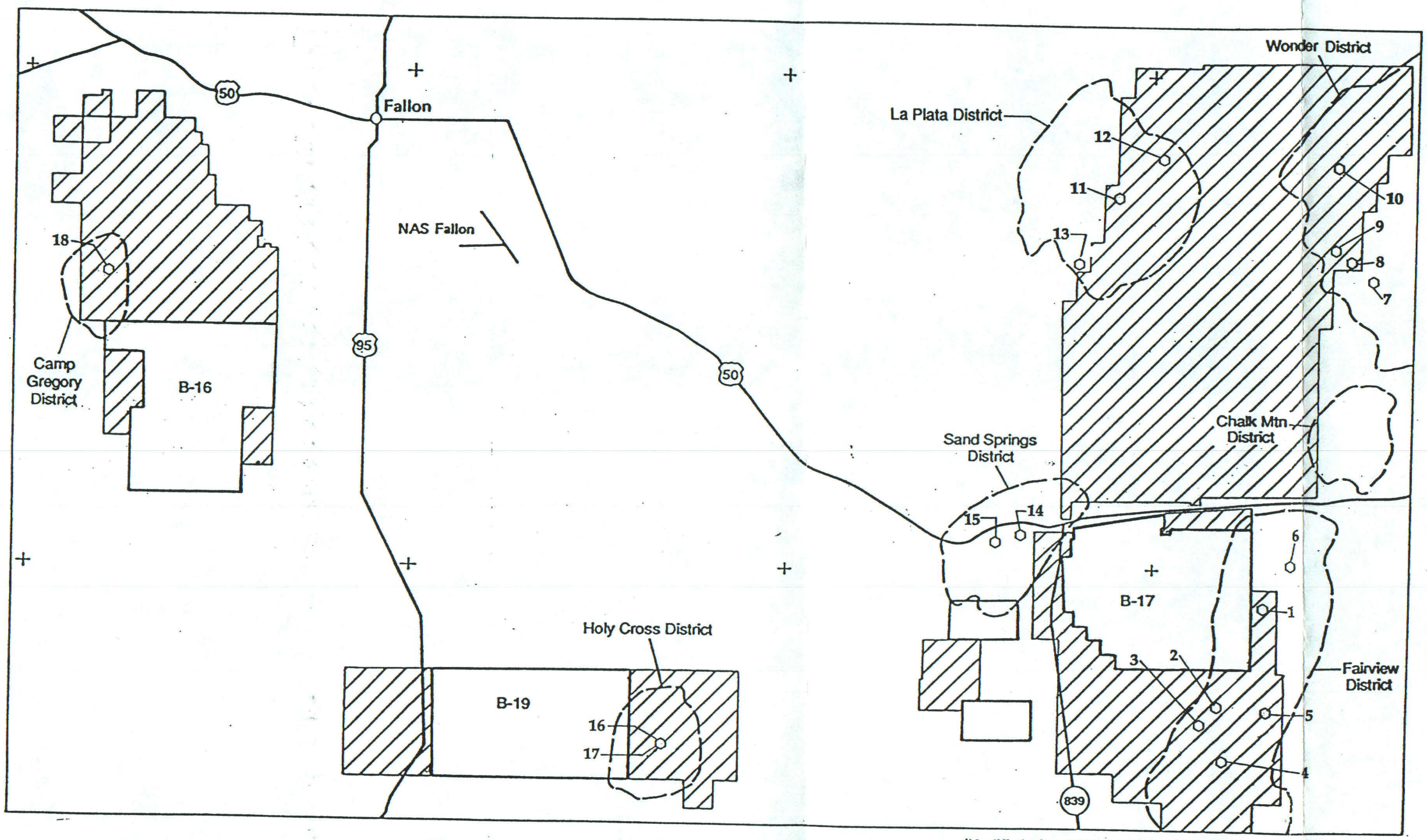


FIGURE 2-1- Availability of Federal Land, Churchill Co., Nevada



(Modified after Willden and Speed, 1974)

FIGURE 2-5-Plan map showing location of proposed MLW, mining districts, and areas of recent exploration activities, Churchill Co., Nevada.

EXPLANATION

○—18 Exploration site/area

MLW area

Existing range B-17

Explorations Sites and Areas

1. Tenneco/Echo Bay Mining
2. Tenneco/Echo Bay Mining
3. Spectrum Exploration
4. Spectrum Exploration
5. Placer Dome Mining, Ltd.
6. Centurion Exploration
7. Belmont Resources
8. Belmont Resources
9. Galli Exploration
10. Kennecott Exploration
11. Phelps Dodge/Freeport Exploration
12. U.S. Borax/Kennecott Exploration
13. Nassau Resources
14. Tulsa Oil & Gas
15. Lorraine Mines
16. Coeur Exploration
17. U.S. Borax
18. Noranda Exploration

N

0 10 MILES

TABLE 2-3.1
UNPATENTED MINING CLAIMS, PROPOSED MLW AREA
(after Quade and Tingley, 1987)

Section(s)	Township	Range	Claim Name	Location Date	Claims in/partly in MLW	Owner
24	15N	30E	Sand Mountain 1-4	3/15/70 and 2/21/71	4	Ted Lemons 2930 Markridge Dr. Reno, NV 89509
1, 12, 13, 14	15N	30E	Brickyard Placers 1-3	4/19/79	3	G. Donovan, Arliss and Kathleen Hyde Box 1073 Fallon, NV 89406
11, 12, 13, 14, 24	15N	30E	CH 1-24, 29-54	3/30/84	48*	Coeur Exploration Box AB Sparks, NV 89431
13, 24, 18	15N 15N	33E 34E	Rex 1-29	7/17/86	29*	L. E. Spriggs Spectrum Exploration P. O. Box 610 Hawthorne, NV 89415
13	15N	33E	Torix	4/6/82	1	Richard Taylor Box 815 Fallon NV 89406 Sandra Torix 308 N. Sherman Okmulgee, OK 74447

TABLE 2-3.1
UNPATENTED MINING CLAIMS, PROPOSED MLW AREA
(Cont'd.)

Section(s)	Township	Range	Claim Name	Location Date	Claims in/partly in MLW	Owner
31, 32	15N	34E	Lucky Four 1-3, 8-18, 20	3/1/70	15	John Bottari and Sam Nelson 1125 Sewell Dr. Elko, NV 89801
			Lucky Four 22	4/8/86	1*	Clive Gurr 732 S. 9th St. Elko, NV 89801
						Louis Byers General Delivery Lamoille, NV 89828
5	15N	34E	Third Prize 1-10	7/14/85	10*	Dugan L. Huntsman 12255 Glenn Circle Reno, NV 89506
7, 8, 17, 18	15N	34E	Buff 1-65	8/30/80	65	George P. and Lorie Ambariantz 1007 - 12th St. Golden, CO 80401
						Great Basin Exploration Box 13589 Las Vegas, NV 89112

TABLE 2-3.1
UNPATENTED MINING CLAIMS, PROPOSED MLW AREA
(Cont'd.)

Section(s)	Township	Range	Claim Name	Location Date	Claims in/partly in MLW	Owner
25, 26	16N	32E	RJB, PAD, SAS, MTE, TES, JMS	6/15/80 and 8/22/80	6	John Dilles 273 Marmona Ct. Menlo Park, CA 94025 Peter A. Dilles 19400 Montevina Rd. Los Gatos, CA 95030
7	15N	33E	Shamrock 1-7	8/6/76	7	C. L. Brown Box 1075 Fallon, NV 89406
10, 11, 14, 15	17N	27E	Wildhorse 1-5, 8-23	1952	21	Nathan Berry 2801 Harrison Ave. Harlingen, TX 78550 Robert Berry 1914 White Dove Dallas, TX 75244 Louis Ramey 220 NW 2nd St. Portland, OR 97209 Stephen J., Verna B, and C. M. Campbell Box 635 Port Orchard, WA

TABLE 2-3.1
UNPATENTED MINING CLAIMS, PROPOSED MLW AREA
(Cont'd.)

Section(s)	Township	Range	Claim Name	Location Date	Claims in/partly in MLW	Owner
						98366
34	17N	34E	Sol's Grubstake	11/85	1*	Sol Resnick 914 Telegraph St. Carson City, NV 89702
34	18N	27E	Good Luck Jasper	5/16/73	1	Arvel A. and Anita Fallis 600 Taylor St. Fallon, NV 89406
27, 28, 29, 30, 31, 32, 33	18N	27E	Camel 1-9, 12-29, 38-62, 71-82, 130, 131	9/22-23/82, 10/6/82	66	Gray Hill Exploration Co. 12189 Ralston Rd., #210 Arvada, CO 80004
7, 16, 18	18N	33E	Charlie 15	5/5/75	1	Charles S. Jacobs 5748 Reno Highway Fallon, NV 89406
3, 9, 10	18N	33E	Short Day 2-12	10/20/76	11	Richard Fisk 3995 Alcorn Rd. Fallon, NV 89406
						La Plata Gold Mines Box 2008 Fallon, NV 89406

TABLE 2-3.1
UNPATENTED MINING CLAIMS, PROPOSED MLW AREA
(Cont'd.)

Section(s)	Township	Range	Claim Name	Location Date	Claims in/partly in MLW	Owner
1, 2, 3, 10, 11, 12, 13, 19, 23, 24, 25, 26	18N	34E	Treasure Hill 1084, 1085, 1130, 1131, 1136, 1139-54, 1157, 1158, 1161-63, 1167-69, 1179-82, 1185, 1197-99, 1200-13, 1252, 1253, 1436, 1451, 1454, 1455, 1456-1458, 1462, 1463	1979, 1980, 1981	63	E. C. & L. H. Erickson Merlin Mining Co. 2245 N. Decatur Blvd. Suite D Las Vegas, NV 89108
20	18N	34E	Nancy Placers 1-15	9/83	5*	Sherman & Donna D. Gardner Robert L. & Iretta Patrie Terra Products Co. 7652 S. Redwood Rd. West Jordan, UT 84084 Dennis & Nancy DeBraga Rt. 1, Box 14 Lovelock, NV 89419 James A. Westergard 1075 W. 7800 S. West Jordan, UT 84084 Jim Kellor Round Mountain, NV 89045

TABLE 2-3.1
UNPATENTED MINING CLAIMS, PROPOSED MLW AREA
(Cont'd.)

Section(s)	Township	Range	Claim Name	Location Date	Claims in/partly in MLW	Owner
3, 4, 5, 6, 7, 8, 9, 10, 16, 17, 18, 29, 30, 31, 32	18N	35E	Treasure Hill 1254-56, 1256, 1259, 1260, 1263, 1264, 1282, 1283	1979, 1980	9	E. C. & L. H. Erickson Merlin Mining Co. 2245 N. Decatur Blvd. Suite D Las Vegas, NV 89108
25, 26, 34, 35, 36	19N	34E	Treasure Hill 1115-20, 1132-35, 1155, 1156, 1159, 1160, 1164-66, 1170-78, 1186-94, 1217-25, 1242, 1243, 1316-18, 1406, 1407, 1437-50, 1459-61, 1464	1979, 1980, 1981	84	E. C. & L. H. Erickson Merlin Mining Co. 2245 N. Decatur Blvd. Suite D Las Vegas, NV 89108
31 36	19N 19N	35E 34E	Silver Center 4, 6-11	4/75, 10/76	7	F. W. Lewis 120 Greenridge Dr. Reno, NV 89502
36	19N	34E	High Divide 1-3	4/11/75, 10/13/76	3	F. W. Lewis 120 Greenridge Dr. Reno, NV 89502

TABLE 2-3.1
UNPATENTED MINING CLAIMS, PROPOSED MLW AREA
(Cont'd.)

Section(s)	Township	Range	Claim Name	Location Date	Claims in/partly in MLW	Owner
19, 20, 28, 29, 30, 31, 32, 33, 34	19N	35E	Treasure Hill 1064-83, 1086, 1121-23, 1126-29, 1408-20, 1423-28, 1431, 1433-35	1979, 1980	51	E. C. & L. H. Erickson Merlin Mining Co. 2245 N. Decatur BLvd. Suite D Las Vegas, NV 89108

* Denotes claims staked after date of closure to mineral entry. (October, 1982).

TABLE 2-3.2
PATENTED MINING CLAIMS, PROPOSED MLW AREA
(after Quade and Tingley, 1987)

Section(s)	Township	Range	Claim Name	Patent Number	M.S. Number	Owner
7, 18 (?)	15N	34E	Bluff, Gold Coin, Gold Coin 1, Gold Coin 2, Fraction	289653	3914	Echo Bay 5250 Neil Road Suite 300 Reno, NV 89502
17 (?)	16N	34E	Detroit, Tiger	47231	2745	Harry C. Summers 1722 S. 6th St. Las Vegas, NV 89101
16 (?)	16N	34E	Lookout No. 2	90643	3383	Gerald E. Roth 80 S. Allen St. Fallon, NV 89406
17 (?)	16N	34E	Ohio	83149	3206	William R. Scheve 2101 - 145th St., #6 Lomita, CA 90717
17, 20 (?)	16N	34E	Ohio No. 1	83149	3206	Rex Lee & Geraldine Ann Gates Rte 6, Box 94 Mission, TX 78572
17 (?)	16N	34E	Great Falls	149254	3752	New Era Mining & Development, Inc. % Walter & Ruth Warman 483 Suncrest Ave., NW Salem, OR 97304

TABLE 2-3.2
PATENTED MINING CLAIMS, PROPOSED MLW AREA
(Cont'd.)

Section(s)	Township	Range	Claim Name	Patent Number	M.S. Number	Owner
36	19N	34E	Bumble Bee, Grey Horse, Grey Horse 1, Grey Horse 2, Triangle Fraction, Kingstone	252474	3424	New Era Mining & Development, Inc. % Walter & Ruth Warman 483 Suncrest Ave., NW Salem, OR 97304
30 (?) 25 (?)	19N 19N	35E 34E	Lost Chord, King Midas, King Midas 1, King Midas 2, King Midas 3	263382	3885	New Era Mining & Development, Inc. % Walter & Ruth Warman 483 Suncrest Ave., NW Salem, OR 97304
36 31	19N 19N	34E 35E	Spider, Wasp, Tony Pah, Long Nel, Last Chance	29199	3064	Archie B. & Julia A. Brown P. O. Box 196 Cave Junction, OR 97523
30 25, 36	19N 19N	35E 34E	Nevadan, Little Witch	104739	3398	Frank W. Lewis 120 Greenridge Dr. Reno, NV 89502
30 25	19N 19N	35E 34E	Great Eastern 1, Great Eastern 3, Great Eastern 4	32958	3122	Frank W. Lewis 120 Greenridge Dr. Reno, NV 89502
31 36	19N 19N	35E 34E	Silver Tip, Valley View, Pan Handle, Yellow Jacket	104739	3398	Frank W. Lewis 120 Greenridge Dr. Reno, NV 89502

TABLE 2-3.2
PATENTED MINING CLAIMS, PROPOSED MLW AREA
(Cont'd.)

Section(s)	Township	Range	Claim Name	Patent Number	M.S. Number	Owner
32	19N	35E	Golden Dawn No. 2, Golden Dawn No. 3	173300	3671	Frank W. Lewis 120 Greenridge Dr. Reno, NV 89502

TABLE 2-3.3
ACTIVE MINERAL LEASES, PROPOSED MLW AREA
(after Quade and Tingley, 1987)

Township	Range	Lease Number	Effective Date	Lessee
18N	34E	OG LSE N19523	4/1/79	Richard J. Fuller, 7202 Eccles Drive, Dallas, TX 75227
19N	34E	OG LSE N28837 OG LSE N28840 OG LSE N28841 OG LSE N28842 OG LSE N28843 OG LSE N28844	7/1/81	Templeton Energy, Inc. 1212 Main Street Houston, TX 77002

2.4 Current Mineral Production and Exploration

There is no current mining activity within the proposed MLW. There are, however, several mines in production or have announced plans for production near the boundaries of the proposed MLW. The Rawhide Mine (public announcement), operated by Kennecott, 10 miles southeast of the southern boundary of the Fairview area, is currently in production. They have announced reserves of 60,000,000 tons at 0.029 troy ounces per ton (opt.) gold. This will provide for a 10-year or better mine life at current gold prices ($400.00/oz. gold).

Inland Gold and Silver Corporation has recently announced reserve figures for the Bell Mountain mine, located in the Bell Mountain District, about 3 miles east of the Fairview District. Reserves are reported at 41,000 troy ounces of gold and 884,000 troy ounces of silver.

2.5 Exploration Activities by Mining District

Fairview District, fig. 2-5 - From 1978 through 1987, Tenneco/Echo Bay did geologic mapping, sampling, and some drilling on patented claims. Most of the activity occurred around the Nevada Hills mine area and the Gold Coin mine area. In 1984, Spectrum Exploration staked the Jet claim group and the Rex claim group in the Bell Canyon area. From 1986 through 1988, D. Huntsman/Placer Dome U.S., Ltd., staked claims and did preliminary mapping and sampling in secs. 4, 5, 8, and 9, T. 15 N., R. 34 E. In 1984, the Centurion claim group was staked in secs. 4, 5, and 6, T. 16 N., R. 34 E. In 1988 and 1989, Kennecott Exploration did reconnaissance sampling and mapping in the middle and southern portions of the Fairview District.

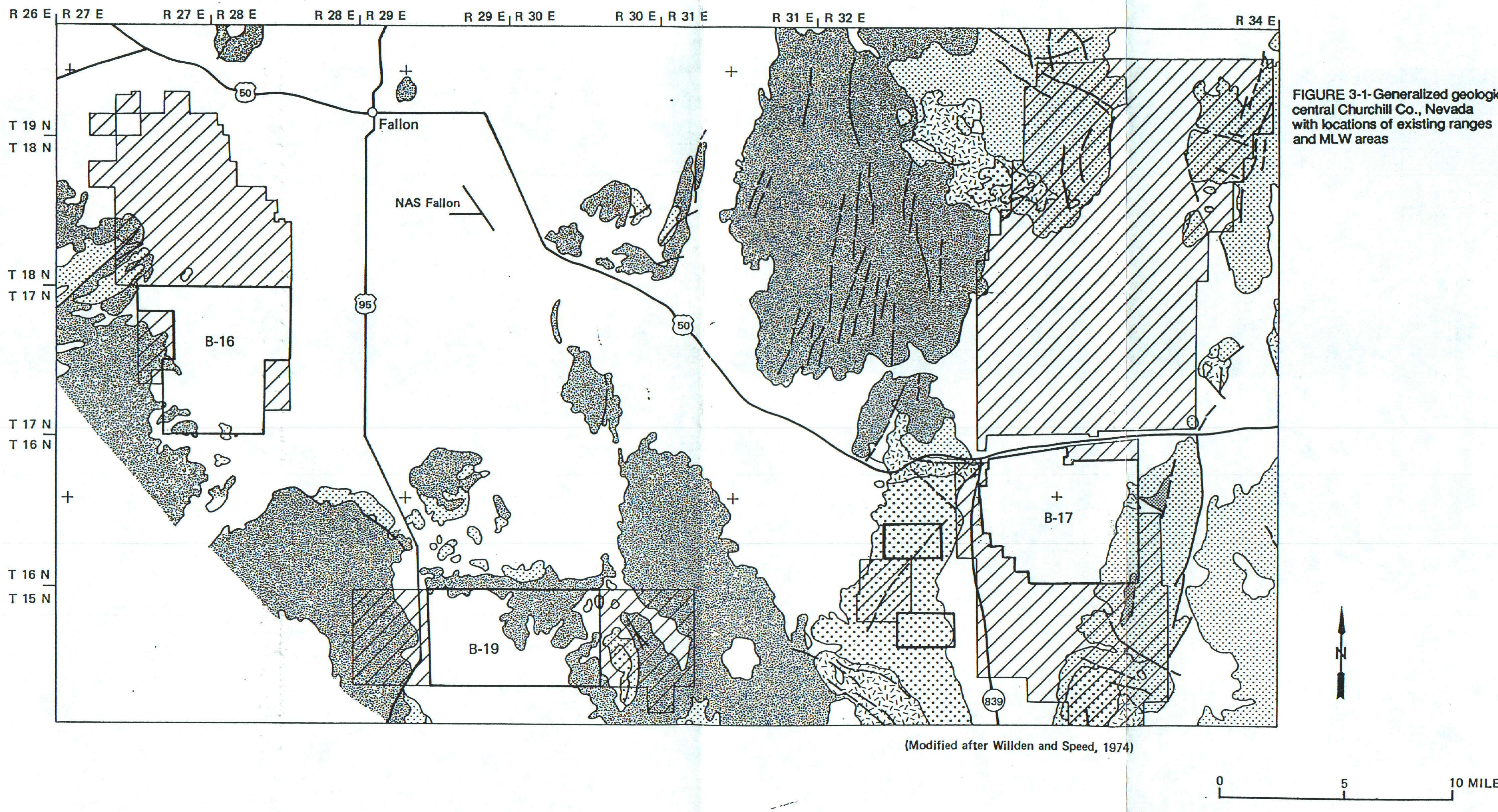
Wonder District, fig. 2-5 - From 1984 to 1988 Belmont Resources mined at the Nevada Wonder mine (outside of the proposed MLW) and the Silver Center mine (inside the proposed MLW). From 1984 to 1986, Galli Exploration worked on the West Extension claims (inside the proposed MLW). During 1988-1989, Kennecott Exploration did reconnaissance mapping and sampling (inside the proposed MLW).

La Plata District, fig. 2-5 - In the 1970s, Phelps Dodge and Freeport Exploration staked claims and drilled in secs. 31, 32, T. 19 N., R. 33 E. and secs. 4, 5, 9, T. 18 N., R. 33 E. In 1988, U.S. Borax/Kennecott identified an exploration target in Slaughter Canyon, secs. 25, 26, 27, 34, 35, T. 19 N., R. 33 E. (inside proposed MLW). In 1988, Nassau Resources has staked claims and is evaluating the potential in western La Plata District (adjacent to proposed MLW).

Sand Springs District, fig. 2-5 - From 1984-1990, Tulsa Oil and Gas is attempting to mine and leach ore, precious metals, from the northeast side of the district. Lorraine Mines is currently mining and leaching 200 tons of ore, silver, per month at the Summit King mine.

Holy Cross District, fig. 2-5 - In 1984, Coeur Exploration staked claims and began evaluation of the Cinnebar Hills mine area (inside the proposed MLW). In 1987, U. S. Borax staked claims and began evaluation of the Cinnabar Hills mine area (inside the proposed MLW).

Camp Gregory District, fig. 2-5 - In 1982, Noranda Exploration Co. staked claims, mapped, sampled, and drilled the Red Mountain area (inside the proposed MLW, B-16 area).



(Modified after Willden and Speed, 1974)

FIGURE 3-1-Generalized geologic map of central Churchill Co., Nevada with locations of existing ranges and MLW areas

3.0 General Geology

3.1 Rock Types

The general geologic relationships in central Churchill County, Nevada, are illustrated by fig. 3-1. The oldest rocks exposed are Triassic-Jurassic in age (see Geologic Time Scale, Table 3-1). These Triassic-Jurassic rocks are composed of shales, siltstones, carbonates, volcanoclastics, and volcanics. This sequence may represent deposition in a back-arc basin of an island-arc, west of the present day California coast. Also noted are Triassic-Jurassic age diorites, gabbros, and felsites (rhyolite/quartz porphyries).

Cretaceous-age rocks are represented by granitic intrusives, ranging from quartz monzonites to granodiorites in composition. Where these rocks have intruded the Triassic-Jurassic rocks, thermal aureoles have been noted, ranging from hornfelsing to the formation of marble. Some of the intrusives may be quite large, exceeding 100 square miles (Willden and Speed, 1974, p. 18). The Cretaceous intrusives noted in the Churchill County area may be the eastern limit of the Sierra Nevada batholith and represent multi-event intrusion activity covering the period of 200 million years ago to approximately 72 million years ago (private consulting report).

The Tertiary period began about 66 million years ago (table 3-1). However, Churchill County does not contain Tertiary rocks older than 27 million years. The 40-million-year gap between the end of Cretaceous intrusive activity and the beginning of Tertiary extrusive activity probably represents a prolonged erosional event. Tertiary rocks are represented by rhyolite flows and intrusives, latite and dacite flow and airfall tuffs, and dacite intrusive bodies. This portion of the Tertiary rock sequence is important as most of the important precious metal deposits occur in these rocks.

Younger Tertiary basalts and andesite flows, and tuffaceous sediments cover considerable areas of older rocks (Quade and Tingley, 1987).

Quaternary rocks are represented by sands and gravels, Lake Lahontan sediments, pediment gravels, and dune sands. Quaternary material covers most of the area in Churchill County, filling broad, north-trending, down-faulted basins (Schrader, 1947; Willden and Speed, 1974).

3.2 Structure

Triassic and Jurassic sedimentary and volcanic rocks have been subjected to folding and faulting in at least two and possibly as many as four tectonic events. Axial trends of the folding are northerly and northwesterly. The faulting, both high-angle normal and low-angle thrusting, trend mostly northwest with minor north-

EXPLANATION

Generalized geologic map,
Central Churchill Co., Nevada

Cenozoic	Quaternary	Includes Lake Lahontan sediments, older alluvium, pediment gravels, and dune sands
	Tertiary	Younger basalts, andesites and dacite flows, some sediments
		Dacite/latite intrusive rocks
		Rhyolite flows and intrusives, some older volcanic rocks
Mesozoic	Cretaceous	Granite rocks
	Jurassic/Triassic	Sedimentary and volcanic rocks, includes some diorites and gabbros

Fault, dashed where projected

MLW area

Existing range — B-17

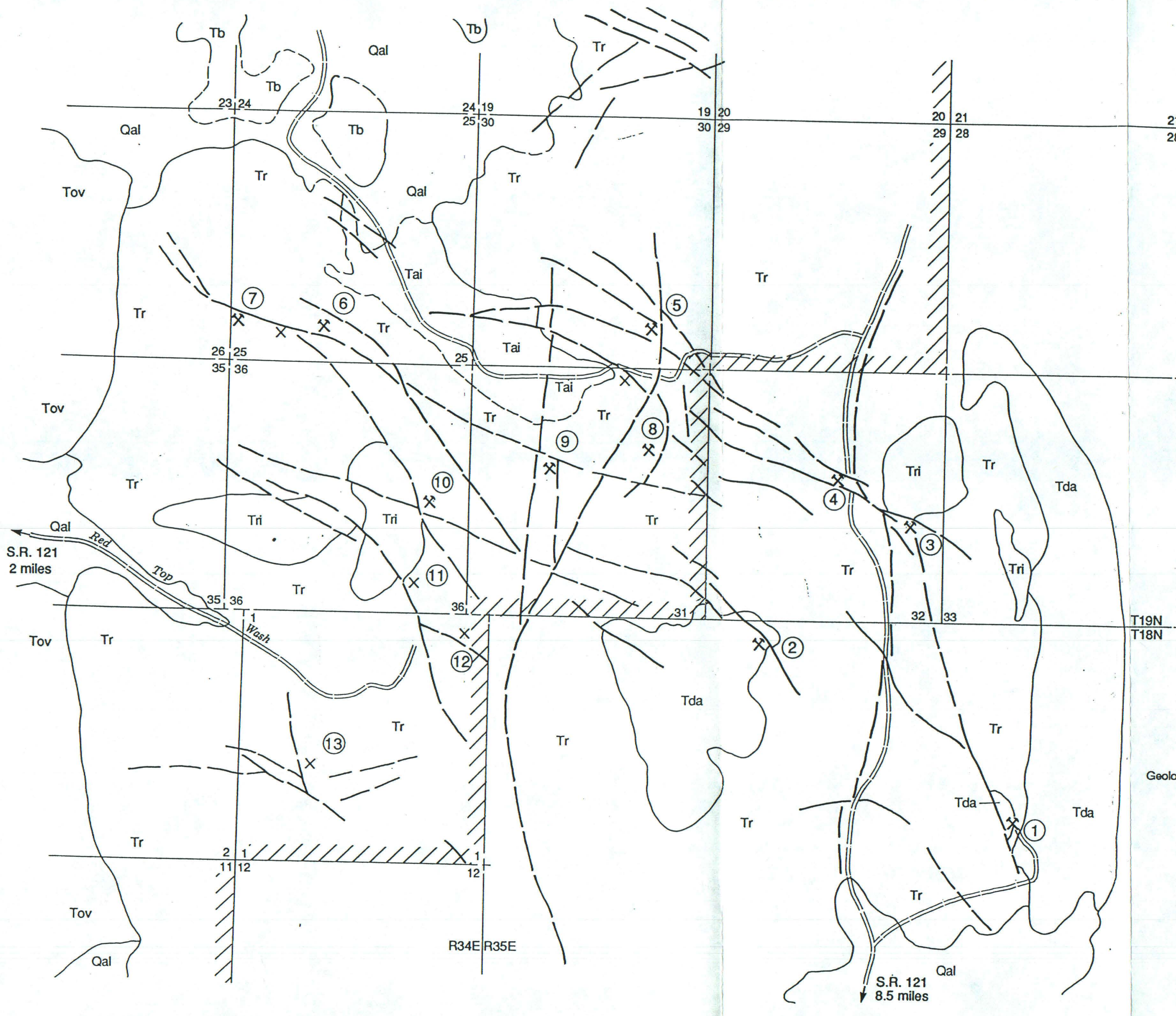


FIGURE 4-2- Geology map with location of mines and prospects
Wonder District
Churchill Co., Nevada

Mines and Prospects

1. Nevada Wonder mine
2. Silver Center mine
3. Jackpot mine
4. Vulture mine
5. Gold King claim group
6. Spider & Wasp mines
7. Dickey Peak area mines
8. Kiowa vein system mines & prospects
9. Christmas-Faustiene vein systems
10. Nevada Belle/Gold Rock vein systems
11. Vena Grande vein system
12. Marie/Ruby vein systems
13. Colorado/Hope vein system

Geology after Willden and Speed (1974) and Schrader (1947)

TABLE 3-1. Geologic Time Scale
(Modified after Decade of North American Geology, Geological Society of America, 1983)

Major Division	Period	Epoch	Age (Million Years)
Precambrian	Archean		
			2 ,500
	Proterozoic		
			570
Paleozoic	Cambrian		
			505
	Ordovician		
			438
	Silurian		
			408
	Devonian		
			360
	Carboniferous	Mississippian	
			320
		Pennsylvanian	
			286
	Permian		
			245
Mesozoic	Triassic		
			208
	Jurassic		
			144
	Cretaceous		
			66
Cenozoic	Tertiary	Paleocene	
			58
		Eocene	
			37
		Oligocene	
			24
		Miocene	
			5
		Pliocene	
			2
	Quaternary	Pleistocene	
			0.01
		Holocene	

trending strikes. This structural pattern is the result of horizontal shortening (compression) aligned east-west (Willden and Speed, 1974).

The intrusion of the Cretaceous granitic rocks has imparted a structural as well as a thermal fabric on the intruded Triassic and Jurassic rocks. This fabric is aligned with the intrusive contact and is somewhat more random, being east-west as well as northerly.

The horizontal shortening continued into the Cenozoic. Tertiary rocks are folded into broad north- and northeast-trending folds. A minor fold trend striking and plunging southeast has been noted. This minor trend may be due to strike-slip faulting post dating the major fold trend (Willden and Speed, 1974).

In late Tertiary time (Pliocene) and possibly continuing into the present, the structure regime changes from compressional to extensional. This change marks the onset of Basin and Range faulting. The present mountain ranges and broad valleys were created at this time. Eroding debris from the uplifted mountain ranges continues to fill the basins.

4.0 Mining District Descriptions

4.1 Fairview District

The Fairview District is located along the east side of B-17. The proposed MLW will cover all but the northern one-fifth of the district.

4.11 General Geology

Fig. 4-1 illustrates the more detailed geologic features of the Fairview District. The oldest rocks exposed are Triassic-Jurassic sediments consisting of shales, siltstones, and limestones. Near intrusives, these rocks have been metamorphosed to schists, slates, and marbles.

Cretaceous intrusive rocks, mostly granodiorites, are noted in the southern portion of the Fairview District. Here they intrude Triassic-Jurassic sediments producing skarn zones and weak to moderate mineralized zones.

The next youngest rocks are Miocene (Tertiary) in age and include flows, welded tuffs, tuffs, and locally some intrusives. The flows are true rhyolites while the tuffs range in composition from rhyolite to quartz latite and in some cases, rhyodacite. Lithic fragments and coarse volcanic breccias are common and suggest a nearby source. The intrusive rhyolites are most commonly small stocks and dikes. At least one of the small stocks may be genetically important to some of the precious metal deposits.

Intruding the older rocks is a medium crystalline to slightly porphyritic granite. It is found in isolated outcrops intruding the rhyolite flows and tuffs, and older rocks. The granite has been mapped in small outcrops south of Fairview Peak and west of the Nevada Hills mine. Several outcrops of less than an acre in size are also present on the north end of the Fairview Range.

Overlying the granite is a sequence of dacitic to latitic flows, tuffs, and intrusives. Dacite flows and flow breccias are dominant with tuffs and welded tuffs being quite restricted. The dacite intrusives are generally a dense, porphyritic rock containing plagioclase phenocrysts in an aphanitic matrix. The dacite intrusives appear to be important in localizing silver-gold deposits. Many of the veins in the Fairview District are at or near the contact between the dacite intrusives and the intruded rhyolite tuffs and flows.

Overlying the dacites are a sequence of andesite flows, flow breccias, agglomerates, and tuffs. This sequence has been dated youngest Miocene to Pliocene. It appears to host an

EXPLANATION

Geology map, Fairview District

Cenozoic	Quaternary	Qal	Includes gravels, talus, and other mass wasting products
	Tertiary	Ta	Andesite flows, flow breccias, agglomerates, lacustrine sediments and air fall tuffs
		Tdp	Latite to dacite flows, tuffs, and intrusives
		Tgr	Granite
		Tri	Rhyolite intrusives
		Trt	Rhyolite flows, welded tuffs, and tuffs
	Triassic/Jurassic	Trjs	Shales, siltstones, limestones, and their metamorphic equivalents, schist, slate, and marble

Vein	
Contact, dashed where projected	
Fault, dashed where projected	
Thrust fault, teeth on upper plate	
Mine	⚒
Prospect	×
MLW area	
Existing range	B-17

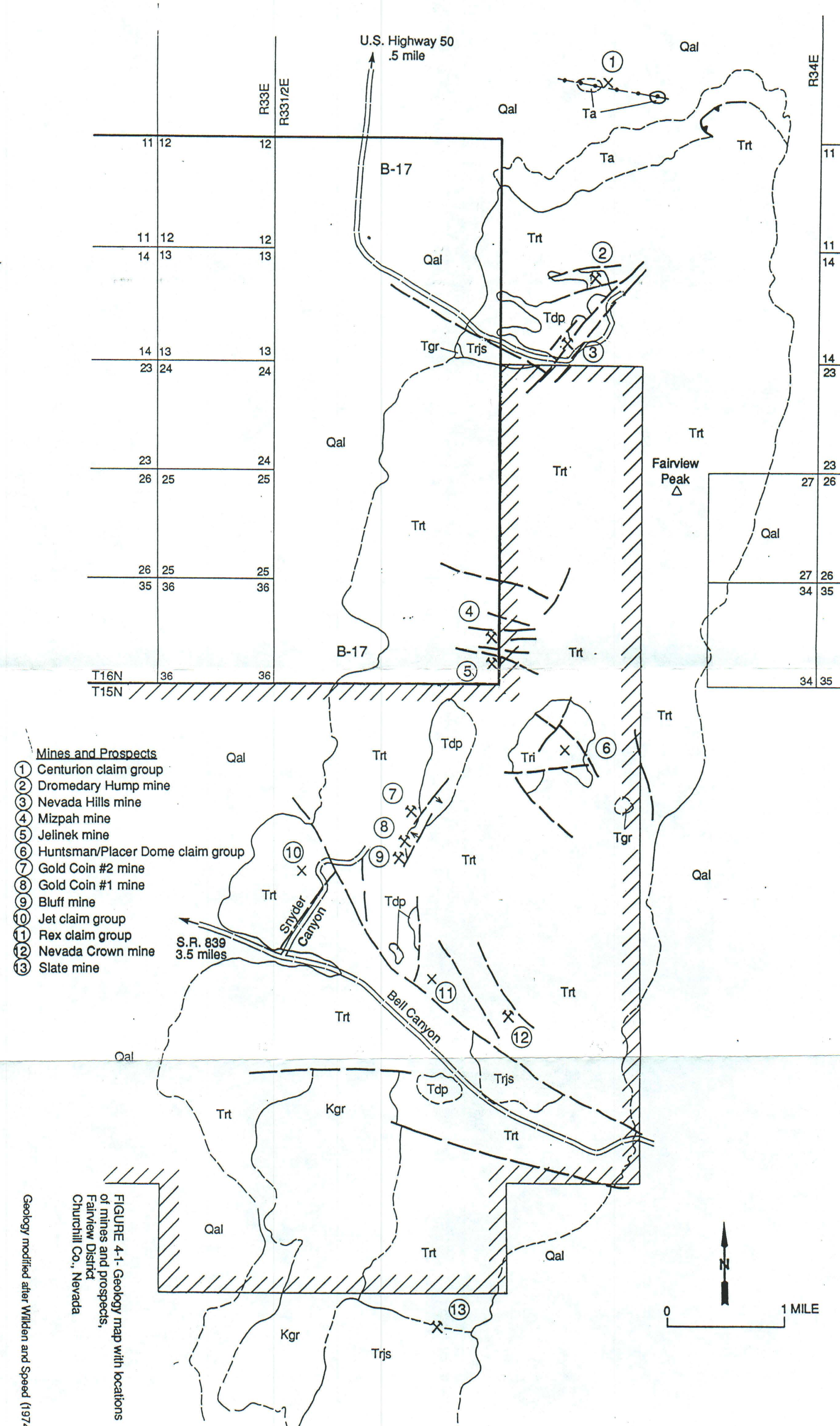


FIGURE 4-1- Geology map with locations of mines and prospects, Fairview District Churchill Co., Nevada

Geology modified after Willden and Speed (1974) epithermal vein on the Centurion claims.

4.12 Mines and Prospects

The more important mines and prospects in the Fairview District are shown on fig. 4-1, general geologic map. The discussion will include mines and prospects in or immediately adjacent to the proposed MLW. They are numbered from 1 through 13.

The Centurion claim group, no. 1, fig. 4-1, was staked by Anthony Payne in 1984. Twenty-five lode claims and six millsites were staked to cover a west-northwest trending vein extending about 4,000 feet. The vein appears to be at least 6 feet wide and dips to the southwest. The vein contains quartz gangue and some base metal sulphides. Sampling by the NBMG program indicates minor precious metal values, high arsenic values, and low base metal values (Quade and Tingley, 1987).

The prospect is classified as an epithermal vein, Tonopah-type, because of similar geologic controls of mineralization, wall rock, mineralogy, and probable mining and metallurgical characteristics (private consulting report). The prospect has been mapped, minimumly sampled, and proposed for exploration trenching. No further information concerning results have been made available to the U.S. Bureau of Mines.

The Dromedary Hump mine, No. 2, fig. 4-1, produced silver and gold beginning in 1906. Production occurred from quartz veins striking west northwest and dipping north. The vein is hosted in dacite porphyry and is brecciated. Sampling by Houston Oil and Minerals (now Echo Bay Mining) indicate surface gold assays ranging from trace to 0.01 opt. and silver assays ranging from trace to 1.13 opt. Sampling by the BOM indicates a gold assay of 0.001 opt. and a silver assay of 0.03 opt. Only limited resource possibilities are thought to exist at the Dromedary Hump mine.

The Nevada Hills mine, No. 3, fig. 4-1, was one of the largest producers in the Fairview District. Multiple veins were mined beginning at the surface and continuing to a depth of 800 feet. The quartz veins are west-northwest-trending and occur within the intrusive dacite porphyry. Production records, 1911-1917 (Vanderburg, 1940, p. 23), indicate that grades decrease with depth, although the vein structure remains persistent.

Sampling by the NBMG indicate very high silver assays, ranging from 2.0 opt. to 146.0 opt., and gold assays ranging from trace to 1.0 opt. Surface sampling by Tenneco (now Echo Bay) reported gold assays ranging from trace to 0.195 opt., and silver assays ranging from 0.03 opt. to 10.5 opt. Sample results from the BOM indicate gold assays ranging from 0.001 opt. to 0.066 opt. and silver assays ranging from 0.03 opt. to 100.52 opt. Arsenic and antimony analytical results were anomalous as well as mercury.

Echo Bay owns the patented ground at the Nevada Hills mine. During some of their work, they measured and sampled the tailings pile at the old mill building. They estimated the tailings, which are amenable to leaching, would contain 200,000 tons of material averaging 0.01 opt. gold and 2.5 opt. silver (private company report).

The Mizpah mine, No. 4, fig. 4-1, occurs within the eastern boundary of B-17, but the east-west striking vein projects into the proposed MLW area. The vein is hosted by ash-flow tuffs and rhyolite flows that have been silicified, locally brecciated, and kaolinized along numerous fractures within and adjacent to the vein margin. The vein is from 4 feet to 20 feet wide and averages 6 feet in width. It is composed of replacement quartz and silicified rhyolite (Quade and Tingley, 1987).

Sampling by the NBMG has indicated gold assays ranging from 0.003 opt. to 0.52 opt. and silver assays ranging from 0.15 opt. to 58.4 opt. Sampling by the BOM has indicated gold assays ranging from less than 0.001 opt. to 0.035 opt. and silver assays ranging from less than 0.01 opt. to 7.71 opt. Molybdenum analytical results are anomalous in this vicinity and help define a 1,500 foot long anomalous trend into the MLW area.

The Jelinek mine, No. 5, fig. 4-1, also occurs within the east boundary of B-17. However, some of the workings and the vein projections are located within the MLW.

The vein was discovered in 1906 and only minor production occurred during the next 10 years. By 1920, there were 1,000 feet of workings. By 1928, there were 2,500 feet of workings (Quade and Tingley, 1987).

The veins vary in width from 2 feet to 20 feet and probably average 5 feet in width. The main Big Ledge vein is exposed for 3,000 feet on surface (private company report), striking N. 70° E. and dips about 80° south. The vein appears to be a fissure-filling type composed of quartz, fragments of silicified and replaced breccia, and quartz-adularia pseudomorphic after calcite (Quade and Tingley, 1987, p. 23). The veins are hosted by rhyolite and latite flows and tuffs, cut by silicified rhyolite, and occasionally dacite/andesite dikes.

Sampling by the NBMG produced the following results: gold assays ranging from 0.004 opt. to 0.52 opt.; silver assays ranging from 0.29 opt. to 58.4 opt. (Quade and Tingley, 1987). Sampling by industry indicates gold assays ranging from nil to 0.001 opt. and silver assays ranging from 0.01 opt. to 0.06 opt. Sampling by the BOM indicates gold assays ranging from less than 0.001 opt. to 0.158 opt. and silver assays ranging from less than 0.01 to 15.9 opt.

No. 6, fig 4-1, Huntsman/Placer Dome claim group, represents claims staked by D. Huntsman, 1984, to cover an area of alteration and vein mineralization. Trenching and sampling by Huntsman produced assays ranging from 0.012 opt. gold to 0.154 opt. gold, and 0.20 opt. silver to 40.8 opt. silver.

Huntsman later leased his claims to Placer Dome USA, Ltd., who added additional claims surrounding the original claim group. Placer did preliminary mapping and sampling. Their mapping indicates Tertiary tuffs and sediments intruded by andesite porphyry and rhyolite porphyry. The Placer work also indicated areas of stockwork fracturing and quartz veining, and altered and iron-stained brecciated areas. The claim group lies within the proposed MLW.

Sampling results from the initial Placer Dome work ranged from trace to 0.04 opt. gold and from less than 0.01 opt. silver to 0.76 opt. silver. Mercury results were also anomalous ranging up to 0.157 ppm.

The Gold Coin No. 2 mine, no. 7, fig. 4-1, the Gold Coin No. 1 mine, fig. 4-1, no. 8, and the Bluff mine, no. 9, fig. 4-1, are known collectively as the Nevada Fairview group. The mines are presently owned by Echo Bay Mining (five patented claims) and lie within the proposed MLW.

The geology of this area consists of Tertiary tuffs and flows cut by a range-front fault, northerly trending, and intruded by dacite porphyry dikes. The dacite is brecciated and contains disseminated pyrite throughout.

Two distinct types of mineralization are noted: calcite-quartz veins, highly manganiferous, occur at the Gold Coin No. 2 workings, striking N. 30°-40° E., dipping 70°-80° southeast and exposed for 1,000 feet; and brecciated replacement-type veins, striking N. 30° E., dipping northwest, occurring at the Gold Coin No. 1 and Bluff mines. The veins vary in width from 1 foot to 20 feet with an average of 4 to 5 feet (Quade and Tingley, 1987).

Echo Bay completed a program of sampling and mapping, surface and underground, followed by drilling (rotary) in an attempt to discover a bulk mineable deposit. They were not successful but have retained the property. The property has potential for high grade, lower tonnage targets which might interest a smaller mining company.

Sampling by the NBMG on the vein structures indicated results as follows: gold values ranging from nil to 0.04 opt.; and silver values ranging from 0.29 opt. to 29.2 opt. (Quade and Tingley, 1987). Sampling by industry (private company report) and the BOM indicates gold assays ranging from less than 0.001 opt. to 0.115 opt. and silver assays ranging from less than 0.01 opt. to 29.20 opt. Arsenic analytical results are anomalous while mercury analytical results are inconsistent.

No. 10 on fig. 4-1 represents the Jet claim group staked by Spectrum Exploration in 1986 in the segregated area. Work, consisting of mapping and sampling, delineated an area of argillic alteration and stockworks of vuggy, iron-oxide-stained quartz veining. The veining occurs in latites and andesites and is approximately 4,000 feet long (north-south) and 1,000 feet wide (east-west).

Sampling by Spectrum Exploration, St. Joe Minerals, and Tenneco produced results ranging up to 0.229 opt. gold. Assuming continuity between altered and mineralized outcrops in an area 2,000 feet long, 300 feet wide, and 40 feet deep, Tenneco geologists calculated a potential of 1,800,000 tons of ore material with grades exceeding 0.02 opt. gold.

BOM sampling and mapping results indicate gold assays ranging from less than 0.001 opt. to 0.077 opt. and silver assays ranging from less than 0.01 opt. to 0.06 opt. Arsenic analytical results are anomalous and mercury anomalous results are spotty.

The combined sampling results of the BOM, NBMG, and industry indicates an anomalous zone of gold and silver mineralization along the northeast trending Snyder Canyon (point 10, fig. 4-1).

Area No. 11 on fig. 4-1, the Rex claim group, was staked by Spectrum Exploration in 1986. They completed some sampling and mapping prior to learning that the area had been segregated and reserved.

The eastern portion of the claim group is underlain by Triassic-Jurassic metasediments and intruded by Cretaceous granitics. The western portion of the claim group is underlain by Tertiary volcanic flows and sedimentary rocks and intruded by rhyolite and dacite. The claim group covers a major northwest-trending fault on the north side of Bell Canyon. The fault appears to cut and offset south-trending mineralized structures extending from the Nevada Fairview group (Nos. 7, 8, 9, fig. 4-1).

This area is moderately to intensely argillized and silicified. Mineralization is described as being non-typical for epithermal deposits and more related to fine-grained pyrite and silver sulfides with gold being associated with areas of hematite enrichment (Quade and Tingley, 1987, p. 31).

NBMG sample results report silver assays up to 0.44 opt., gold assays from nil to 0.035 opt., and molybdenum analytical results up to 300 ppm. These results are similar to those reported by Spectrum Exploration and Tenneco (Quade and Tingley, 1987).

The BOM sample results indicate gold assays ranging from less than 0.001 opt. to 0.004 opt., and silver assays ranging from less than 0.01 opt. to 0.22 opt. Arsenic analytical results are anomalous. Molybdenum results are very anomalous and help define the north trending 3,500 foot long zone parallel to and just north of Bell Canyon.

The Nevada Crown mine, No. 12, fig. 4-1, lies about one-half mile north of Bell Canyon. The mine workings explore a 10 to 30 foot wide breccia vein, highly silicified, bearing N. 50° W., dipping 40° NE. Other veins, trending N. 5° E., dipping 70° SE, are noted. The veins are hosted by an andesite/dacite breccia which has been argillized and silicified.

NBMG sampling has indicated gold assays ranging from nil to 0.03 opt. and silver assays ranging from 0.03 opt. to 0.44 opt (Quade and Tingley, 1987). Of some interest were the anomalous molybdenum analytical results which ranged from 100 ppm to 150 ppm.

BOM sample results indicate gold assays ranging from less than 0.001 opt. to 0.004 opt., and silver assays ranging from less than 0.01 opt. to 0.11 opt. Again arsenic analytical results are anomalous and mercury results are inconsistent.

No. 13, fig. 4-1, represents the prospects and trenches for the Slate mine. The mine is south of the southern boundary of the proposed MLW area, but the claim group continues northward into the MLW.

Tungsten mineralization was discovered in 1941 and intermittent production occurred until 1957. The average grade was 0.5% WO_3 (Quade and Tingley, 1987).

The principal rocks exposed at the Slate mine are schists with intercalated limestone and intruded by granite, aplite, and rhyolite sills. Production came from skarn zones in the limestone horizons in the form of scheelite (Quade and Tingley, 1987, p. 33).

4.13 Resource Potential

Fig. 4-1 illustrates the location of those areas in the Fairview District within or adjacent to the proposed MLW where identified and inferred resources have been evaluated. These areas are assigned resource ratings based on criteria developed in U.S. Geological Survey Circular 831, 1980 (see Appendix 4).

The Centurion claim group, No. 1, is classified as an inferred resource based on a minimum of surface sampling and similarity to known deposits outside the district. If exploration proceeds, this resource would be expected to have grades approaching 0.2 opt. gold, 3-7 opt. silver, and tonnages greater than 500,000 tons.

The Nevada Hills mine, No. 3, is classified as an identified resource. The resource consists of 200,000 tons of tailings material from previous operations. Sampling resulted in grades of 0.01 opt. gold and 2.5 opt. silver.

The Mizpah mine, No. 4, the Jelinek mine, No. 5, Gold Coin # 2 mine, No. 7, the Gold Coin # 1 mine, No. 8, and the Bluff mine, No. 9, are classified as inferred resources. This classification is based on previous production and continuation of the structures from which the production was derived.

The Huntsman/Placer Dome claim group, No. 6, is classified as an inferred resource. This is based on preliminary surface sampling and rock types and alteration similar to producing deposits.

The Jet claim group, No. 10, is classified as an indicated resource based on surface sampling (number of samples and spacing) and similarity to known deposits. About 1,800,000 tons of ore at a grade of greater than 0.02 opt. gold have been estimated.

The Rex claim group, No. 11, and the Nevada Crown mine, No. 12, are classified as inferred resources. Surface sampling has identified an area large enough to support a bulk mineable deposit. This is further substantiated by the assessment of the geology and its relationship to other known deposits.

4.2 Wonder District

The Wonder District is located northeast of B-17. The proposed MLW will include approximately 45% of this district.

4.21 General Geology

Fig. 4-2 illustrates the general geology of the Wonder District. The oldest rocks in the district are the andesite and basalts that occur north and south of Red Top Wash on the west side of the district. They are thought to be late Oligocene to Miocene in age (Quade and Tingley, 1987, p. 37).

Overlying the andesites and basalts is a unit named the Wonder rhyolite. This unit is composed of rhyolite and quartz latite welded tuffs and flows with thickness greater than 2,000 feet. The unit has been dated as early Miocene and is the host of much of the mineralization within the district (Quade and Tingley, 1987, p. 37).

A dacite intrudes the Wonder rhyolite. The dacite is porphyritic with plagioclase phenocrysts in an aphanitic ground mass. It has been dated as mid-Miocene and hosts some of the productive veins in the district.

A rhyolite intrusive is the next youngest rock unit. The rhyolite occurs as plugs for the most part and has been dated at late Miocene in age.

An andesite intrusive is the next youngest rock. It occurs as a small stock in the northwest portion of the Wonder District. It has been dated as late Miocene to early Pliocene.

Overlying the andesite intrusive are basalt flows which are found in the northwest corner of the district. These flows apparently post date the mineralization and have been dated as mid-Pliocene.

The youngest unit, alluvium, is composed of gravels, sands, and other mass-wasting products. This material is currently adding to the fill in the Dixie Valley basin, west of Wonder District.

There are at least 50 veins in the district (Schrader, 1947). Most of the veins occur in the Wonder rhyolite and are very siliceous, with quartz-adularia gangue common and values in silver-gold. The veins are largely replacement types and range in thickness from 1 to 40 feet. The veins form prominent ledges because they are highly siliceous and resistant to erosion.

The age of mineralization is thought to be late Miocene to early Pliocene as all rocks older than this age contain mineralization (Quade and Tingley, 1987, p. 37).

4.22 Mines and Prospects

Fig 4-2 shows the location of the more prominent mines and prospects in the Wonder District. The Nevada Wonder mine, No.

epithermal vein on the Centurion claims.

4.12 Mines and Prospects

The more important mines and prospects in the Fairview District are shown on fig. 4-1, general geologic map. The discussion will include mines and prospects in or immediately adjacent to the proposed MLW. They are numbered from 1 through 13.

The Centurion claim group, no. 1, fig. 4-1, was staked by Anthony Payne in 1984. Twenty-five lode claims and six millsites were staked to cover a west-northwest trending vein extending about 4,000 feet. The vein appears to be at least 6 feet wide and dips to the southwest. The vein contains quartz gangue and some base metal sulphides. Sampling by the NBMG program indicates minor precious metal values, high arsenic values, and low base metal values (Quade and Tingley, 1987).

The prospect is classified as an epithermal vein, Tonopah-type, because of similar geologic controls of mineralization, wall rock, mineralogy, and probable mining and metallurgical characteristics (private consulting report). The prospect has been mapped, minimumly sampled, and proposed for exploration trenching. No further information concerning results have been made available to the U.S. Bureau of Mines.

The Dromedary Hump mine, No. 2, fig. 4-1, produced silver and gold beginning in 1906. Production occurred from quartz veins striking west northwest and dipping north. The vein is hosted in dacite porphyry and is brecciated. Sampling by Houston Oil and Minerals (now Echo Bay Mining) indicate surface gold assays ranging from trace to 0.01 opt. and silver assays ranging from trace to 1.13 opt. Sampling by the BOM indicates a gold assay of 0.001 opt. and a silver assay of 0.03 opt. Only limited resource possibilities are thought to exist at the Dromedary Hump mine.

The Nevada Hills mine, No. 3, fig. 4-1, was one of the largest producers in the Fairview District. Multiple veins were mined beginning at the surface and continuing to a depth of 800 feet. The quartz veins are west-northwest-trending and occur within the intrusive dacite porphyry. Production records, 1911-1917 (Vanderburg, 1940, p. 23), indicate that grades decrease with depth, although the vein structure remains persistent.

Sampling by the NBMG indicate very high silver assays, ranging from 2.0 opt. to 146.0 opt., and gold assays ranging from trace to 1.0 opt. Surface sampling by Tenneco (now Echo Bay) reported gold assays ranging from trace to 0.195 opt., and silver assays ranging from 0.03 opt. to 10.5 opt. Sample results from the BOM indicate gold assays ranging from 0.001 opt. to 0.066 opt. and silver assays ranging from 0.03 opt. to 100.52 opt. Arsenic and antimony analytical results were anomalous as well as mercury.

Echo Bay owns the patented ground at the Nevada Hills mine. During some of their work, they measured and sampled the tailings pile at the old mill building. They estimated the tailings, which are amenable to leaching, would contain 200,000 tons of material averaging 0.01 opt. gold and 2.5 opt. silver (private company report).

The Mizpah mine, No. 4, fig. 4-1, occurs within the eastern boundary of B-17, but the east-west striking vein projects into the proposed MLW area. The vein is hosted by ash-flow tuffs and rhyolite flows that have been silicified, locally brecciated, and kaolinized along numerous fractures within and adjacent to the vein margin. The vein is from 4 feet to 20 feet wide and averages 6 feet in width. It is composed of replacement quartz and silicified rhyolite (Quade and Tingley, 1987).

Sampling by the NBMG has indicated gold assays ranging from 0.003 opt. to 0.52 opt. and silver assays ranging from 0.15 opt. to 58.4 opt. Sampling by the BOM has indicated gold assays ranging from less than 0.001 opt. to 0.035 opt. and silver assays ranging from less than 0.01 opt. to 7.71 opt. Molybdenum analytical results are anomalous in this vicinity and help define a 1,500 foot long anomalous trend into the MLW area.

The Jelinek mine, No. 5, fig. 4-1, also occurs within the east boundary of B-17. However, some of the workings and the vein projections are located within the MLW.

The vein was discovered in 1906 and only minor production occurred during the next 10 years. By 1920, there were 1,000 feet of workings. By 1928, there were 2,500 feet of workings (Quade and Tingley, 1987).

The veins vary in width from 2 feet to 20 feet and probably average 5 feet in width. The main Big Ledge vein is exposed for 3,000 feet on surface (private company report), striking N. 70° E. and dips about 80° south. The vein appears to be a fissure-filling type composed of quartz, fragments of silicified and replaced breccia, and quartz-adularia pseudomorphic after calcite (Quade and Tingley, 1987, p. 23). The veins are hosted by rhyolite and latite flows and tuffs, cut by silicified rhyolite, and occasionally dacite/andesite dikes.

Sampling by the NBMG produced the following results: gold assays ranging from 0.004 opt. to 0.52 opt.; silver assays ranging from 0.29 opt. to 58.4 opt. (Quade and Tingley, 1987). Sampling by industry indicates gold assays ranging from nil to 0.001 opt. and silver assays ranging from 0.01 opt. to 0.06 opt. Sampling by the BOM indicates gold assays ranging from less than 0.001 opt. to 0.158 opt. and silver assays ranging from less than 0.01 to 15.9 opt.

No. 6, fig 4-1, Huntsman/Placer Dome claim group, represents claims staked by D. Huntsman, 1984, to cover an area of alteration and vein mineralization. Trenching and sampling by Huntsman produced assays ranging from 0.012 opt. gold to 0.154 opt. gold, and 0.20 opt. silver to 40.8 opt. silver.

Huntsman later leased his claims to Placer Dome USA, Ltd., who added additional claims surrounding the original claim group. Placer did preliminary mapping and sampling. Their mapping indicates Tertiary tuffs and sediments intruded by andesite porphyry and rhyolite porphyry. The Placer work also indicated areas of stockwork fracturing and quartz veining, and altered and iron-stained brecciated areas. The claim group lies within the proposed MLW.

Sampling results from the initial Placer Dome work ranged from trace to 0.04 opt. gold and from less than 0.01 opt. silver to 0.76 opt. silver. Mercury results were also anomalous ranging up to 0.157 ppm.

The Gold Coin No. 2 mine, no. 7, fig. 4-1, the Gold Coin No. 1 mine, fig. 4-1, no. 8, and the Bluff mine, no. 9, fig. 4-1, are known collectively as the Nevada Fairview group. The mines are presently owned by Echo Bay Mining (five patented claims) and lie within the proposed MLW.

The geology of this area consists of Tertiary tuffs and flows cut by a range-front fault, northerly trending, and intruded by dacite porphyry dikes. The dacite is brecciated and contains disseminated pyrite throughout.

Two distinct types of mineralization are noted: calcite-quartz veins, highly manganiferous, occur at the Gold Coin No. 2 workings, striking N. 30°-40° E., dipping 70°-80° southeast and exposed for 1,000 feet; and brecciated replacement-type veins, striking N. 30° E., dipping northwest, occurring at the Gold Coin No. 1 and Bluff mines. The veins vary in width from 1 foot to 20 feet with an average of 4 to 5 feet (Quade and Tingley, 1987).

Echo Bay completed a program of sampling and mapping, surface and underground, followed by drilling (rotary) in an attempt to discover a bulk mineable deposit. They were not successful but have retained the property. The property has potential for high grade, lower tonnage targets which might interest a smaller mining company.

Sampling by the NBMG on the vein structures indicated results as follows: gold values ranging from nil to 0.04 opt.; and silver values ranging from 0.29 opt. to 29.2 opt. (Quade and Tingley, 1987). Sampling by industry (private company report) and the BOM indicates gold assays ranging from less than 0.001 opt. to 0.115 opt. and silver assays ranging from less than 0.01 opt. to 29.20 opt. Arsenic analytical results are anomalous while mercury analytical results are inconsistent.

No. 10 on fig. 4-1 represents the Jet claim group staked by Spectrum Exploration in 1986 in the segregated area. Work, consisting of mapping and sampling, delineated an area of argillic alteration and stockworks of vuggy, iron-oxide-stained quartz veining. The veining occurs in latites and andesites and is approximately 4,000 feet long (north-south) and 1,000 feet wide (east-west).

Sampling by Spectrum Exploration, St. Joe Minerals, and Tenneco produced results ranging up to 0.229 opt. gold. Assuming continuity between altered and mineralized outcrops in an area 2,000 feet long, 300 feet wide, and 40 feet deep, Tenneco geologists calculated a potential of 1,800,000 tons of ore material with grades exceeding 0.02 opt. gold.

BOM sampling and mapping results indicate gold assays ranging from less than 0.001 opt. to 0.077 opt. and silver assays ranging from less than 0.01 opt. to 0.06 opt. Arsenic analytical results are anomalous and mercury anomalous results are spotty.

The combined sampling results of the BOM, NBMG, and industry indicates an anomalous zone of gold and silver mineralization along the northeast trending Snyder Canyon (point 10, fig. 4-1).

Area No. 11 on fig. 4-1, the Rex claim group, was staked by Spectrum Exploration in 1986. They completed some sampling and mapping prior to learning that the area had been segregated and reserved.

The eastern portion of the claim group is underlain by Triassic-Jurassic metasediments and intruded by Cretaceous granitics. The western portion of the claim group is underlain by Tertiary volcanic flows and sedimentary rocks and intruded by rhyolite and dacite. The claim group covers a major northwest-trending fault on the north side of Bell Canyon. The fault appears to cut and offset south-trending mineralized structures extending from the Nevada Fairview group (Nos. 7, 8, 9, fig. 4-1).

This area is moderately to intensely argillized and silicified. Mineralization is described as being non-typical for epithermal deposits and more related to fine-grained pyrite and silver sulfides with gold being associated with areas of hematite enrichment (Quade and Tingley, 1987, p. 31).

NBMG sample results report silver assays up to 0.44 opt., gold assays from nil to 0.035 opt., and molybdenum analytical results up to 300 ppm. These results are similar to those reported by Spectrum Exploration and Tenneco (Quade and Tingley, 1987).

The BOM sample results indicate gold assays ranging from less than 0.001 opt. to 0.004 opt., and silver assays ranging from less than 0.01 opt. to 0.22 opt. Arsenic analytical results are anomalous. Molybdenum results are very anomalous and help define the north trending 3,500 foot long zone parallel to and just north of Bell Canyon.

The Nevada Crown mine, No. 12, fig. 4-1, lies about one-half mile north of Bell Canyon. The mine workings explore a 10 to 30 foot wide breccia vein, highly silicified, bearing N. 50° W., dipping 40° NE. Other veins, trending N. 5° E., dipping 70° SE, are noted. The veins are hosted by an andesite/dacite breccia which has been argillized and silicified.

NBMG sampling has indicated gold assays ranging from nil to 0.03 opt. and silver assays ranging from 0.03 opt. to 0.44 opt (Quade and Tingley, 1987). Of some interest were the anomalous molybdenum analytical results which ranged from 100 ppm to 150 ppm.

BOM sample results indicate gold assays ranging from less than 0.001 opt. to 0.004 opt., and silver assays ranging from less than 0.01 opt. to 0.11 opt. Again arsenic analytical results are anomalous and mercury results are inconsistent.

No. 13, fig. 4-1, represents the prospects and trenches for the Slate mine. The mine is south of the southern boundary of the proposed MLW area, but the claim group continues northward into the MLW.

Tungsten mineralization was discovered in 1941 and intermittent production occurred until 1957. The average grade was 0.5% WO_3 (Quade and Tingley, 1987).

The principal rocks exposed at the Slate mine are schists with intercalated limestone and intruded by granite, aplite, and rhyolite sills. Production came from skarn zones in the limestone horizons in the form of scheelite (Quade and Tingley, 1987, p. 33).

4.13 Resource Potential

Fig. 4-1 illustrates the location of those areas in the Fairview District within or adjacent to the proposed MLW where identified and inferred resources have been evaluated. These areas are assigned resource ratings based on criteria developed in U.S. Geological Survey Circular 831, 1980 (see Appendix 4).

The Centurion claim group, No. 1, is classified as an inferred resource based on a minimum of surface sampling and similarity to known deposits outside the district. If exploration proceeds, this resource would be expected to have grades approaching 0.2 opt. gold, 3-7 opt. silver, and tonnages greater than 500,000 tons.

The Nevada Hills mine, No. 3, is classified as an identified resource. The resource consists of 200,000 tons of tailings material from previous operations. Sampling resulted in grades of 0.01 opt. gold and 2.5 opt. silver.

The Mizpah mine, No. 4, the Jelinek mine, No. 5, Gold Coin # 2 mine, No. 7, the Gold Coin # 1 mine, No. 8, and the Bluff mine, No. 9, are classified as inferred resources. This classification is based on previous production and continuation of the structures from which the production was derived.

The Huntsman/Placer Dome claim group, No. 6, is classified as an inferred resource. This is based on preliminary surface sampling and rock types and alteration similar to producing deposits.

The Jet claim group, No. 10, is classified as an indicated resource based on surface sampling (number of samples and spacing) and similarity to known deposits. About 1,800,000 tons of ore at a grade of greater than 0.02 opt. gold have been estimated.

The Rex claim group, No. 11, and the Nevada Crown mine, No. 12, are classified as inferred resources. Surface sampling has identified an area large enough to support a bulk mineable deposit. This is further substantiated by the assessment of the geology and its relationship to other known deposits.

4.2 Wonder District

The Wonder District is located northeast of B-17. The proposed MLW will include approximately 45% of this district.

4.21 General Geology

Fig. 4-2 illustrates the general geology of the Wonder District. The oldest rocks in the district are the andesite and basalts that occur north and south of Red Top Wash on the west side of the district. They are thought to be late Oligocene to Miocene in age (Quade and Tingley, 1987, p. 37).

Overlying the andesites and basalts is a unit named the Wonder rhyolite. This unit is composed of rhyolite and quartz latite welded tuffs and flows with thickness greater than 2,000 feet. The unit has been dated as early Miocene and is the host of much of the mineralization within the district (Quade and Tingley, 1987, p. 37).

A dacite intrudes the Wonder rhyolite. The dacite is porphyritic with plagioclase phenocrysts in an aphanitic ground mass. It has been dated as mid-Miocene and hosts some of the productive veins in the district.

A rhyolite intrusive is the next youngest rock unit. The rhyolite occurs as plugs for the most part and has been dated at late Miocene in age.

An andesite intrusive is the next youngest rock. It occurs as a small stock in the northwest portion of the Wonder District. It has been dated as late Miocene to early Pliocene.

Overlying the andesite intrusive are basalt flows which are found in the northwest corner of the district. These flows apparently post date the mineralization and have been dated as mid-Pliocene.

The youngest unit, alluvium, is composed of gravels, sands, and other mass-wasting products. This material is currently adding to the fill in the Dixie Valley basin, west of Wonder District.

There are at least 50 veins in the district (Schrader, 1947). Most of the veins occur in the Wonder rhyolite and are very siliceous, with quartz-adularia gangue common and values in silver-gold. The veins are largely replacement types and range in thickness from 1 to 40 feet. The veins form prominent ledges because they are highly siliceous and resistant to erosion.

The age of mineralization is thought to be late Miocene to early Pliocene as all rocks older than this age contain mineralization (Quade and Tingley, 1987, p. 37).

4.22 Mines and Prospects

Fig 4-2 shows the location of the more prominent mines and prospects in the Wonder District. The Nevada Wonder mine, No.

EXPLANATION

Geologic map, Wonder District

Quaternary	Qal	Gravels, sand
Tertiary	Tb	Basalt
	Tai	Andesite intrusive
	Tri	Rhyolite intrusive
	Tda	Dacite intrusive
	Tr	Wonder rhyolite, rhyolite to quartz latite welded tuffs and flows
	Tov	Older volcanics, andesite to basalt flows

Contact, dashed where projected	———— — —
Fault, dashed where projected	———— — —
Mine	⚒
Prospect	X
MLW area	(hatched box)

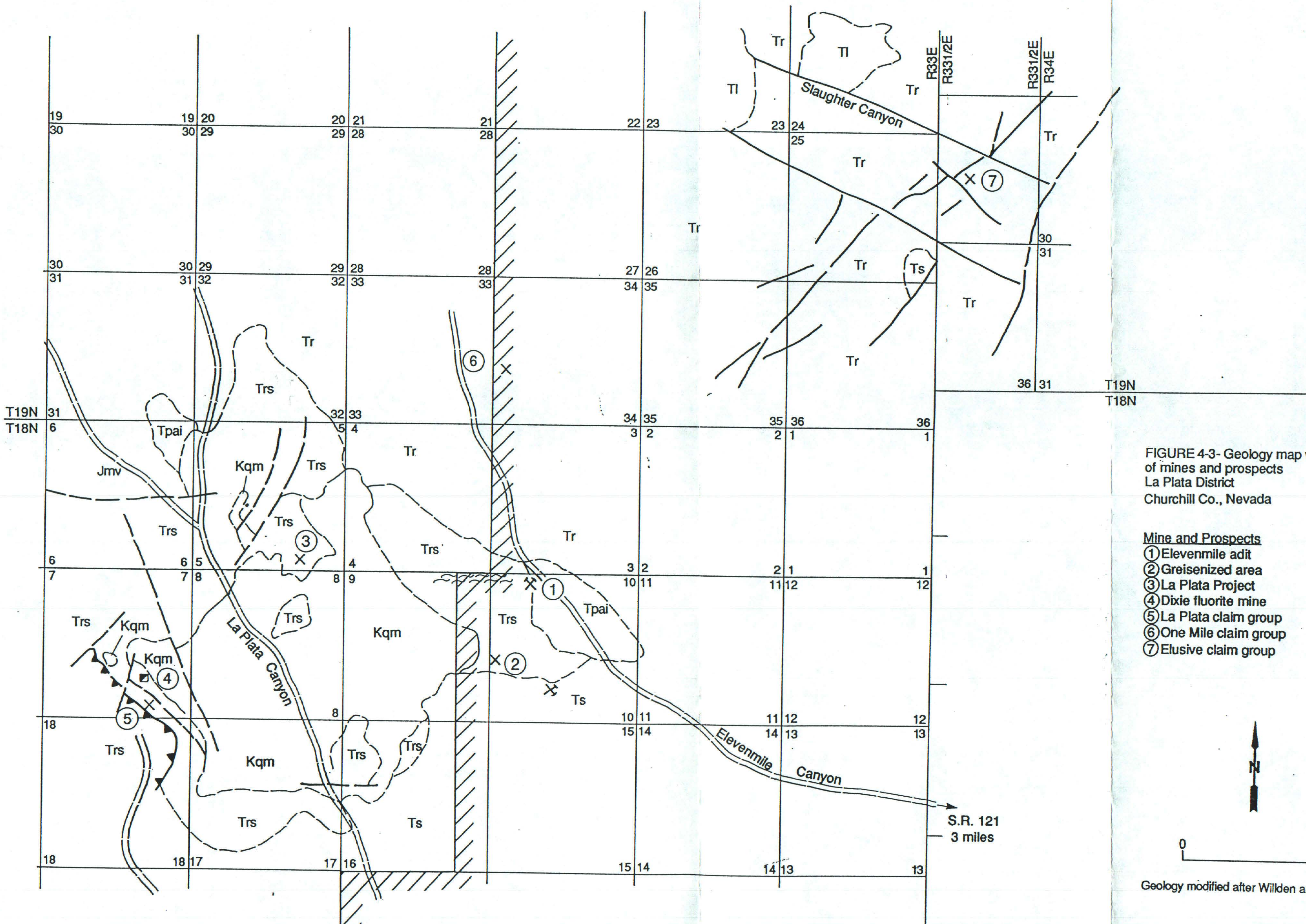


FIGURE 4-3- Geology map with location of mines and prospects
La Plata District
Churchill Co., Nevada

Mine and Prospects
1. Elevenmile adit
2. Greisenized area
3. La Plata Project
4. Dixie fluorite mine
5. La Plata claim group
6. One Mile claim group
7. Elusive claim group

Geology modified after Willden and Speed (1974)

1, was the largest producer in the district. The Nevada Wonder is credited with about 392,763 tons of ore (Quade and Tingley, 1987, p. 39) at a grade of 0.185 opt. gold and 17.5 opt. silver (private consulting report).

The mine was opened to a depth of 2,000 feet, but most of the production came from above the 1,300-foot level (Quade and Tingley, 1987, p. 39). The vein is traceable for at least 3,000 feet on the surface and is up to 100 feet wide.

Belmont Resources, Canada, had leased the property from Mr. Frank Lewis, the owner. Belmont leached material from the old Wonder mine dump, some new ore from the Silver Center mine, and tailings from the old Wonder mill. With the decrease in the price of silver, Belmont shut down the operation and returned the property to the owner.

Mr. Lewis has calculated reserves on the Wonder vein zone based on surface sampling, underground sampling, and drilling. Mr. Lewis currently inventories greater than 5,000,000 tons at 0.019 opt. gold and 2.42 opt. silver as probable reserves.

The Silver Center mine, No. 2, fig. 4-2, is also owned by Mr. Frank Lewis of Reno. The mine is on a vein up to 30 feet wide, that is hosted by Tertiary dacite intrusive. A small amount of production has been utilized by Belmont for leaching at the Wonder mine leach pad.

Mr. Lewis has calculated reserves at the Silver Center mine based on surface sampling and some drilling. He estimates 100,000 tons of ore at 0.02 opt. gold and 4.0 opt. silver. There is adequate vein strike length to expand this estimate.

The Jackpot mine, No. 3, fig. 4-2, was probably the first claim staked in the district and may be on the northern extension of the Wonder vein. Because of post-mineral cover, the vein is not continuously exposed on the surface. The vein was opened up to 960 feet in depth with 6,000 feet of lateral workings. Most of the production came from above the 700-foot level (Quade and Tingley, 1987, p. 41).

NBMG sample results indicate assays up to 0.14 opt. gold and 146 opt. silver. BOM sampling indicates gold assays ranging from 0.001 opt. to 0.321 opt. and silver assays ranging from 0.01 opt. to 10.19 opt. Arsenic and antimony analytical results are anomalous and closely mimic the better precious metal mineralization. Some anomalous mercury results are noted but are not consistent. Only limited resource possibilities are thought to remain at the Jackpot mine.

The Vulture mine, No. 4, fig. 4-2, made the first shipment of ore in 1907 from the Wonder District, 40 tons at $100/ton

(Quade and Tingley, 1987, p. 41). The Vulture vein strikes N. 10° W., dipping vertically. The brecciated vein is hosted in the Wonder rhyolite which is fractured and faulted.

NBMG sampling indicates assays ranging from 0.17 opt. gold to 0.32 gold and 43.8 opt. silver to 146 opt. silver. They also reported low base metal and mercury analytical results (Quade and Tingley, 1987).

BOM sampling indicates gold assays ranging from 0.006 opt. to 0.374 opt., and silver assays ranging from less than 0.01 opt. to 47.39 opt. Arsenic and antimony results are anomalous. Because of limited vein strike length, the resource possibilities are thought to be low.

The Gold King claim group, No. 5, fig. 4-2, lies on the Gold King fault. In general, adits follow structures that trend N. 40°-60° E. and dip 70°-85° NW. The veins are 4 to 6 feet wide and brecciated. The veins are hosted by clay altered and partly silicified Wonder rhyolite (Quade and Tingley, 1987, p. 42).

Sampling by the NBMG indicates results ranging from 0.01 opt. gold to 0.64 opt.gold and 0.44 opt. silver to 146 opt silver (Quade and Tingley, 1987, p. 32). Sampling by the BOM indicates gold assays ranging from less than 0.001 opt. to 0.006 opt. and silver assays ranging from less than 0.01 opt. to 8.47 opt. Arsenic and antimony analytical results are anomalous; mercury results are low and not consistently anomalous.

The Spider and Wasp mine, No. 6, fig. 4-2, are located on the Spider and Wasp veins. The veins are hosted in the Wonder rhyolite. Apparently, the mineralized portion of the veins in this area are only 100 feet deep as mining rarely went below this level (Quade and Tingley, 1987, p. 49). The depth limit may be due to low angle structures or a rapid decrease in mineralized vein widths.

NBMG sample results range from 0.001 opt. to 0.25 opt. gold and 2.92 opt. to 87.6 opt. silver. BOM sample results indicate gold assays ranging from less than 0.001 opt. to 0.041 opt., and silver assays ranging from less than 0.01 opt. to 16.72 opt. Arsenic and antimony results are mostly anomalous and again mimic the precious metal mineralization. Anomalous molybdenum analytical results were encountered.

The Dickey Peak area mines are located at No. 7, fig. 4-2. The mines and prospects are located on the western extension of the Spider and Wasp vein system. Here, the vein is 5 to 6 feet wide and brecciated. The vein host rock is clay altered and silicified Wonder rhyolite.

NBMG sampling results indicate gold ranging from 0.02 opt. to 0.14 opt. and silver ranging from 29.2 opt. to 58.4 opt (Quade and Tingley, 1987, p. 49). BOM sampling results indicate gold assays ranging up to 0.001 opt., and silver assays ranging up to 0.30 opt. Arsenic and antimony analytical results are less anomalous but still elevated. Molybdenum results are also anomalous.

The Kiowa vein system mines and prospects follow a curving, northeast-striking structure, No. 8, fig. 4-2. The veins are fractured to brecciated quartz hosted in very strongly clay-altered Wonder rhyolite.

NBMG sample results indicate gold ranging from 0.001 opt. to 0.27 opt. and silver ranging from 0.20 opt. to 20.4 opt (Quade and Tingley, 1987, p. 48).

BOM sample results indicate gold assays up to 0.003 opt., and silver assays up to 1.36 opt. Again arsenic analytical results are anomalous and antimony results are anomalous. Some exploration possibilities may exist at these prospects.

The Christmas-Faustiene vein systems are located at No. 9, fig. 4-2. Southwest-bearing adits in the Wonder rhyolite explore the intersection. The quartz vein appears at or near the contact between the Wonder rhyolite and the andesite.

NBMG sampling, one sample, indicates 0.017 opt. gold and 5.84 opt. silver (Quade and Tingley, 1987, p. 52). BOM sampling indicates gold assays up to 0.003 opt., and silver up to 0.66 opt. Arsenic and antimony analytical results are anomalous and mimic the precious metal mineralization pattern. Some exploration possibilities are thought to exist at these prospects.

The Nevada Belle/Gold Rock vein systems, No. 10, fig. 4-2, the Vena Grande vein systems, No. 11, fig. 4-2, and the Marie/Ruby vein systems, No. 12, fig. 4-2, explore veins hosted in variably argillized and silicified Wonder rhyolite. Sample results from NBMG sampling indicate gold assays ranging from 0.001 opt. to 0.01 opt. and silver assays ranging from 0.05 opt. to 0.44. It is noted that the base metal content begin to increase in this area. Only limited resource possibilities are thought to exist at these prospects.

The Colorado/Hope vein system prospects are located at No. 13, fig. 4-2. The prospects explore north-trending and N. 70° W.-trending veins. The veins are hosted in argillized and slightly silicified Wonder rhyolite. In some cases, the rock is highly leached (Quade and Tingley, 1987, p. 53).

NBMG sample results indicate gold values ranging from 0.001

opt. to 0.006 opt. and silver values ranging from 20.4 opt. to 29.2 opt. Again, it is noted that the base metal contents have increased. Some exploration possibilities are thought to remain at these prospects.

4.23 Resource Potential

Fig 4-2 illustrates the location of areas in the Wonder District within or adjacent to the proposed MLW where identified and inferred resources have been evaluated.

No. 1, the Nevada Wonder mine, is classified as an identified resource. This classification is based on surface and underground sampling and drilling by the owner which produced a reserve inventory of greater than 5,000,000 tons at 0.019 opt. gold and 2.42 opt. silver.

No. 2, the Silver Center mine, is classified as an identified resource based on surface sampling and drilling. The claim group owner estimates 100,000 tons at 0.02 opt. gold and 4.0 opt. silver.

No. 5, the Gold King claim group, is classified as an inferred resource. This classification is based on past production, continuation of producing structures, and permissive geology including BOM appraisal of alteration and fracture densities.

No. 6, The Spider and Wasp mine, is classified as an inferred resource. This classification is based on past production, continuation of producing structures, sampling results, and permissive geology.

No. 7, the Dickey Peak area mines, is classified as an inferred resource. Again, the classification is based on the continuation of producing structures, BOM sampling results, and permissive geology.

4.3 La Plata District

The La Plata District is located north of B-17. Approximately 50% of the district is included within the proposed MLW.

4.31 District Geology

Fig 4-3 illustrates the general geology of the La Plata District. The oldest rocks are Triassic shales and siltstones which have been metamorphosed to phyllites and andalusite schist. Overlying the metasediments is a Triassic limestone. The limestone appears to have been thrust faulted into this position and the actual age relationship is unclear.

The next youngest rocks are Jurassic in age and consist of

EXPLANATION

Geology map, La Plata District

Cenozoic	Tertiary	Ts	Tuffaceous and lake bed sediments, and basalt flows
		Tpai	Andesite porphyry intrusive
		Tr	Rhyolite tuffs and flows
		Tl	Latite flows and tuffs
Mesozoic	Cretaceous	Kqm	Quartz monzonite intrusive
	Jurassic	Jmv	Metamorphosed volcanics and sediments
	Triassic	Trs	Metamorphosed siltstone and shales, and limestones

Contact, dashed where projected	———— — —
Fault, dashed where projected	———— — —
Thrust fault, teeth on upper plate	▼▼▼▼▼▼
Shear zone	≈≈≈
Mine	⚒
Prospect	X
MLW area	▨

metasediments and metavolcanics. These rocks are found on the west side of the district.

The Triassic and Jurassic rocks have been intruded by Cretaceous granitics and aplites. The intrusion converted much of the older limestones to marble and possibly caused the observed skarns.

The oldest Tertiary rocks are shown as undifferentiated volcanics, probably Miocene in age. These volcanics consist of rhyolite to latite tuffs and flows. This sequence was intruded by andesite porphyries and rhyolite porphyries. Rhyolite tuffs and flows accompanied this intrusive activity. This intrusive/extrusive activity was probably mid to late Miocene in age.

The youngest rocks in the district consist of tuffaceous sediments, lake bed sediments, and basalt flows. This sequence post dates the mineralization activity in the La Plata District.

There are at least two periods of structural activity noted within this district. The oldest structural event consisted of thrust faulting. This faulting placed Triassic limestone over Triassic metasediments in northeast-trending thrust plates (Quade and Tingley, 1987, p. 57). The next event was the intrusion of the Cretaceous granitics and aplites into the Triassic-Jurassic sequence. Younger (Cenozoic) deformation involved the formation of north-south trending folds in Tertiary rocks and the onset of high-angle normal faulting (Quade and Tingley, 1987, p. 57).

The mineralization in this district appears to be related to two events. The older mineralizing event is associated with granite/aplite intrusion; the younger event is associated with the andesite porphyry/rhyolite porphyry intrusive activity.

4.32 Mines and Prospects

Mineral occurrences can be grouped into four categories. Silver-copper bearing quartz veins occur in shear zones. The molybdenum-tungsten-copper bearing skarn zones are related to the granitic intrusives and to later aplite and andesite dikes that cut the intrusive rock. The fluorite deposits in shear zones are associated with aplite dikes and sills. Precious metal-bearing quartz veins/silicified zones occur within Tertiary volcanics. (Quade and Tingley, 1987, p. 59).

No. 1, fig. 4-3, is the Elevenmile Adit which explores a possible sheared contact zone between granitic intrusives and Triassic sediments.

NBMG sample results indicate silver assays ranging from 0.29 opt. to 4.4 opt., copper analytical results up to 0.3 %/ton, and high antimony (Quade and Tingley, 1987, p. 60). BOM work mapped a 900-foot-wide sheared and altered zone west-southwest of the Elevenmile Adit. Sample results indicate gold assays ranging from less than 0.001 opt. to 0.006 opt., and silver assays ranging from less than 0.01 opt. to 20.44 opt. Also recorded were copper analytical results up to 0.7% per ton, molybdenum results up to 0.02% per ton, and anomalous arsenic results.

A greisenized area, No. 2, fig. 4-3, at or near the contact between Triassic sediments, granite intrusive, and an andesite porphyry dike was investigated. Greisen is defined as a granitic that has been altered to a quartz-mica, generally muscovite, rock. The greisen area had been identified by industry geologists and verified by both NBMG and BOM personnel. Sample results, one sample, from NBMG work indicate silver at 8.5 opt., copper at 0.3% per ton, and high antimony. BOM sample results indicate gold assays ranging from less than 0.001 opt. to 0.010 opt., and silver assays ranging from less than 0.01 opt. to 4.38 opt. Also recorded were copper analyses up to 0.3% per ton, and anomalous molybdenum analyses. Some exploration possibilities may exist in this area.

No. 3, fig. 4-3, the La Plata project area, is an area that has been explored for tungsten-molybdenum. Mapping has noted Triassic limestones intruded by Cretaceous granitics and Tertiary andesites which has resulted in the formation of both banded skarn and massive skarn. Phelps Dodge completed nine relatively short drill holes without finding mineable ore (Quade and Tingley, 1987, p. 60).

BOM sampling results indicate gold assays less than 0.001 opt., and silver assays ranging from less than 0.01 opt. to 0.01 opt. However, molybdenum analytical results range up to 0.1% per ton and tungsten results are anomalous.

No. 4, fig. 4-3, the Dixie fluorite trend, is an area of fluorspar mineralization in a west-northwest bearing contact zone between aplite dikes and Triassic limestone and phyllites. Fluorite occurs in small masses and veinlets in prospects at both ends of the trend. At the northwest end of this trend, the Dixie mine operated and shipped over 500 tons of fluorite between 1953 and 1955 (Papke, 1979).

BOM sampling along this trend indicate fluorine analytical results ranging from 2.8% to 9.9% per ton.

No. 5, fig. 4-3, the La Plata claim group, is an area being actively examined for precious metals. Triassic limy sediments have been faulted and brecciated, argillized, silicified, and mineralized. Industry (Nassau, Ltd.), 1988-89, sample results indicate gold assays ranging from nil to 0.03 opt. and silver ranging from less than 0.01 opt. to 1.8 opt. Anomalous arsenic and antimony results were recorded.

BOM sample results in this area indicate gold assays ranging from less than 0.001 opt. to 0.002 opt., and silver assays ranging from less than 0.01 opt. to 0.04 opt. Arsenic and antimony results are anomalous.

No. 6, fig. 4-3, has been identified as the One Mile claim group. Old workings investigate narrow quartz veins in shear zones cutting andesite. Veins strike northwest, northeast, and north-south. Projections of the northeast and/or the northwest structures would extend into the proposed MLW (Quade and Tingley, 1987, p. 60).

NBMG sample results indicate gold values in two samples of 0.001 opt. and 0.196 opt. and silver values in four samples ranging from 0.58 opt. to 14.6 opt. (Quade and Tingley, 1987, p. 60).

BOM sample results, one sample, indicate 0.342 opt. gold, 2.27 opt. silver, and anomalous antimony, arsenic, and molybdenum. Some exploration possibilities may exist at this prospect.

No. 7, fig. 4-3, the Elusive claim group, was staked by U. S. Borax/Kennecott Exploration in 1988. The claims cover an area of faulted, altered, and mineralized Tertiary volcanics and Tertiary intrusives. Preliminary mapping and sampling by the companies have identified 5 areas containing anomalous gold analytical results (geochemical gold results greater than 0.001 opt.).

BOM work has verified the structural complexity and alteration, and has sampled these mineralized areas. The sample results indicate gold assays ranging from less than 0.001 opt. to 0.044 opt., and silver assays ranging from less than 0.01 opt. to 34.12 opt. Also noted were very anomalous arsenic analytical results, less anomalous antimony results, and inconsistent mercury and molybdenum results.

4.33 Resource Potential

Fig 4-3 shows the location of the investigated areas in the La Plata District within or adjacent to the proposed MLW where identified or inferred resources have been evaluated.

Area no. 1, the Elevenmile Adit, is classified as an inferred resource. The classification is based on the previous mining, identification of structure/vein projection, and surface sampling results.

Area no. 3, the La Plata project, is classified as an inferred resource. The classification is based on permissive geology, surface sampling results, and drilling results.

Area no. 4, the Dixie fluorite mine, is classified as an indicated resource. The area has a production record. Mapping and sampling have identified continuation of the producing structure.

Area no. 5, the La Plata claim group, is classified as an inferred resource based on permissive geology and sampling results.

Area no. 7, the Elusive claim group is classified as an inferred resource. This classification is based on permissive geology, including the identification of rock types, structures, alteration, and mineralization that compares favorably with known producing mines. This is further substantiated by initial sampling results.

4.4 Chalk Mountain District

Chalk Mountain District is located northeast of B-17. Most of the district lies outside of the proposed MLW.

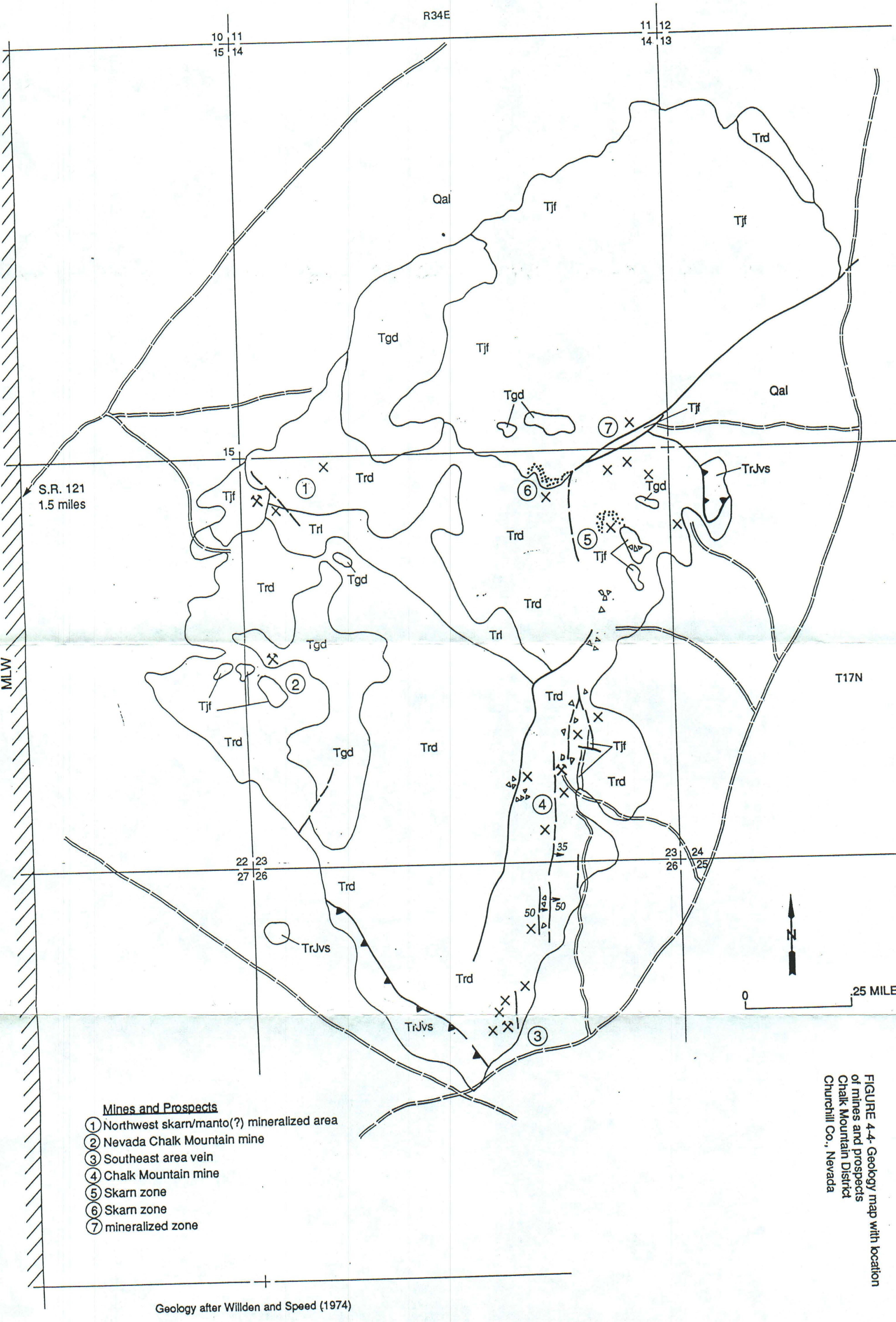
4.41 General Geology

The oldest rock unit, fig. 4-4, is a carbonate which is composed of a lower limestone member and an upper dolomite member. The carbonate has been tentatively correlated with the Triassic Gabbs Formation and Jurassic Sunrise Formation based on lithology and composition (Willden and Speed, 1974, p. 64). Much of the lower carbonate unit is exposed as a white dolomite or dolomitic marble.

The next youngest unit is a mixed volcanic and sedimentary sequence. The unit is composed of volcanic conglomerates and wackes, basaltic to dacitic tuffs, tuffaceous sandstones, and sandstone. The unit is generally olive green in color. The unit has been assigned a late Triassic to post late Triassic age based on inclusions of upper Triassic clasts (Willden and Speed, 1974, p. 64).

The mixed volcanics and sediment unit is exposed in the upper plate of a thrust fault, southeast corner of fig. 4-4. The unit is also exposed in the upper plate of a thrust fault, northwest 1/4 of fig. 4-4 indicating possible widespread thrusting in the Chalk Mountain district.

The next youngest units are igneous. An older felsite



Geology after Willden and Speed (1974)

FIGURE 4-4- Geology map with location of mines and prospects Chalk Mountain District Churchill Co., Nevada

EXPLANATION

Geology map
Chalk Mountains
Churchill Co. Nevada

Cenozoic	Quaternary	Qal	Alluvium
	Tertiary	Tgd	Granodiorite
		Tjf	Rhyolite porphyry (felsite)
Mesozoic	Jurassic	TrJvs	Mixed volcanic and sedimentary rocks
		Trd	Dolomite
		Trl	Limestone

Contact	———————
Fault, showing dip; dashed where projected	50
Thrust fault, teeth on upper plate	
Breccia or brecciated rock	
Skarn zone (sk)	
Mine	⚒
Prospect	X
MLW area	

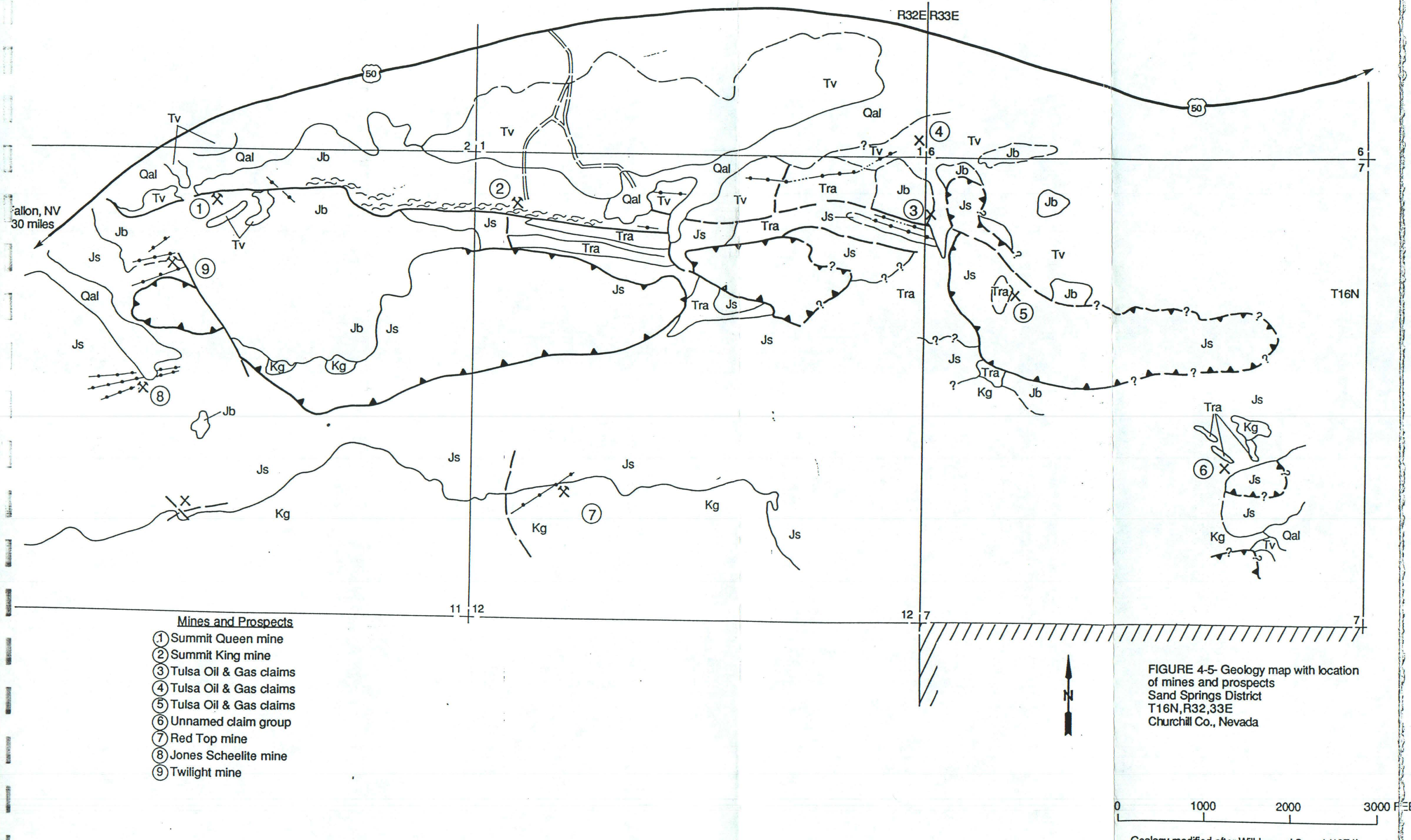


FIGURE 4-5- Geology map with location of mines and prospects
Sand Springs District
T16N,R32,33E
Churchill Co., Nevada

(rhyolity porphyry ?) has been intruded by a granodiorite. The felsite is a light-colored, porphyritic intrusive rock with quartz and feldspar phenocrysts. Commonly, the felsite is stained a light orange-brown color. The felsite is variably altered, ranging from silicification to weak argillization.

The granodiorite is a medium to coarse grained to porphyritic rock with phenocrysts of plagioclase and potassium feldspars. The granodiorite is fractured and variably altered. The alteration ranges from propylitic to argillic. The granodiorite intrudes the older carbonate unit and the felsite. The relationship with the thrusted volcanics and sediment unit is unclear.

The youngest unit is the alluvium. This unit is composed of mass wasting materials, sand, gravels, and boulders. The alluvium occurs as fans and valley fill. The alluvial fans may be as much as 200 feet above the valley floor.

4.42 Mines and Prospects

Two small mining companies operated mines in the Chalk Mountain mining district. The Chalk Mountain Lead-Silver Mining Company operated on the east side and recorded the more significant metal production. The Nevada Chalk Mountain Mining Company operated on the west side.

No production records are available for the west side mines. Production may have totalled several car loads of ore. At least ten prospects of the more than 60 identified could have yielded small amounts of ore.

On the west side of the Chalk Mountain district, ore has been exposed in quartz-limonite veins, manto (?)-like replacements along beds, fractures or faults in carbonate units and from skarn zones at carbonate-felsite contacts.

Point 1, fig. 4-4, is an area containing up to 20 prospects. The prospects occur within bleached or marbilized carbonates. Quartz-limonite veins, manto zones, and skarn zones are noted. The zones range in thickness from a few inches up to 10 feet and have strike lengths less than 50 feet exposed on the surface.

NBMG sampling from the area about point 1, fig. 4-4, yielded gold assays ranging from nil to 0.001 opt., and silver assays ranging from 0.09 opt. to 43.8 opt. For other metals, analytical results indicate copper ranging from trace to greater than 2.0% per ton, lead ranging from trace to greater than 2.0% per ton, and zinc ranging from trace to greater than 2.0% per ton. (Quade and Tingley, 1987, p. 56).

BOM sampling for the point 1 area, fig. 4-4, indicates gold assays ranging from less than 0.001 opt. to 0.073 opt., and silver assays ranging from less than 0.01 opt. to 4.53 opt. For other metals, analytical results indicated copper ranging from less than 0.01% per ton to 0.5% per ton, lead ranging from less than 0.01% per ton to 9.8% per ton, and zinc ranging from 0.03% per ton to 9.5% per ton. Some exploration possibilities may exist at these prospects.

The Nevada Chalk Mountain mine, point 2, fig. 4-4, occurs in a bleached and marblized carbonate. The carbonate has been intruded by felsite which contains finely disseminated pyrite. The felsite is altered, ranging from propylitic to argillic alteration.

NBMG sampling indicates gold assays ranging from 0.001 opt. to 0.017 opt., and silver assays ranging from 0.06 opt. to 2.92 opt. Other metal analytical results indicate copper ranging from 0.01% per ton to 0.07% per ton, lead ranging from 0.15% per ton to greater than 2.0% per ton, and zinc ranging from 0.15% per ton to 0.30% per ton (Quade and Tingley, 1987, p. 56).

BOM sampling indicates gold assays ranging from less than 0.001 opt. to 0.002 opt. and silver assays ranging from 0.01 opt. to 0.09 opt. Other element analytical results indicate copper ranging from less than 0.01% per ton to 0.18% per ton, lead ranging from less than 0.01% per ton to greater than 0.5% per ton, and zinc ranging from 0.03% per ton to 0.42% per ton.

The mines on the east side of the Chalk Mountain district had the most significant production. Most of the production came from oxidized veins in carbonates.

Point 3, fig. 4-4, an unnamed claim, explores a north trending, steeply dipping vein in bleached carbonates. A single sample by NBMG shows gold at 0.006 opt., silver at 0.58 opt., copper at 0.15% per ton, lead at 2.0% per ton, and zinc at 0.3% per ton.

BOM sample results report gold assays ranging from less than 0.001 opt. to 0.002 opt., and silver assays ranging from less than 0.01 opt. to 0.61 opt. Other metal analytical results show copper ranging from less than 0.01% per ton to 0.05% per ton, lead ranging from less than 0.01% per ton to 2.25% per ton, and zinc ranging from less than 0.01% per ton to 8.5% per ton. Only limited resource potential is thought to exist here.

The Chalk Mountain mine, no. 4, fig. 4-4, had the most significant production in the district. Through 1927, the mine is credited with 99 ounces gold, 59,651 ounces silver, and 861,355 pounds of lead. In 1929 a 50 ton per day mill was constructed, but it was metallurgically unsuccessful. It was dismantled in 1930. The mine developed a 10 to 20 foot wide structure to a depth of 517 feet by four shafts. The total lateral development on six levels was about 5,000 feet (Vanderburg, 1940, p. 18).

The ore occurs as replacement zones ranging from 1 to 12 feet in width along fissures and bedding planes in the carbonate. The ore minerals were reported as cerussite, anglesite (?), cerargyrite, wulfenite, vanadinite, and argentiferous galena. The ore zone is largely oxidized to the lowest level in the mine (Vanderburg, 1940, p. 18).

A single sample by NBMG at the Chalk Mountain mine, no. 4, fig. 4-4, reports gold at 0.041 opt., and silver at 14.6 opt. The sample also reports copper at 0.05% per ton, lead greater than 2.0% per ton, and zinc at 1.0% per ton.

BOM sampling reports gold assays ranging from less than 0.001 opt. to 0.032 opt., and silver assays ranging from 0.01 opt. to 11.33 opt. Analytical results from other metals indicate copper ranging from 0.02% per ton to 7.6% per ton, lead ranging from 0.01% per ton to 9.9% per ton, and zinc ranging from less than 0.01% per ton to 2.1% per ton.

At point 5, unnamed prospect, fig. 4-4, prospect pits and adits explore an area of carbonate intruded by felsites. The felsites are brecciated and silicified. The carbonate has been marblized and converted to skarn at or near the contact with the felsite.

There was no NBMG sampling in this area. BOM sampling results report gold ranging from 0.001 opt. to 0.021 opt., and silver ranging from 0.03 opt. to 2.86 opt. The sampling also reports copper ranging from less than 0.01% per ton to 0.10% per ton, lead ranging from less than 0.01% per ton to 6.4% per ton, and zinc ranging from less than 0.01% to 1.8% per ton. Some exploration possibilities may exist here at these prospects.

At point no. 6, fig. 4-4, a series of prospects explore a skarn zone at the contact between the felsite and carbonate. The skarn is composed of epidote and serpentine and is up to 20 feet thick. The skarn, where examined, contain no visible garnet although the epidote-serpentine could represent retrograde alteration products of a garnet zone. Also noted was massive magnetite.

There was no NBMG sampling in this area. BOM sampling reported gold assays ranging from less than 0.001 opt. to 0.003 opt., and silver assays ranging from 0.05 opt. to 9.93 opt. Analytical results for other metals indicate copper ranging from 0.01% per ton to 0.53% per ton, lead ranging from 0.02% per ton to 7.7% per ton, and zinc ranging from less than 0.01% per ton to 0.02% per ton.

At point no. 7, fig. 4-4, unnamed, prospect pits explore altered and mineralized felsite. Much of the felsite is silicified and mineralized with pyrite.

There was no NBMG sampling in this area. BOM samples report gold assays ranging from less than 0.001 opt. to 0.002 opt., and silver assays ranging from less than 0.01 opt. to 0.07 opt. Base metal analytical results report copper ranging from less than 0.01% per ton to 0.02% per ton, lead ranging from less than 0.01% per ton to 0.11% per ton, and zinc at less than 0.01% per ton. Only limited resource possibilities are thought to exist here.

4.43 Resource Potential

The Nevada Chalk Mountain mine, no. 2, fig. 4-4, is classified as an inferred resource for silver, lead, copper, and gold (?). This classification is based on sample results and permissive geology. A skarn-type orebody is possible and could produce a complex ore containing gold.

The Chalk Mountain mine, no. 4, fig. 4-4, is classified as an indicated resource based on continuation of the producing structure, surface sampling, and permissive geology.

The area around point no. 6, fig. 4-4, is classified as an inferred resource. This classification is based on favorable geologic setting and sampling results.

4.5 Sand Springs District

The Sand Springs district lies east of B-17. The proposed MLW will encroach on the eastern and southern portions of the district.

4.51 General Geology

Fig. 4-5 illustrates the general geology of the district. The oldest geologic unit exposed is composed of limestone, marble, phyllite, metarhyolite, and schist. The unit has been dated as Triassic to mid-Jurassic in age. The unit appears to have been isoclinally folded and thrust faulted prior to deposition of the overlying unit (Willden and Speed, 1974, p. 43).

The next youngest unit is a basalt. The basalt is porphyritic and dark olive gray in color. The basalt has been dated as mid-Jurassic. The basalt has been structurally tilted in the vicinity of the east-west trending range front fault and at or

EXPLANATION

Geology and mine/prospect location map
Sand Springs District
Churchill Co., Nevada

Quaternary	Qal	Alluvium
Tertiary	Tv	Rhyolite tuff, andesitic and dacitic volcanic rocks
	Tra	Rhyolite and andesite intrusive rocks
Cretaceous	Kg	Granodiorite intrusive
Jurassic	Jb	Basalt
	Js	Limestone, marble, phyllite, schist, and metavolcanics

Vein

Contact, dashed where projected

Fault, dashed where projected

Thrust fault, teeth on upper plate, dashed where projected

Shear zone, containing multiple quartz-adularia veins

Mine ⚒

Prospect ×

MLW area

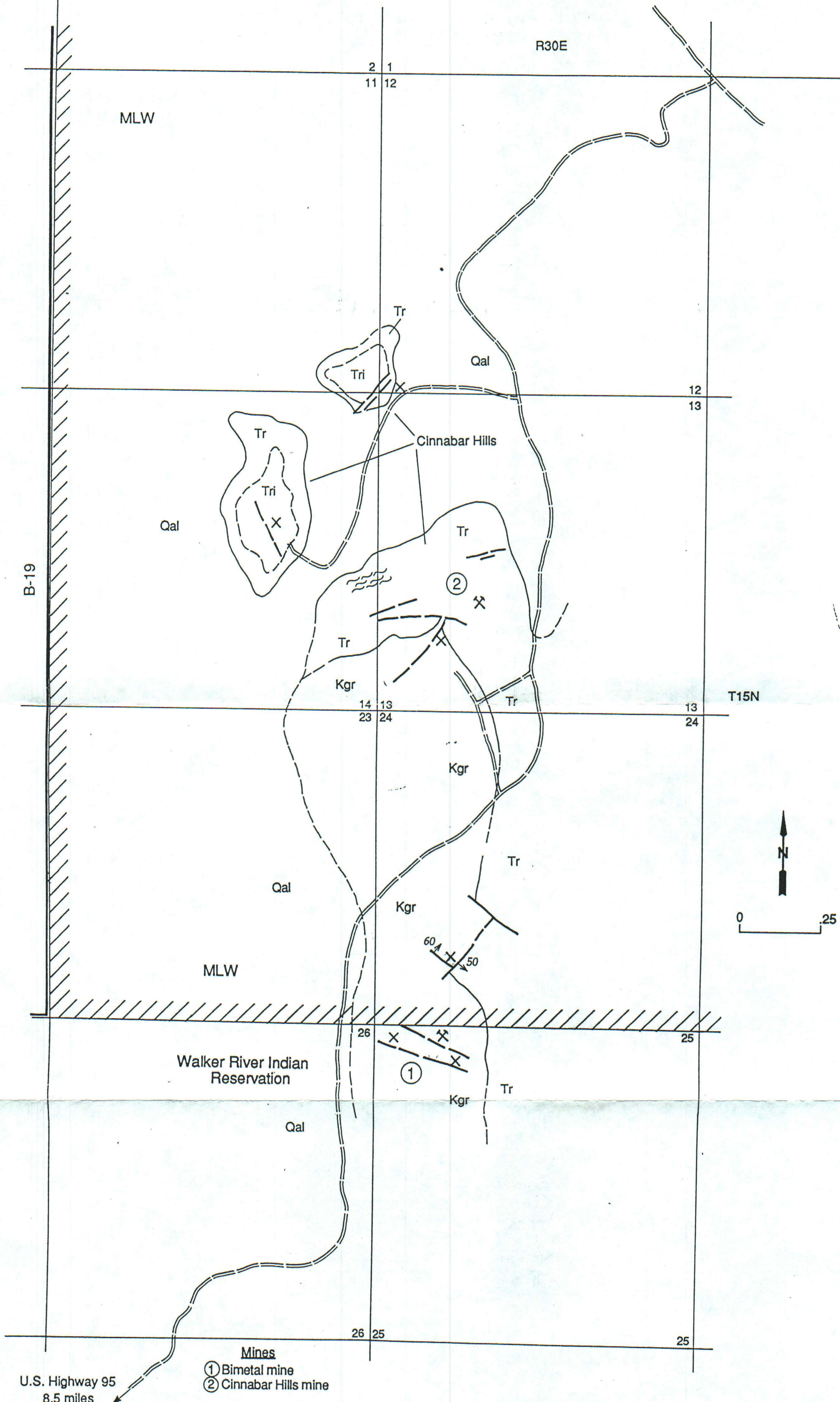


FIGURE 4-6. Geologic map with location of mines and prospects, Holy Cross District Churchill Co., Nevada

near the intruding granodiorite contact (Willden and Speed, 1974, p. 43).

The granodiorite is the next youngest rock. It is an equigranular, medium crystalline intrusive igneous rock. The granodiorite grades into porphyritic quartz monzonite (Willden and Speed, 1974, p. 43). The granodiorite intrusion imparted a strong foliation parallel to itself at the contact with the intruded rocks. The foliation is discordant to the axes of the folding and thrust faulting of the volcanics and sediments.

The next youngest rock unit is composed of andesite and rhyolite extrusives and intrusives. The precious metal ore forming event is possibly associated with late stages of andesite-rhyolite activity.

The youngest unit in the Sand Springs district is the alluvium. The alluvium is composed of sands and gravels, and other mass wasting products.

4.52 Mines and Prospects

The Summit King mine, no. 2, fig. 4-5, (also includes the Summit Queen mine, no. 1, fig. 4-5) is credited with 100,979 tons of ore which yielded 20,895 troy ounces of gold and 1,262,655 troy ounces of silver through 1951 (Willden and Speed, 1974, p. 80).

The Summit King mine vein system extends from the Summit Queen mine, no. 1, fig. 4-5, eastward to the Summit King mine. The vein is traceable on the surface for at least 5,000 feet east of the Summit King mine. At this point the vein surface trace is not distinct and may become multiple, thinner veins.

The Summit King mine vein consists of crushed and oxidized quartz and adularia in a braided vein system. The vein occupies a shallow, south dipping shear zone. Ore values occur as fine gold, cerargyrite, and argentite (Quade and Tingley, 1987, p. 65). In the upper levels, the gold to silver ratio is 1:40 and increases to 1:80 in the lower levels.

The Summit King mine workings consist of three shafts and 1,000 feet of lateral drifts (Vanderburg, 1940, p. 40). The mine reached a depth of 450 feet.

NBMG sampling, one sample, assayed gold at 0.001 opt. and silver at 0.20 opt. BOM sampling, Summit Queen mine and Summit King mine, no. 1 and no. 2, fig. 4-5, record gold assays ranging from 0.001 opt. to 0.616 opt. and silver assays ranging from 0.04 opt. to 22.40 opt.

Tulsa Oil and Gas claims, nos. 3, 4, and 5, fig. 4-5, show multiple veins, generally parallel. The veins contain pyrite and limonite, and are often brecciated. The vein breccias are cemented with a second generation of quartz and/or calcite.

NBMG sampling in this area indicates gold assays ranging from nil to 0.009 opt. and silver assays ranging from less than 0.01 opt. to 2.04 opt.

BOM sampling in this area, nos. 3, 4, and 5, fig. 4-5, indicate gold assays ranging from less than 0.001 opt. to 0.001 opt. and silver assays ranging from less than 0.01 opt. to 0.09 opt.

The Tulsa Oil and Gas claims are thought to have moderate to good exploration possibilities for discovery of vein-hosted precious metals.

At point 6, unnamed claim group, fig. 4-5, Jurassic sediments have been intruded by Cretaceous granitic rocks, and Tertiary andesites and rhyolites. The intrusive rocks are argillized and slightly silicified. Minor skarn formation and quartz-calcite veins are noted.

NBMG sampling in this area report gold assays as less than 0.001 opt., and silver assays ranging from less than 0.01 opt. to 0.05 opt. The molybdenum analytical results are anomalous, ranging up to 0.02% per ton.

BOM sampling in this area indicates gold assays of less than 0.001 opt., and silver assays ranging from less than 0.01 opt. to 0.06 opt. It is noted that the copper and molybdenum values are slightly anomalous.

The exploration possibilities in this area for precious metals are thought to be low, but the possibilities for base metals are thought to be moderate.

The Red Top mine, no. 7, fig. 4-5, was active between 1951 and 1956 and produced 691 units of WO_3, tungsten trioxide. Nearby claims were credited with 291 units of WO_3 (Quade and Tingley, 1987, p. 65).

The production came from small deposits at the contact between Triassic-Jurassic limy sediments and the Cretaceous granodiorite. The tungsten minerals scheelite and powellite were mined from garnet, diopside, cordierite skarns (Quade and Tingley, 1987, p. 65).

NBMG sampling at the Red Top mine area, no. 7, fig. 4-5, yielded gold and silver assays of less than detection limits. Tungsten analytical results ranged from 0.007% per ton to 0.2%

per ton. Base metal contents were anomalous.

BOM sampling in the Red Top mine area, no. 7, fig. 4-5, show gold assays ranging from less than 0.001 opt. to 0.003 opt. and silver assays ranging from less than 0.01 opt. to 0.02 opt. Tungsten results ranged from 0.02% per ton to 0.21% per ton. Other base metal contents were clearly anomalous.

Geologic mapping around the Jones Scheelite mine, no. 8, fig. 4-5, shows Jurassic sediments intruded by east-west trending andesite/rhyolite dikes. Also mapped were northeast trending quartz and quartz-calcite veins.

There was no NBMG sampling at the Jones Scheelite mine. BOM sampling shows gold assays ranging from less than 0.001 opt. to 0.004 opt., and silver assays ranging from less than 0.01 opt. to 0.03 opt. Tungsten, copper, and molybdenum analytical results are slightly anomalous. It is thought that the exploration possibilities are low in this area.

The Twilight mine, no. 9, fig. 4-5, occurs on northeast trending quartz-calcite veins in Jurassic limy sediments. The sediments are bleached and stained with iron oxides. The veins contain iron oxides after pyrite, pyrite, and manganese oxides.

There is no NBMG sampling in this area. BOM sampling at the Twilight mine, no. 9, fig. 4-5, indicates gold assays ranging from less than 0.001 opt. to 0.004 opt., and silver assays ranging from less than 0.01 opt. to 1.32 opt. Arsenic and antimony analytical results are anomalous. It is thought that there is moderate exploration potential in this area.

4.53 Resource Potential

No. 2, fig. 4-5, the Summit King mine, is classified as an inferred resource. The classification is based on past production, continuation of the producing structure, Nevada Bureau of Mines and Geology, and U.S. Bureau of Mines surface sampling, and permissive geology.

No. 6, the Red Top mine, fig. 4-5, is classified as an inferred resource. This classification is based on past producing structures, permissive geology, and BOM surface sampling results.

4.6 Holy Cross District

The Holy Cross District is located on the east side of B-19. The district will be included in the proposed MLW.

4.61 General Geology

Fig 4-6 illustrates the geology at the Bimetal mine and the Cinnabar Hill area in the Holy Cross District. The oldest rock exposed in this area is the Cretaceous granodiorite intrusive. The granodiorite is medium crystalline to slightly porphyritic and presumably intruded pre-Cretaceous rocks which are not exposed in this area.

Overlying the granodiorite is Tertiary volcanic sequence. The volcanic sequence is composed of rhyolite to latite welded tuffs and flows. Also noted are hydro-frac breccias and sinter aprons/fall back breccias. Two rhyolite flow domes are present north and west of Cinnabar Hill.

Also known in the area but not shown on fig. 4-6 are dacite and basalt flows and small intrusives.

The youngest unit is the alluvium. The alluvium is composed of gravel, talus, and wind blown sand.

4.62 Mines and Prospects

The Bimetal mine, No. 1, fig. 4-6, which is located south of the proposed MLW and within the Walker River Indian Reservation. Adits and pits have explored quartz veins in a northwest-trending shear zone. Some ore may have been produced, but BOM does not have a record of production.

Sampling by the NBMG yielded gold assays ranging from 0.04 opt. to 2.48 opt. and silver assays ranging from 0.09 opt. to 29.2 opt. (Quade and Tingley, 1987, p. 71).

Sampling results from BOM work yielded gold assays ranging from less than 0.001 opt. to 0.29 opt. and silver assays ranging from 0.01 opt. to 1.40 opt. Mercury analytical results were anomalous.

No. 2, fig. 4-6, represents the Cinnabar Hills mine area. Cinnabar Hill was originally prospected for mercury. No production was recorded, but evidence suggests that a small amount was produced (Quade and Tingley, 1987, p. 70).

Cinnabar Hill is a rhyolite welded ash-flow tuff. The two small hills north and west are silicified rhyolite domes. Northwest-striking shear zones, hydrothermal breccias and silicified zones have been prospected with small pits and trenches. NBMG sampling results show weak gold assays with only 1 of 8 samples reporting 0.006 opt. Two of 8 samples reported silver assays of 0.02 opt. and 0.20 opt. However, arsenic, antimony, and especially mercury were strongly anomalous.

In 1984, Coeur Exploration staked claims covering the area in

EXPLANATION

Geologic map
Holy Cross Disitrct
Churchill Co., Nevada

Cenozoic	Quaternary	Qal	Gravels, talus, and eolian sand
	Tertiary	Tr	Rhyolite to latite welded tuffs and flows, includes rhyolite flow domes (Tri)
Mesozoic	Cretaceous	Kgr	Granodiorite, medium crystalline to slightly porphyritic

Contact, dashed where projected	
Fault, showing dip, dashed where projected	60
Shear zone	
Mine	
Prospect	
MLW area	
Existing range	B-19

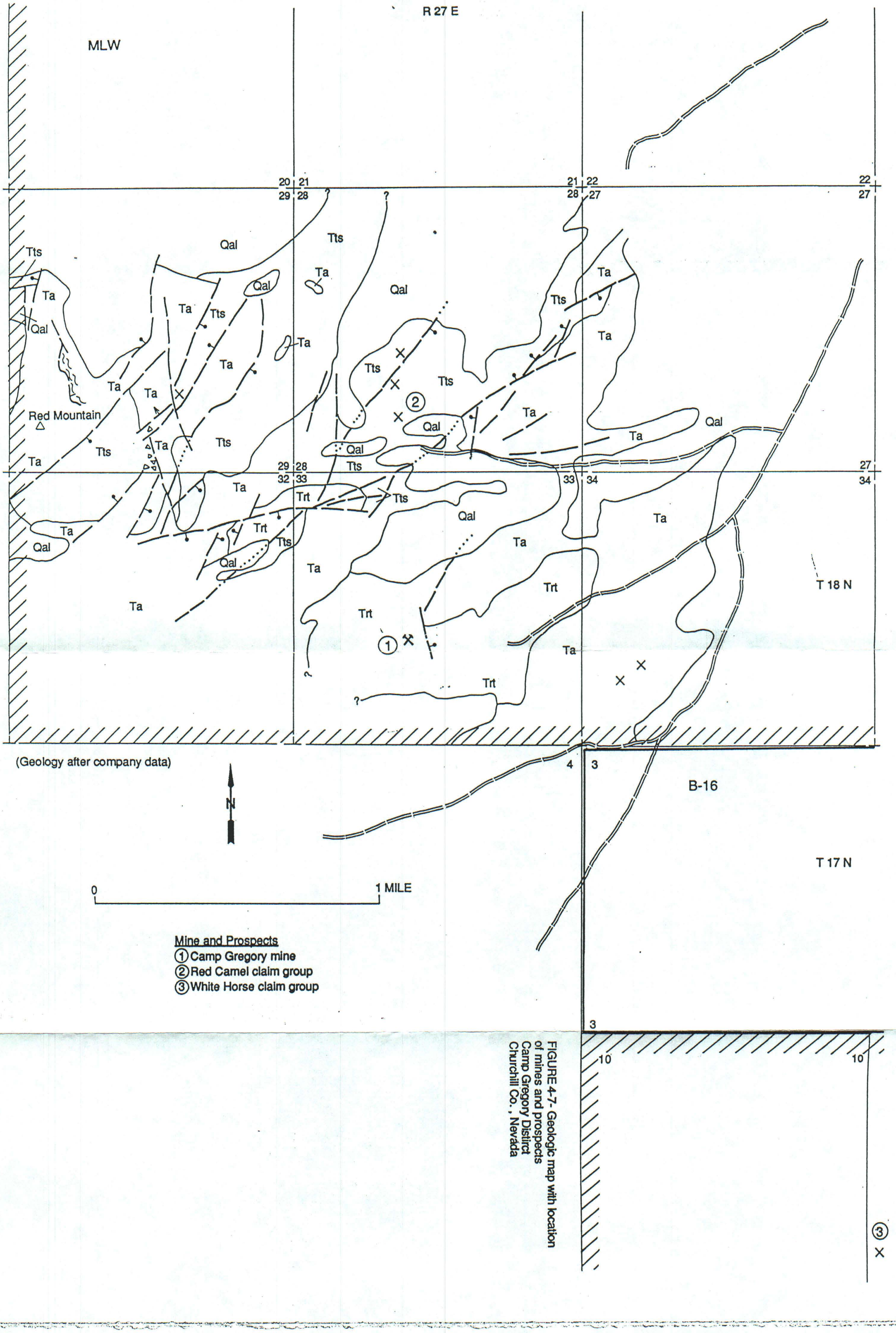


FIGURE 4-7- Geologic map with location of mines and prospects Camp Gregory District Churchill Co., Nevada

EXPLANATION

Geologic map
Camp Gregory District
Churchill Co., Nevada

Cenozoic	Quaternary	Qal	Lake sediments, eolian sands, alluvial deposits and basalts
	Tertiary	Trd	Rhyolite, porphyritic, flow dome
		Tts	Surge debris, tuffaceous and clastic, stratified; contains siliceous sinters and coarse hydrothermal fall-back breccia
		Ta	Andesitc and basaltic flows, flow breccias, lahars and clastic debris with siliceous sinters and coarse hydrothermal fall-back breccias
		Trt	Rhyolite tuff, lithic, unwelded

Contact, dashed where projected

Fault, dashed where projected; dotted where concealed, ball on down-thrown side

Shear zone

Brecciation, along fault

Mine

Prospect ×

MLW area

Existing range B-16

secs. 11, 12, 13, 14, 23, and 24, T. 15 N., R. 30 E. They completed preliminary mapping and sampling prior to learning that the area had been segregated. Their sample results show gold ranging from less than 0.001 opt. to 0.007 opt. and silver ranging from less than 0.05 opt. to 0.18 opt. Their results are also strongly anomalous in arsenic, antimony, and mercury.

In 1987, U. S. Borax also staked claims in this area. It is not known if they completed any exploration activity.

BOM sample results indicate gold assays ranging from less than 0.001 opt. to 0.028 opt. and silver assays ranging from less than 0.01 opt. to 0.27 opt. Mercury, arsenic, and antimony were all strongly anomalous.

4.63 Resource Potential

The entire area shown on the geologic map, fig. 4-6, is within the proposed MLW or on the Walker River Indian Reservation. Projecting the mineralized structures at the Bimetal mine about 1,000 feet northwest would place the structures within the proposed MLW. The exploration potential is thought to be quite good for this area.

The Cinnabar Hill and immediate area is classified as an inferred resource. This classification is based on permissive geology (silicified, brecciated, mineralized rhyolite welded tuffs and flow domes), geochemical sampling results and model comparison to known producing mines (volcanic hosted, hot springs-type deposit).

4.7 Camp Gregory

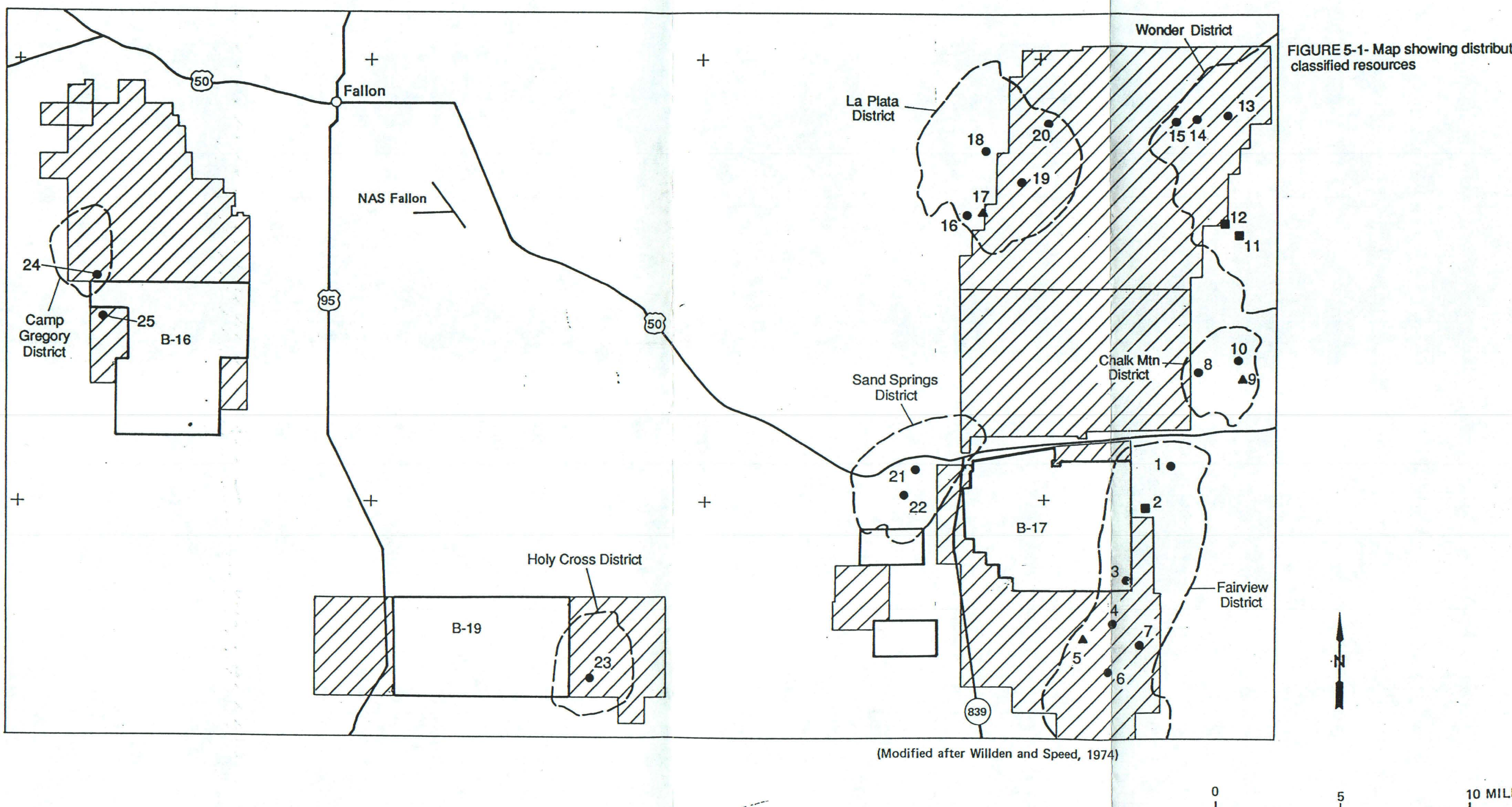
The Camp Gregory district is located north of B-16. Approximately 80 percent of the district will be included within the proposed MLW.

4.71 General Geology

Fig 4-7 illustrates the geology for the Camp Gregory District. No pre-Tertiary basement rock is exposed in this area.

The oldest rock exposed in this area is a rhyolite lithic tuff, unwelded. The tuff is intercalated with water-lain/reworked tuffaceous and silt material.

Overlying the rhyolite lithic tuff is an andesitic to basaltic composite unit. The unit consists of dominantly andesitic to basaltic flows, flow breccias, lahars, base-surge deposits, fallback breccias, and siliceous sinter. Vent breccias are also present.



(Modified after Willden and Speed, 1974)

FIGURE 5-1- Map showing distribution of classified resources

The next youngest unit consists of partially water-lain, well-bedded (?) tuffaceous siltstone. The tuffaceous siltstone is intertongued with coarser, poorly-bedded mafic surge debris. Lying on the silt/surge debris are basaltic flows.

The youngest unit in this area is rhyolite flow domes. The rhyolite is flow-banded, convoluted, and autobrecciated. The flow portion of the rhyolite is vitrophyric.

Two faulting episodes are noted in this district. The earliest and most prominent are east-northeast-trending faults. The faults are normal and down dropped to the southeast. These faults form northeast elongate blocks which dip to the northwest.

A second fault set is noted striking north to north-northwest. This fault set may be contemporaneous with the northeast-trending faults to accommodate differential down dropping.

4.72 Mines and Prospects

The Camp Gregory mine, point 1, fig. 4-7, is located in the SW1/4 of sec. 33, T. 18 N., R. 27 E. Not much is known about the mine, but the activity probably took place in the 1920's and 1930's (Quade and Tingley, 1987, p. 75). The claims around the mine are currently held by Greyhill Exploration of Colorado.

The deeper shaft explores a steeply dipping northeast-striking, moderately to well silicified shear zone. Iron-oxide staining is noted, but evidence of other metal mineralization is lacking.

NBMG sample results are negative, reporting no results for gold and silver. Base metal results were also low (Quade and Tingley, 1987, p. 76).

BOM sampling results indicate gold assays ranging from less than 0.001 opt. to 0.004 opt. and silver assays ranging from less than 0.01 opt. to 0.03 opt. Mercury results were anomalous and arsenic and antimony results were slightly anomalous towards the east end of this area.

In 1982, Noranda Exploration staked the Red Camel claim group in secs. 27, 28, 29, 32, 33, T. 18 N., R. 27 E., fig. 4-7. They did geologic mapping, surface geochemical sampling, and 1,500 feet of rotary drilling testing part of the claim block for hot springs-type precious metal deposits (Quade and Tingley, 1987, p. 76).

Their surface sample results indicated gold assays ranging from less than 0.001 opt. to 0.001 opt. and silver assays ranging from less than 0.003 opt. to 0.13 opt. Anomalous analytical results in arsenic and mercury were noted (company data).

Noranda drilling results from 200-foot-deep holes were not encouraging. Noranda has since dropped the claims.

BOM sample results indicate gold assays ranging from less than 0.001 opt. to 0.001 opt. and silver assays ranging from less than 0.01 opt. to 0.09 opt. Arsenic, antimony, and mercury analytical results were very anomalous.

The White Horse claim group, No. 3, fig. 4-7, is located in SW1/4, sec. 11, T. 17 N., R. 27 E. The claim area is underlain by Tertiary lake sediments which contain lenses of diatomite. The material is pure white, homogenous, and apparently of good quality (Quade and Tingley, 1987, p. 78). Locally, the diatomite lenses attain a thickness of 30 feet.

The White Horse claim group has been trenched and drilled. However, grade and tonnage information is not available (Quade and Tingley, 1987, p. 76).

4.73 Resource Potential

The Camp Gregory mine area, No. 1, fig. 4-7, is thought to have low exploration possibilities.

The Red Camel group, No. 2, fig. 4-7, is classified as an inferred resource because of permissive geology, and moderately favorable surface sample results. Minimum shallow drilling did not prove the existence of economic quantities of precious metals. There is still an area to the east that could be tested where geologically favorable rock is covered by sands and gravels. This Red Camel claim group is thought to have moderate exploration possibilities.

The White Horse claim group, No. 3, fig. 4-7, is classified as an inferred resource based on permissive geology, trenching, sampling, and drilling.

5.0 Summary of Study Area Resource Potential

Table 5-1 summarizes the resource potential for the proposed MLW. The classification is based on criteria presented in U.S. Geological Survey Circular 831, 1980.

Fig. 5-1 shows the relationship of the resource classifications to the proposed MLW areas.

TABLE 5-1
MLW Area Resource Potential

District	Map Number	Name	Classification
Fairview	1	Centurion claim group	Inferred resource: silver-gold, based on permissive geology and similarity to known deposits
	2	Nevada Hills mine (tailings)	Identified resource: silver-gold, based on measurements and yields 200,000 tons at 0.01 opt. gold and 2.5 opt. silver
	3	Mizpah and Jellinek mines	Inferred resource: silver-gold, based on continuation of producing structures and permissive geology
	4	Gold Coin No. 1, No. 2, and the Bluff mine area	Inferred resource: silver-gold, based on continuation of producing structures
	5	Jet claim group	Indicated resource: gold-silver, based on NBMG sampling, industry sampling, BOM sampling, and permissive geology
	6	Rex claims/Nevada Crown mine area	Inferred resource: silver-gold, based on BOM, NBMG, and industry sampling and permissive geology
	7	Huntsman/ Placer Dome claim group	Inferred resource: gold-silver, based on industry sampling and permissive geology

Table 5-1
MLW Area Resource Potential (Cont'd.)

District	Map Number	Name	Classification
Chalk Mountain	8	Nevada Chalk Mountain mine	Inferred resource: lead, copper, silver, based on NBMG and BOM sampling, permissive geology
	9	Chalk Mountain mine	Indicated resource: lead-silver, based on the continuation of producing structure, surface sampling, and permissive geology
	10	Unidentified claim group	Inferred resourse: lead-silver, based on favorable geologic setting and sample results
Wonder	11	Nevada Wonder mine	Identified resource: silver-gold, based on past production, surface and underground sampling and drilling which produced a reserve estimate of greater than 5,000,000 tons at 0.019 opt. gold and 2.42 opt. silver
	12	Silver Center mine	Identified resource: silver-gold, 100,000 tons at 0.02 opt. gold and 4.0 opt. silver. Based on previous mining, surface sampling, and surface drilling
	13	Gold King claim group	Inferred resource: gold-silver, based on permissive geology, NBMG and BOM sampling results

Table 5-1
MLW Area Resource Potential (Cont'd.)

District	Map Number	Name	Classification
	14	Spider & Wasp mine	Inferred resource: based on past production, permissive geology, and sample rsults
	15	Dickey Peak area mines	Inferred resource: silver-gold, based on permissive geology, and sample results
La Plata	16	La Plata claim group	Inferred resource: gold-silver, based on permissive geology, industry, NBMG and BOM sampling
	17	Dixie fluorite mine	Indicated resource: fluorite, based on previous production and continuation of producing structures
	18	La Plata project area	Inferred resource: molybdenum-tungsten, based on permissive geology, industry, NBMG and BOM sampling and nine drill holes
	19	Elevenmile Adit	Inferred resource: silver-gold, based on permissive geology, past production, and continuation of producing structures
	20	Elusive claim group	Inferred resource: gold-silver, based on permissive geology and industry and BOM surface sampling

Table 5-1
MLW Area Resource Potential (Cont'd.)

District	Map Number	Name	Classification
Sand Springs	21	Summit King mine	Inferred resource: silver, gold-lead, based on past production, continuation of producing structure, NBMG and BOM surface sampling and permissive geology
	22	Red Top mine area	Inferred resource: tungsten, based on past production, continuation of producing structure, NBMG and BOM surface sampling, and permissive geology
Holy Cross	23	Cinnabar Hills mine area	Inferred resource: gold-silver, based on permissive geology, NBMG, industry, BOM surface sampling
Camp Gregory	24	Red Camel claim group	Inferred resource: gold-silver, based on permissive geology, NBMG, industry, and BOM sampling, industry drilling
	25	White Horse claim group	Inferred resource: diatomite, based on permissive geology, NBMG sampling, and industry drilling

The next youngest unit consists of partially water-lain, well-bedded (?) tuffaceous siltstone. The tuffaceous siltstone is intertongued with coarser, poorly-bedded mafic surge debris. Lying on the silt/surge debris are basaltic flows.

The youngest unit in this area is rhyolite flow domes. The rhyolite is flow-banded, convoluted, and autobrecciated. The flow portion of the rhyolite is vitrophyric.

Two faulting episodes are noted in this district. The earliest and most prominent are east-northeast-trending faults. The faults are normal and down dropped to the southeast. These faults form northeast elongate blocks which dip to the northwest.

A second fault set is noted striking north to north-northwest. This fault set may be contemporaneous with the northeast-trending faults to accommodate differential down dropping.

4.72 Mines and Prospects

The Camp Gregory mine, point 1, fig. 4-7, is located in the SW1/4 of sec. 33, T. 18 N., R. 27 E. Not much is known about the mine, but the activity probably took place in the 1920's and 1930's (Quade and Tingley, 1987, p. 75). The claims around the mine are currently held by Greyhill Exploration of Colorado.

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The White Horse claim group has been trenched and drilled. However, grade and tonnage information is not available (Quade and Tingley, 1987, p. 76).

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The Red Camel group, No. 2, fig. 4-7, is classified as an inferred resource because of permissive geology, and moderately favorable surface sample results. Minimum shallow drilling did not prove the existence of economic quantities of precious metals. There is still an area to the east that could be tested where geologically favorable rock is covered by sands and gravels. This Red Camel claim group is thought to have moderate exploration possibilities.

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	4	Gold Coin No. 1, No. 2, and the Bluff mine area	Inferred resource: silver-gold, based on continuation of producing structures
	5	Jet claim group	Indicated resource: gold-silver, based on NBMG sampling, industry sampling, BOM sampling, and permissive geology
	6	Rex claims/Nevada Crown mine area	Inferred resource: silver-gold, based on BOM, NBMG, and industry sampling and permissive geology
	7	Huntsman/ Placer Dome claim group	Inferred resource: gold-silver, based on industry sampling and permissive geology

Table 5-1
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	9	Chalk Mountain mine	Indicated resource: lead-silver, based on the continuation of producing structure, surface sampling, and permissive geology
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	12	Silver Center mine	Identified resource: silver-gold, 100,000 tons at 0.02 opt. gold and 4.0 opt. silver. Based on previous mining, surface sampling, and surface drilling
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Table 5-1
MLW Area Resource Potential (Cont'd.)

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	15	Dickey Peak area mines	Inferred resource: silver-gold, based on permissive geology, and sample results
La Plata	16	La Plata claim group	Inferred resource: gold-silver, based on permissive geology, industry, NBMG and BOM sampling
	17	Dixie fluorite mine	Indicated resource: fluorite, based on previous production and continuation of producing structures
	18	La Plata project area	Inferred resource: molybdenum-tungsten, based on permissive geology, industry, NBMG and BOM sampling and nine drill holes
	19	Elevenmile Adit	Inferred resource: silver-gold, based on permissive geology, past production, and continuation of producing structures
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Table 5-1
MLW Area Resource Potential (Cont'd.)

District	Map Number	Name	Classification
Sand Springs	21	Summit King mine	Inferred resource: silver, gold-lead, based on past production, continuation of producing structure, NBMG and BOM surface sampling and permissive geology
	22	Red Top mine area	Inferred resource: tungsten, based on past production, continuation of producing structure, NBMG and BOM surface sampling, and permissive geology
Holy Cross	23	Cinnabar Hills mine area	Inferred resource: gold-silver, based on permissive geology, NBMG, industry, BOM surface sampling
Camp Gregory	24	Red Camel claim group	Inferred resource: gold-silver, based on permissive geology, NBMG, industry, and BOM sampling, industry drilling
	25	White Horse claim group	Inferred resource: diatomite, based on permissive geology, NBMG sampling, and industry drilling

EXPLANATION

Distribution of classified resources

Resource classification

Identified resource ■

Indicated resource ▲

Inferred resource ●

MLW area [hatched box]

Existing range [B-17]

Mining district outline [dashed outline]

Mines and Prospects, by district

Fairview District
1. Centurion claim group
2. Nevada Hills mine
3. Mizpah and Jelinek mines area
4. Gold Coin and Bluff mines area
5. Jet claim group
6. Rex claim group/Nevada Crown mine area
7. Huntsman/Placer Dome claim group

Chalk Mountain District
8. Nevada Chalk Mountain mine
9. Chalk Mountain mine
10. Unidentified claim group

Wonder District
11. Nevada Wonder mine
12. Silver Center mine
13. Gold King claim group
14. Spider & Wasp mine
15. Dickey Peak area mines

La Plata District
16. La Plata claim group
17. Dixie fluorite mine
18. La Plata project area
19. Elevenmile adit
20. Elusive claim group

Sand Springs District
21. Summit King mine
22. Red Top mine area

Holy Cross District
23. Cinnabar Hills mine area

Camp Gregory District
24. Red Camel claim group
25. White Horse claim group

6.0 Mine/Mill Models

The following section contains brief mine and mill descriptions and associated capital and operating cost estimates. The estimates were derived from mine/mill cost models developed for identified, nonproducing mineral resources within the proposed MLW, fig. 6-1. Models were developed only for those deposits which would generate major socioeconomic impacts if mined.

For each deposit model, mining and processing systems most applicable were selected on the basis of other U.S. deposits currently in production or in the planning stage. All costs were calculated using the following information sources:

- Mining Cost Service, published by Western Mine Engineering.
- Cost Reference Guide for Construction Equipment.
- Richardson Rapid System, Process Plant Construction Standards, Process Equipment.
- Richardson Rapid System, Process Plant Construction, Mechanical and Electrical.
- Underground Mining Method Handbook.
- Underground Mine Design and Costs, by S. Stebbins.
- Green Guide for Construction Equipment.
- Means, Building Construction Cost Data.

Details for ore deposit models are presented in Appendix 1. Rock types, structural conditions, alteration, and mineralization patterns and surface sample analytical results approximate known deposits.

Details of mining and processing systems and associated costs are presented in Appendix 2. All cost estimates were calculated in January 1990 U.S. dollars. Table 6-1 is the Mine/Mill Model resource summary. Table 6-2 summarizes the mining and processing systems proposed for development of each deposit, and Table 6-3 summarizes the production rate, capital, and annual operating costs for each deposit.

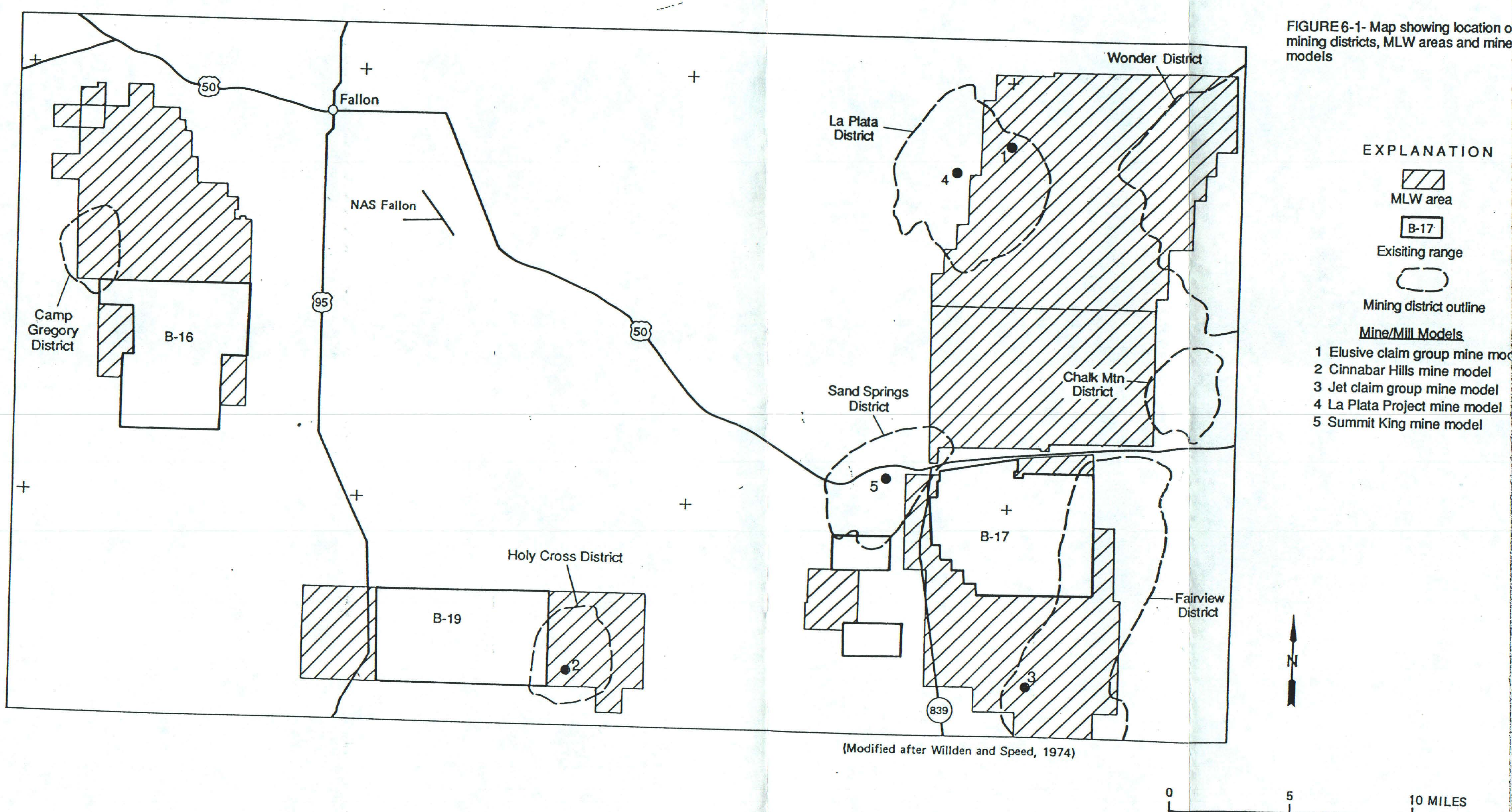

FIGURE 6-1- Map showing location of mining districts, MLW areas and mine mill models

TABLE 6-1. Mine/Mill Models, Mineral Resource Summary

Deposit	Commodity	Tonnage	Grade
Elusive mine model	Gold Silver	19,500,000	0.054 opt. Au 0.23 opt. Ag
Cinnabar Hills mine model	Gold Silver	9,900,000	0.08 opt. Au 0.75 opt. Ag
Jet claims mine model	Gold Silver	5,600,000	0.055 opt. Au 1.0 opt. Ag
		7,200,000	0.10 opt. Au 2.0 opt. Ag
La Plata project mine model	Tungsten Molybdenum	4,700,000	0.65% tungsten trioxide 0.40% molybdenum
Summit King mine model	Gold Silver Lead	824,000	0.35 opt. Au 2.50 opt. Ag 1.0% lead

TABLE 6-2. Mine/Mill Models, Mining and Processing Methods

Deposit	Mining Method	Processing Method/Product
Elusive mine model	Open Pit mine - 2.5:1 stripping ratio	Heap leaching/Carbon in Column recovery. Gold/Silver Dore Bullion.
Cinnabar Hills mine model	Open Pit mine - 1:1 to 2:1 stripping ratio	Heap leaching/Carbon in Column recovery. Gold/Silver Dore Bullion.
Jet claims mine model	Open Pit mine - 1.5:1 stripping for oxide ore; 3.3:1 stripping for sulfide ore.	Oxide ore - Heap leaching/Carbon in Column recovery. Gold/Silver Dore Bullion. Sulfide ore - Flotation/Roasting/ Leaching. Gold/Silver Dore Bullion.
La Plata project mine model	Underground room and pillar.	Single product flotation to produce a tungsten-molybdenum concentrate.
Summit King mine model	Underground shrinkage stoping	Gravity concentration to produce gold/silver concentrate. Flotation concentration to produce lead/silver concentrate.

TABLE 6-3. Mine/Mill Models, Production Rates, and Costs

Deposit	Annual Production Tons x 1,000	Costs - US $ x 1,000 Capital	Annual Operating	Mine Life
Elusive mine model	1,800	$44,374	$20,483	11.0 yrs.
Cinnabar Hills mine model	1,800	44,458	18,555	5.5 yrs.
Jet claims (Oxide) mine model	1,800	40,194	17,763	3.0 yrs.
Jet claims (Sulfide) mine model	1,800	25,291	24,119	4.0 yrs.
La Plata project mine model	260	26,147	9,628	16.0 yrs.
Summit King mine model	104	22,615	3,640	8.0 yrs.

7.0 Socioeconomics of Mineral Development in Churchill County, Nevada

This chapter is a brief summary of the results of an IMPLAN analysis made on the impact of three potential mining developments in Churchill County, Nevada. IMPLAN is an interdisciplinary economic modeling system maintained for general government use by the U.S. Forest Service, Fort Collins, Colorado. The potential mine estimates, with construction and operating costs, were developed by the staff of the Bureau of Mines Western Field Office, Spokane, Washington. A description of the impact modeling is described in Appendix 3.

This analysis will address estimated changes in total output, regional population increase and regional employment increases as the major impacts. Each potential mine will be analyzed individually and a separate composite IMPLAN analysis is also included.

The mine/mill models discussed earlier address the economics of construction and operation of the mineral deposits models. All mine models estimates were made assuming one year of construction and a mine life of twenty years or the point of deposit exhaustion, whichever comes first. Table 7-1 lists the deposit models used in this study.

7.1. Method of Estimation

For this study, IMPLAN's 1982 data base was used to determine the multipliers which provided the regional final impact. An updated data base was not completed before this analysis was made and therefore costs were deflated to the 1982 base to ensure relative effects.

Churchill County is a sparsely populated area with a 1982 2/ population of 14,000. Fallon, population 4,300, is the major city in the county. Major industries and services center on agriculture, recreation and gaming and miscellaneous service. Presently, the Naval Air Station centered at Fallon is the major employer. However, the area has historically supported mining. Recently an announcement was made that the Bell Mountain Gold Mine will be developed. The Rawhide Gold Mine is currently operating. Nevada is the leading gold mining state in the U.S. and a support/infrastructure is in place to service new ventures.

The mine models in this district are all within driving distance of Fallon and therefore the study area was limited to Churchill County. Major support-service industries are available in bordering districts, but will be impacted to a lesser degree and were not included.

2/ The data base update has not been completed at the time of the study.

TABLE 7-1. Mine Model Development in the Study Area ($ Million)

Deposit	Construction Costs (3)	Operating Costs Annual for 1st Yr	Cumulative Operating Costs (4)
Elusive claim group mine mode	39.3	20.5	225.5
Cinnabar Hills mine model	39.8	18.6	102.1
Jet claims group (1) mine model	35.8	17.8	53.3
Jet claims group (2) mine model	25.3	24.1	96.5
La Plata project mine model	23.7	9.6	153.6
Summit King mine model	21.7	3.6	28.8

Note (1) The first development of the Jet claim group is an oxide heap leach ore.

(2) The second development of the Jet claim group is a sulfide flotation-roast ore.

(3) Excludes working capital.

(4) 20-yr or deposit life.

Mine data was adjusted to address potential regional output available, i.e., local industries that would provide input (see Appendix 3 for assumptions). The Nevada data base for counties based on 1982 IMPLAN files was used to create regional output multipliers, total impact tables, direct impact tables, regional employment changes and population growth in the county. This compilation was used to estimate the total impact of the five mine models on the study area.

Taxes and mine employment were taken directly from the mine estimates. Costs and multipliers were broken down by:

Phase 1 - Construction
Phase 2 - Operation

The multipliers were split between:

Type 1 - Mining and support industry output
Type 2 - Output as a result of household spending

The main assumptions made to create a realistic model were that a major part of the mine employees will commute and most supplies and services will be provided from outside of the study area. As a result the impacts were reduced, but still significant.

7.2 Results of Analysis

The purpose of the socioeconomic analysis is to describe how the development of mines in the study area will affect communities in the county. Impacts are estimated in terms of the economic variables associated with mining, including industrial production, employment, income, spending and taxes. Regional multipliers (calculated by IMPLAN) are applied to estimate total impacts.

a) The first calculation made was to determine the change in final total demand in standard TOTAL-INDUSTRY-OUTPUT (TIO) related flows. The results listed in Table 7-2 show the estimated change in total industry output. Total output represents the total sales by the industries and services within the region.

b) Changes in Population and Employment

With the final demand calculation, population impacts are estimated in terms of growth and new employees (direct, indirect and induced). New employees (jobs) must be adjusted to account for part-time jobs. The results are shown in Table 7-3.

c) Tax Summary

Mining ventures generate a number of tax revenues from the operation. In addition, employees pay income and property taxes, suppliers pay excise, property and income taxes and fees are paid for leases and permits. Table 7-4 summarizes only the direct taxes attributable to the mines.

TABLE 7-2
Potential Change in Final Total Industry Output of Study Area
($ Million)

Deposit	Phase 1	Phase 2 (One Year)	Phase 2 (Cumulative)
Elusive claim group model	6.4	15.9	174.0
Cinnabar Hills model	7.1	14.6	80.3
Jet claims group model	5.7	14.5	101.5
La Plata project model	4.0	6.2	99.2
Summit King model	3.3	1.4	9.8

TABLE 7-3

Changes in Population and Employment in Study Area

Deposit	No. New Jobs (1) Phase 1	No. New Jobs (1) Phase 2	Area Population Growth (2) Phase 1	Area Population Growth (2) Phase 2
Elusive claim group	66	240	523	1,924
Cinnabar Hills model	55	160	587	1,679
Jet claims group model	55	222	436	1,759
La Plata project model	30	82	243	248
Summit King model	69	36	240	358

Note (1) New jobs include indirect and induced. Mine jobs are shown in mine description.

(2) Population growth relates to new families in the area, not commuters.

TABLE 7-4
Potential Mine Taxes Generated in Study Area
($ Million)

Deposit	Nevada State Proceeds of Mine	Federal Income Tax	Property Tax	Sales & Use Tax
Elusive claim group	1.200	8.3	5.8	9.01
Cinnabar Hills model	.625	4.3	3.1	4.88
Jet claims group model	4.700	32.9	5.3	6.15
La Plata project model	1.100	7.3	4.2	4.75
Summit King model	.950	6.5	1.3	1.54

7.3 Conclusions

The IMPLAN analysis uses the labor market to define the changes in the regional economy which determine the multipliers to project final demand changes and population growth. Cyclical processes, such as price changes, are not addressed and disequilibrium is not considered. Spatial behavior was estimated (see Appendix) to allow for both impact of commuter labor and major construction and operating equipment and supplies. Downstream effects from transportation and local consumption of mine production were considered negligible. The 1982 data base may distort the results, but only to the conservative side. With population increases since 1982 in Fallon and Churchill County, a larger amount of inter-industry trading will increase the total industry output.

Although mine development within the study area will add significantly to the economy of Churchill County, predicting when the development will occur is not possible. It is unlikely that all properties, if proved feasible, would be brought into production simultaneously. In the long term, a range of thirty to over seven hundred new jobs (full time equivalent) could be created, with population increases of two hundred to six thousand. Industry annual sales growth could range from $1 million to over $50 million as a result of mine development. Industries involved in recreation, food and restaurants, fuel distribution, and sales and health care would experience the major increases. The most likely scenario is a longer period of mining with new project starts overlapping and a mid-range economic effect.

Major distributors of explosives, fuel, tires, parts and plant supplies will most likely be imported from outside of the study area.

Mine development in the study area, as in most areas across the United States, obviously makes a significant impact. Of course, order-of-magnitude estimates such as the resource base, costs and input-output analysis infer a degree of risk. An analysis which provides a risk-weighted impact may reduce the total potential impact.

However, Churchill County would experience both population growth and industry growth to support mining development and production.

8.0 Bibliography

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Appendix 1
Ore Deposit Models

1. Elusive claims deposit model

Location: fig. A-1.1

Sections 26, 27, 35, T 19 N., R. 33 E., Churchill County, Nevada

Model Type:

Volcanics hosted, epithermal, disseminated precious metals.

Mineralogy:

Ore occurs in the oxide zone.

Base metal content is low, < 0.05%.

Arsenic, antimony, and mercury contents are low.

Infrastructure:

4.5 miles of access road to build from Dixie Valley highway, S.R. 121.

Powerline exists on Dixie Valley highway.

Water available in Dixie Valley, 2 miles east of deposit, 600 feet deep.

Mining:

Deposit occurs in a pediment area, sloping eastward at 6%, with maximum relief of 300 feet.

Deposit will be mined from 2 pits, striking WNW, separated by 1,500 to 2,000 feet of waste/low grade material.

Pit #1 ore zone dimensions are 1,200 feet long, 600 feet wide, and 200 feet thick.

Pit #2 ore zone dimensions are 900 feet long, 500 feet wide, and 200 feet thick.

Stripping ratio is 2.5:1 with 40% gravels and 60% rock.

Reserves:

Tonnage factor: 12 cu ft/ton

Grades: Pit 1: 0.058 opt. gold, 0.25 opt. silver

Pit 2: 0.048 opt. gold, 0.20 opt. silver

Dimensions of ore zones:

Pit 1: 1,200 feet long, 600 feet wide, 200 feet thick

Pit 2: 900 feet long, 500 feet wide, 200 feet thick

Tons:

Pit 1: 1,200 feet x 600 feet x 200 feet = 144,000,000 cu ft

$$\frac{144{,}000{,}000 \text{ cu ft}}{12 \text{ cu ft/ton}} = 12{,}000{,}000 \text{ tons}$$

Pit 2: 900 feet x 500 feet x 200 feet = 90,000,000 cu ft

$$\frac{90{,}000{,}000 \text{ cu ft}}{12 \text{ cu ft/ton}} = 7{,}500{,}000 \text{ tons}$$

Totals:

Tons	Grade Au, opt.	Ounces Gold	Grade Ag, opt.	Ounces Silver
12,000,000	0.058	696,000	0.25	3,000,000
7,500,000	0.048	360,000	0.20	1,500,000
19,500,000	0.054	1,056,000	0.23	4,500,000

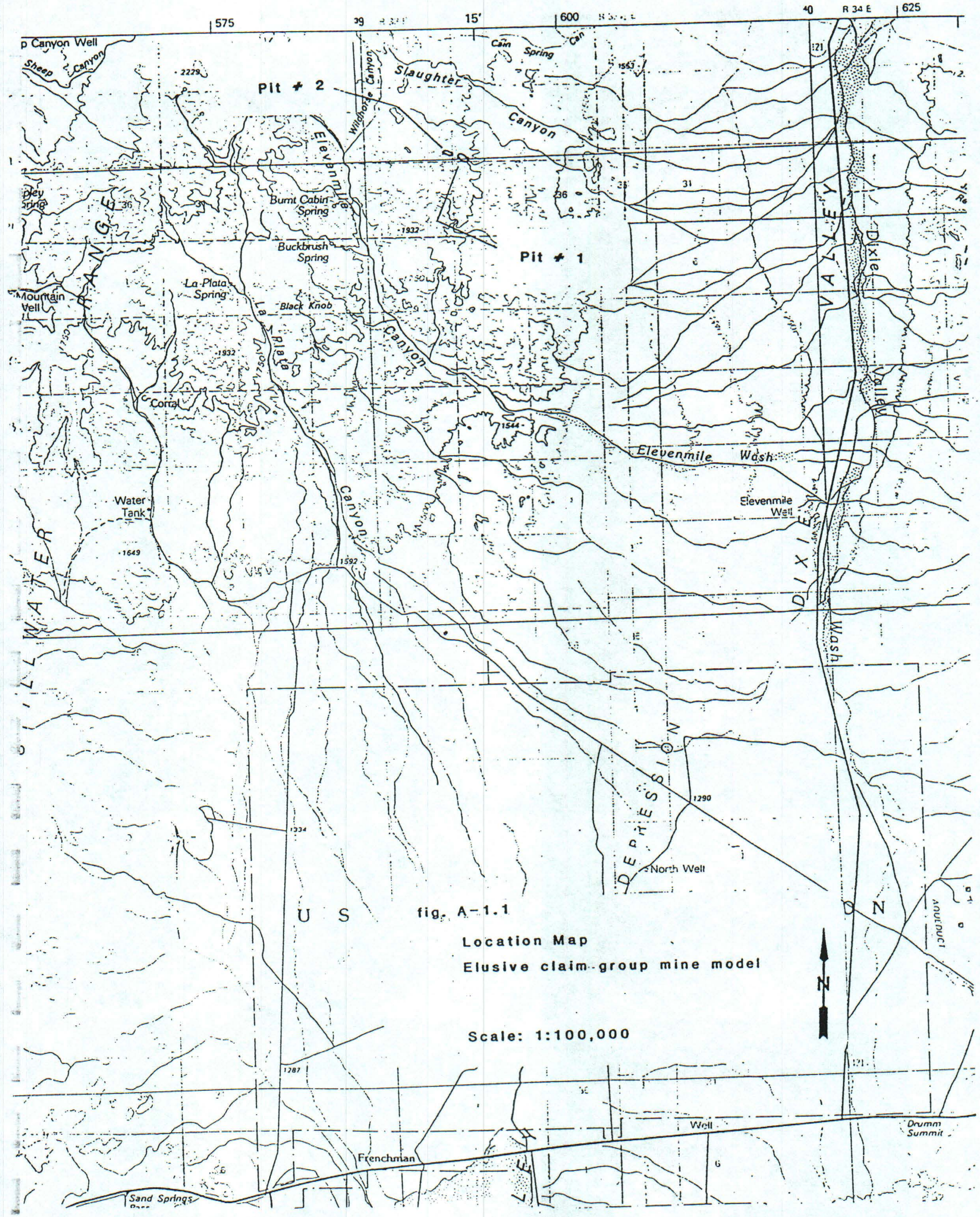

fig. A-1.1

Location Map

Elusive claim group mine model

Scale: 1:100,000

2. Cinnabar Hills deposit model

Location: fig. A-1.2

Sections 13, 14, 23, 24,, T. 15 N., R. 30 E., Churchill County Nevada.

Model Type:

Hot Springs, rhyolite/dacite flows - siliceous breccias and aprons.

Mineralogy:

Ore occurs in the oxide zone.

Base metals content low, <0.05%

Mercury content high, arsenic, antimony content low.

Infrastructure:

9 miles of access road to upgrade to connect to U.S. 95.

Power line on U.S. 95, 9 miles west.

Water available in Raw Hide Flats wash, 4 miles SW of deposit, about 800 feet deep.

Mining:

Deposit occurs on the flanks of 3 small hills.

Deposit will be mined from 3 pits, not connected and will be separated by waste material

Pit #1 ore zone dimensions are 900 feet long, 400 feet wide, and 150 feet thick.

Pit #2 ore zone dimensions are 700 feet long, 250 feet wide, and 200 feet thick.

Pit #3 ore zone dimensions are 650 feet long, 250 feet wide, and 200 feet thick.

Reserves:

Tonnage factor: 12 cu ft/ton

Grades: 0.08 opt. gold, 0.75 opt. silver

Dimensions of ore zone:

Pit 1: 900 feet long, 400 feet wide, 150 feet thick.

Pit 2: 700 feet long, 250 feet wide, 200 feet thick.

Pit 3: 600 feet long, 250 feet wide, 200 feet thick.

Tons:

Pit 1: 900 feet x 400 feet x 150 feet = 54,000,000 cu ft

$$\frac{54{,}000{,}000 \text{ cu ft}}{12 \text{ cu ft/ton}} = 4{,}500{,}000 \text{ tons}$$

Pit 2: 700 feet x 250 feet x 200 feet = 35,000,000 cu ft

$$\frac{35{,}000{,}000 \text{ cu ft}}{12 \text{ cu ft/ton}} = 2{,}916{,}667 \text{ rounded to } 2{,}900{,}000 \text{ tons}$$

Pit 3: 600 feet x 250 feet x 200 feet = 30,000,000 cu ft

$$\frac{30{,}000{,}000 \text{ cu ft}}{12 \text{ cu ft/ton}} = 2{,}500{,}000 \text{ tons}$$

Totals:

Tons	Grade Au, opt.	Ounces Gold	Grade Ag, opt.	Ounces Silver
4,500,000	0.08	360,000	0.75	3,375,000
2,900,000	0.08	232,000	0.75	2,175,000
2,500,000	0.08	200,000	0.75	1,875,000
9,900,000	0.08	792,000	0.75	7,425,000

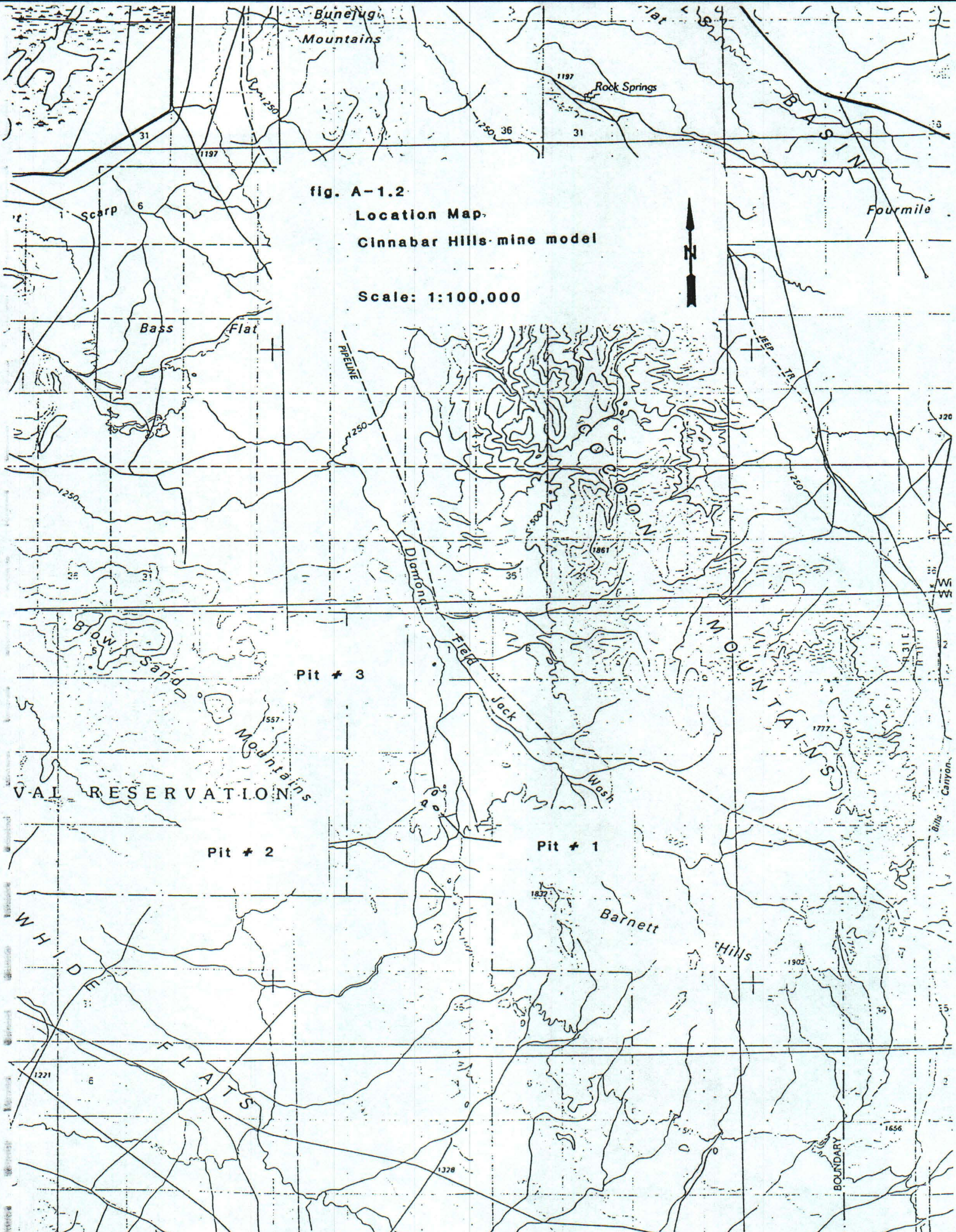

fig. A-1.2
Location Map
Cinnabar Hills mine model
Scale: 1:100,000
N
Bunejug Mountains
Rock Springs
BASIN
Fourmile
Scarp
Bass Flat
PIPELINE
JEEP TR
COCOON
MOUNTAINS
Diamond Field Jack Wash
Blow Sand Mountains
Pit # 3
Pit # 2
Pit # 1
VAL RESERVATION
WHIDE FLATS
Barnett Hills
Bills Canyon
BOUNDARY
1197
1250
1861
1557
1777
1832
1903
1656
1328
1221

3. Jet claim group deposit model

Location: fig. A-1.3

Sections 11, 14,, T. 15 N., R. 33 E., Churchill County, Nevada

Model Type:

Epithermal, volcanic hosted, low grade, disseminated precious metals

Mineralogy:

Two ore zones, oxide and sulfide.

Oxide zone: copper oxides at 0.01% per ton, arsenic, antimony, and mercury at less than 0.01% per ton

Sulfide zone: chalcopyrite at less than 0.01% per ton, arsenic, antimony at 0.01% per ton, mercury at less than 0.01% per ton.

Infrasturcture:

Upgrade 7 miles of access road.

Power line 10 miles to the west on S.R. 839.

Drill water well, about 600 feet deep, 4 miles west.

Mining:

Deposit will be mined from 1 pit with ore zone dimensions of 2,000 feet long, 350 feet wide, 100 feet thick (oxide) and 2,000 feet long, 350 feet wide, 130 feet thick (sulfide).

Rock is argillically altered (20-35% by volume) and silicified (10-20% by volume).

Rock is fractured:

N. 60°-70° W., ± 70° SW., 3-8 fractures per foot

N. 30°-40° W., ± 50° NE., 4-7 fractures per foot

N. 40°-50° E., ± 40° SE., 3-6 fractures per foot

Stripping ratio: 1.5:1 oxide, 3.3:1 sulfide

Reserves:

Tonnage factor: 12.5 cu ft/ton.

Grades: Oxide zone: 0.055 opt. gold, 1.00 opt. silver

Sulfide zone: 0.100 opt. gold, 2.00 opt. silver

Dimensions of ore zone, 1 pit

Oxide zone: 2,000 feet long, 350 feet wide, 100 feet thick.

Sulfide zone: 2,000 feet long, 350 feet wide, 130 feet thick.

Tons: Oxide zone

2,000 feet x 100 feet x 100 feet = 70,000,000 cu ft

$\frac{70,000,000 \text{ cu ft}}{12.5 \text{ cu ft/ton}}$ = 5,600,000 tons

Tons: Sulfide zone

2,000 feet x 350 feet x 130 feet = 91,000,000 cu ft

$\frac{91,000,000 \text{ cu ft}}{12.5 \text{ cu ft/ton}}$ = 7,280,000 rounded to 7,200,000 tons

Totals:

Tons	Grade Au, opt.	Ounces Gold	Grade Ag, opt.	Ounces Silver
Oxide Zone				
5,600,000	0.055	308,000	1.00	5,600,000
Sulfide Zone				
7,200,000	0.100	720,000	2.00	14,000,000
12,800,000	0.080	1,028,000	1.56	20,000,000

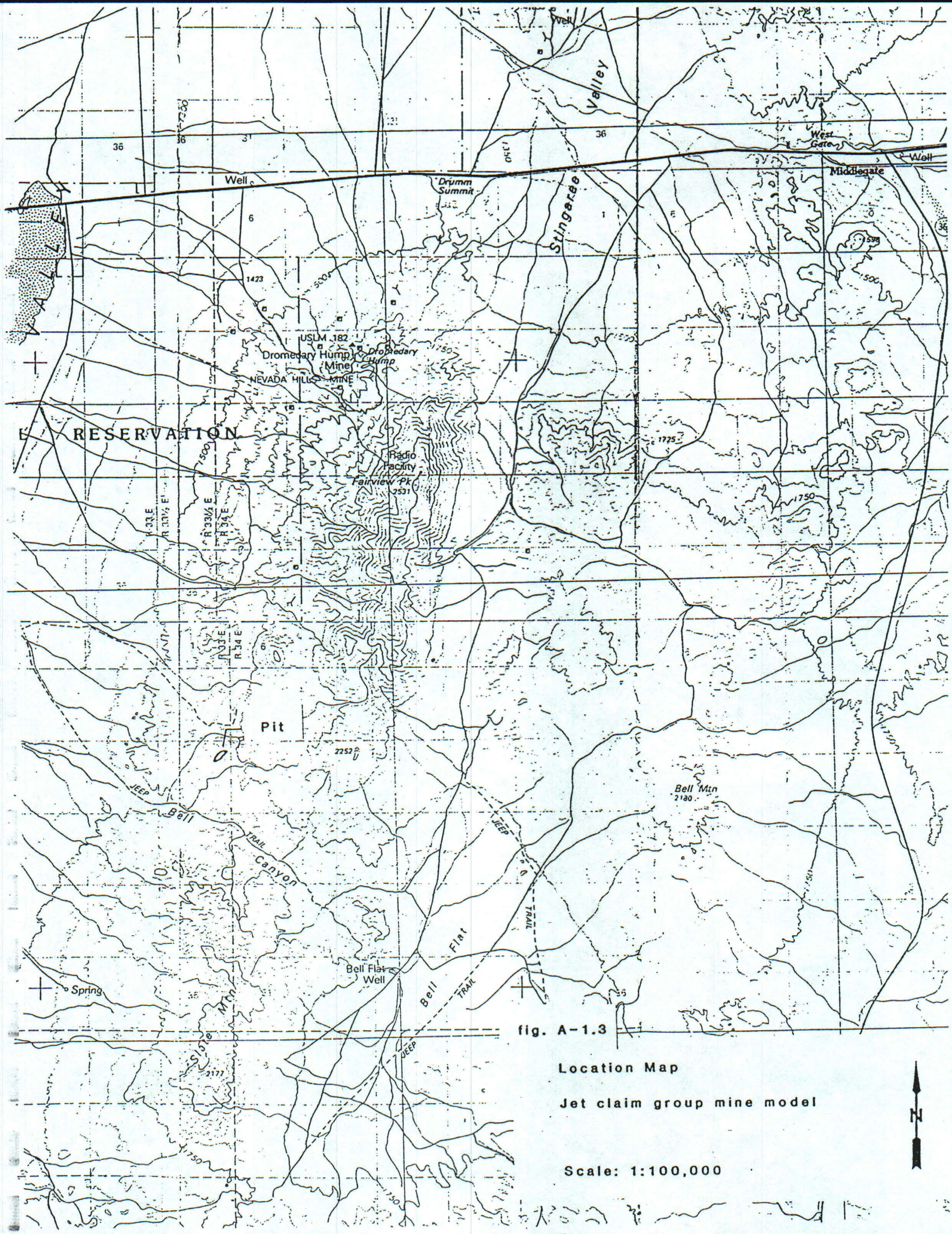

fig. A-1.3

Location Map

Jet claim group mine model

Scale: 1:100,000

4. La Plata Project deposit model

Location: fig. A-1.4

Sections 4, 5, 8, 9, T. 18 N., R. 33 E., Churchill County, Nevada

Model Type:

Skarn; limestone, and limy sediments intruded by quartz monzonite.

Mineralogy:

Ore is composed of molybdenite at 0.4% per ton and scheelite at 0.65% per ton. There may be some precious metal credits with a maximum of 0.100 ounce gold per ton concentrate and 0.55 ounce silver per ton concentrate.

Infrastructure:

15 miles of access road to upgrade

5 miles to well site for water, drill water well 600 feet deep

Self-generated power

Mining:

Adit, decline entry

Trackless, room and pillar with 75% extraction on first pass and 10% additional extraction second pass pillar robbing.

Two mining areas

Reserves:

Tonnage factor: 10.5 cu ft/ton

Grades:

Molybdenum 0.40% per ton

Tungsten trioxide 0.65% per ton

(May be some precious metal credits, maximum of 0.100 ounce gold per ton of concentrate, and 0.55 ounce silver per ton of concentrate)

Dimensions:

Area 1: 2,800 feet long, 800 feet wide, 14 feet thick

Area 2: 2,200 feet long, 600 feet wide, 14 feet thick

Tons:

Area 1: 2,800 x 800 x 14 = 31,360,000 cu ft

$$\frac{31{,}360{,}000 \text{ cu ft}}{10.5 \text{ cu ft/ton}} = 2{,}986{,}667 \text{ rounded to } 2{,}987{,}000 \text{ tons}$$

Area 2: 2,200 x 600 x 14 = 18,480,000 cu ft

$$\frac{18{,}480{,}000 \text{ cu ft}}{10.5 \text{ cu ft/ton}} = 1{,}760{,}000 \text{ tons}$$

Totals: 4,747,000 rounded to 4,700,000 tons

Tons	Grade Mo, %	Pounds Mo	Grade WO_3, %	Pounds WO_3
4,700,000	0.40	37,600,000	0.65	61,100,000

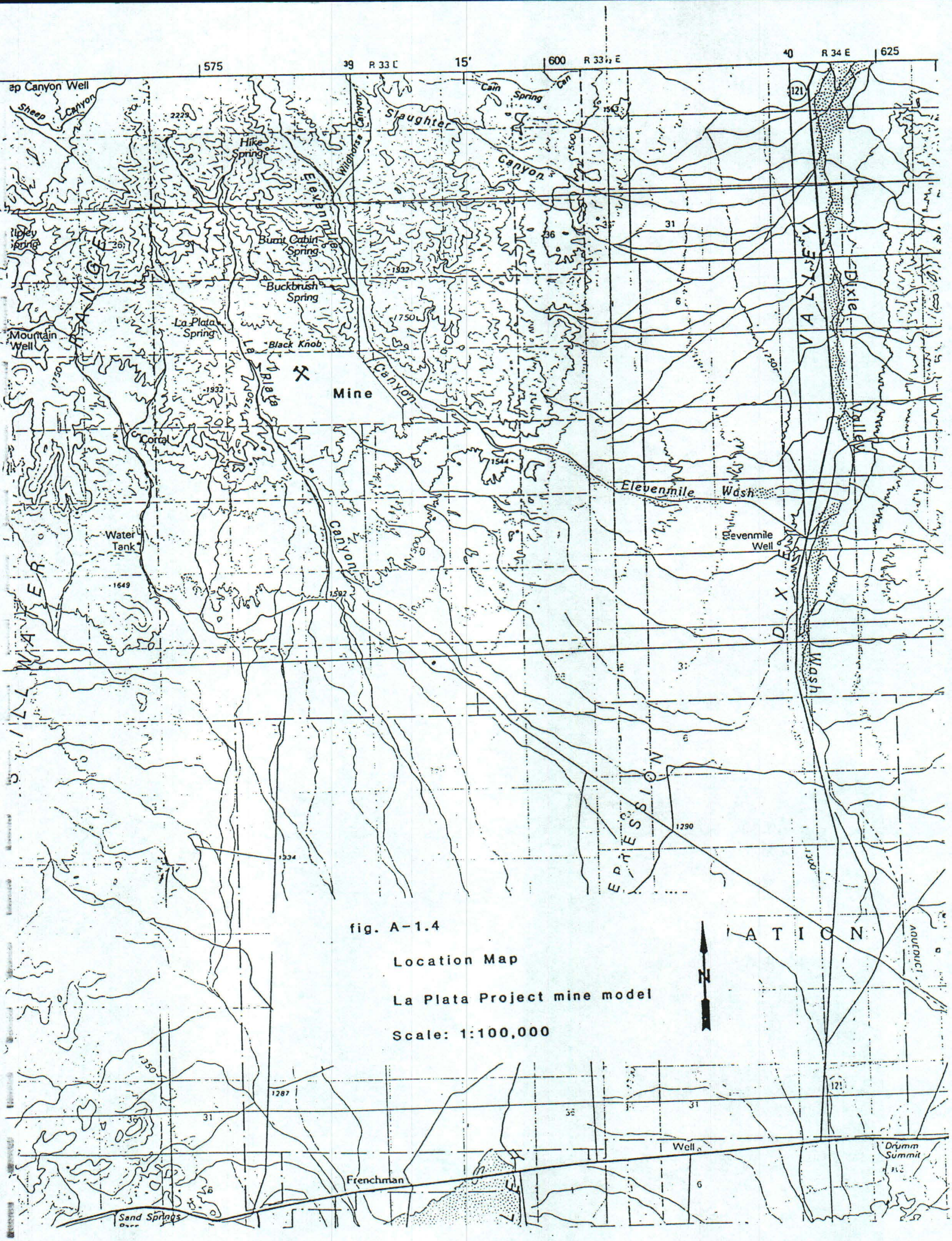

fig. A-1.4

Location Map

La Plata Project mine model

Scale: 1:100,000

5. Summit King deposit model

Location: fig. A-1.5
Sections 10, 11, T. 16 N., R. 32 E., Churchill County, Nevada

Model Type:

Epithermal vein; quartz-calcite-barite, adularia, replacement-type vein with indistinct vein walls, probably assay cut-off.

Vein width: ranges from 3 to 20 feet wide and averages 7.0 feet wide.

Strike length: 2,100 feet, N. 60°-70° W., ± 600 feet.

Mineralogy: upper 350 feet of vein is oxidized.

Au, native

Ag, native with chlorides/halides

Pb, oxide and sulfide

Also antimony oxides and manganese oxides

Infrastructure:

3 miles of access roads to upgrade.

3 miles to water well site, drill well ± 800 feet deep.

3 miles to power substation.

Mining:

Underground, shrinkage stoping.

Reserves:

Tonnage factor: 10.7 cu ft/ton

Grades: gold ranges from 0.08 opt. to 0.60 opt., averages 0.35 opt.

silver ranges from 0.50 opt. to 6.00 opt., averages 2.50 opt.

lead averages 1.00% per ton.

Dimensions of ore zone:

2,100 feet long, 600 feet deep, 7 feet thick.

Tons:

2,100 feet x 600 feet x 7 feet = 8,820,000 cu ft

$\frac{8,820,000 \text{ cu ft}}{10.7 \text{ cu ft/ton}}$ = 824,292 rounded to 824,000 tons

Tons	Grade Au, opt	Ounces Gold	Grade Ag, opt.	Ounces Silver	Grade Pb, %	Pounds Lead
824,000	0.35	288,400	2.50	2,060,000	1.0	16,480,000

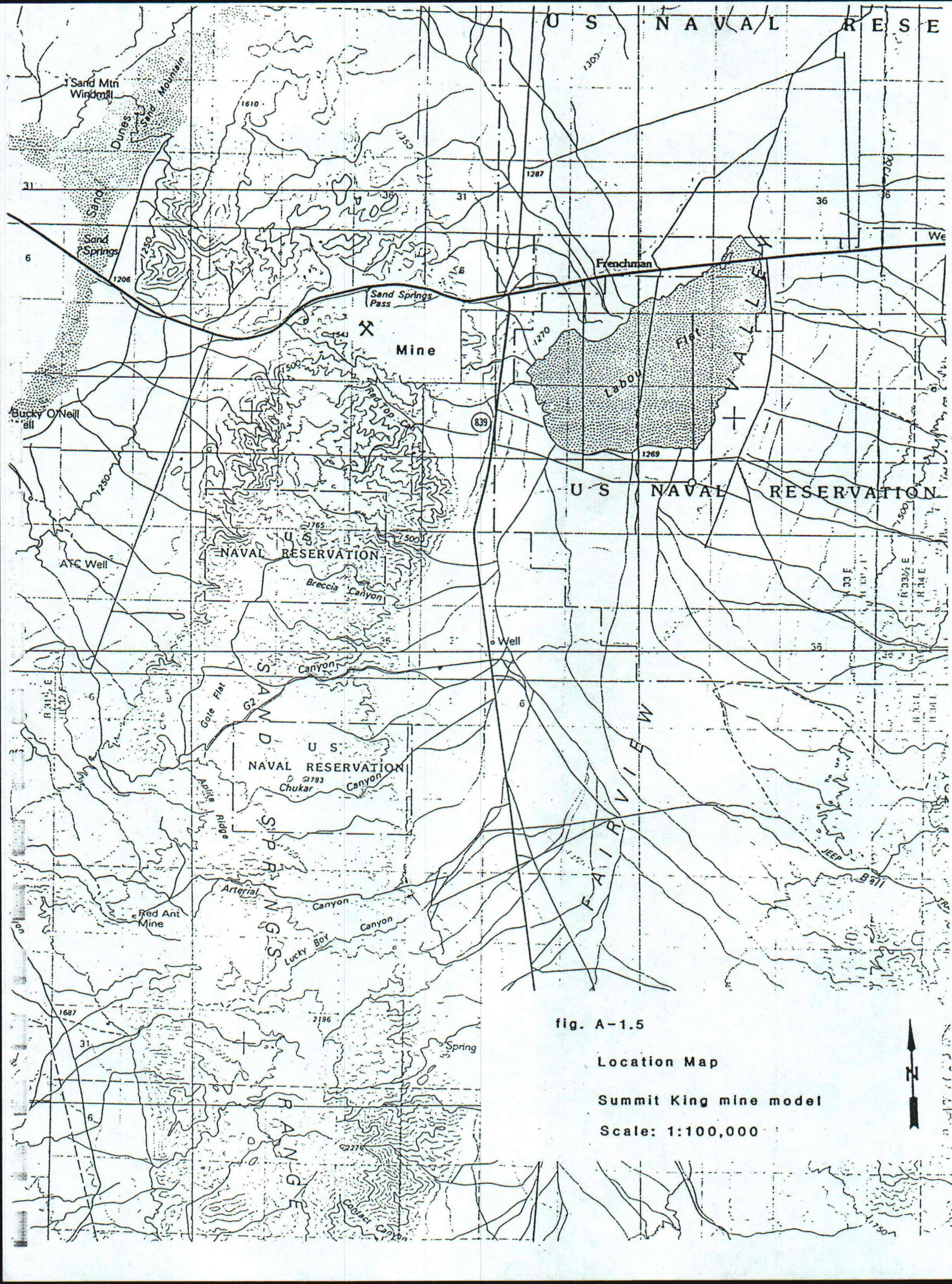

fig. A-1.5

Location Map

Summit King mine model

Scale: 1:100,000

Appendix 2
Mine/Mill Models

Introduction

The following section contains brief mine and mill descriptions, capital and operating cost estimates, 3/ and direct socioeconomic impacts for various cost models developed for known mineral deposits within the proposed MLW. Deposits include the following: 1) Elusive claims mine model, 2) Cinnabar Hills mine model, 3) Jet claims mine model, 4) La Plata project mine model, and 5) Summit King mine model.

Elusive claims mine model

Introduction: The mine/mill model developed for the Elusive mine is based on the following assumptions:

1) An oxide reserve of 19,500,000 tons of ore grading 0.054 opt. gold and 0.23 opt. silver.

2) Resources are contained in two discrete zones - zone 1 averaging 1,200 feet by 600 feet by 200 feet and zone 2 averaging 900 feet by 500 feet by 200 feet. The average stripping ratio is 2.5:1.

3) Ore is amenable to heap leaching.

Preproduction: Preproduction development includes the following; 1) upgrading of 4.5 miles of access road and 2) sinking a 600 foot deep water well 2 miles from the plant site.

Additional development would include construction of 2.5 miles of mine haul roads, leach pad and pond development, site preparation, preproduction stripping, and gold recovery plant construction.

Mining/Milling: Following preproduction development, open pit mining would commence at a rate of 5,000 tons per day ore and 12,500 tons per day waste, three shifts per day, 360 days per year. Mining would use 6-1/2 inch rotary drills, 7 yard loaders and 35 ton rear dump trucks. Broken ore would be hauled to the crushing plant. Mine run ore would be crushed in three stages, two shifts per day, 360 days per year. Crushing would utilize a 48-inch by 60-inch jaw, and two 5.5-foot cone crushers. Crushing would yield a 80 percent minus 3/8 inch which would be conveyed to the agglomeration plant where cement would be added prior to heap leaching.

From the agglomeration plant, ore would be loaded into 85 ton rear dump trucks for haulage to the leach pads.

Alkaline sodium cyanide, NaCN, drip solution would be applied to the

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3/ Totals may not add up due to a rounding factor used in the computer software.

heap at a rate of about 2,344.6 gallons per minute and be maintained at a concentration of 0.1 percent NaCN and a pH of 11. Pregnant solution collected in the ponds would average 1,875.7 gallons per minute (allowing for approximately 469 gallons per minute of evaporation loss).

From the ponds, pregnant solution would be pumped through five (5), 4.5 foot by 14 foot carbon adsorption columns charged with 6 by 12 mesh carbon. Spent leach solution would be routed to an intermediate pond where makeup water (469 gallons per minute), solution from the rinse circuit, and additional NaCN and lime would be added to maintain an optimum system flow rate (0.1 percent NaCN and a pH of 11).

The gold-laden carbon from the adsorption columns would be loaded in strip tanks where a solution of 0.1 percent NaCN and 1.0 percent NaOH would be applied. Stripped carbon would be removed to a propane-fired, 2.5-foot by 22-foot carbon regeneration kiln before reuse in the carbon adsorption columns.

The gold-laden strip solution would be pumped to one of two 350-gallon electrowinning cells where the gold would be plated out on steel wool cathodes. The cathodes would then be delivered to a 125 Kw induction furnace for smelting into dore. The final dore bullion would then be shipped to the Handy and Harmen refinery in El Monte, CA.

Circuit gold recovery would be approximately 75 percent. A metallurgical balance is presented in table A-2.1. Capital and operating cost estimates are presented in tables A-2.2 and A-2.3, respectively.

Table A-2.1. Heap Leach Metallurgical Balance,
Elusive claims mine model

Item	st/d	gpm soln.	Assay opt.	Units Au oz/day	Units Au oz/year	Distrb. wt.pct
Heap leach						
Feed	5,000.0	--	0.054	270.00	97,200	100.00
Drip soln. 1/	6,381.5	2,345	0.001	3.24	1,116	1.20
Recycle 2/	--	--	--	3.24	1,116	1.20
Evaporation	1,276.3	469	--	--	--	--
Makeup water	1,276.3	469	--	--	--	--
Preg. soln.	5,105.2	1,876	0.040	205.20	73,872	76.00
Heap tail	5,000.0	--	0.013	64.80	23,328	24.00
Carbon adsorption						
Preg. soln.	5,105.2	1,876	0.040	205.20	73,872	76.00
Loaded carbon	1.0	--	200.972	205.20	73,872	76.00
Barren soln. 2/	5,105.2	1,876	0.001	3.24	1,116	1.20
Carbon desorption						
Loaded carbon	1.0	--	200.972	205.20	73,872	76.00
Strip soln.	149.2	55	1.376	205.20	73,872	76.00
Strip carbon 2/	1.0	--	3.702	3.78	1,361	1.40
Electrowinning						
Strip soln.	149.2	55	1.376	205.20	73,872	76.00
Strip electrodes 2/	--	--	--	0.27	97	0.10
Fe/Au cathode	--	--	--	205.20	73,872	76.00
Smelting						
Dore Bullion	--	--	--	201.15	72,414	74.50
Slag	--	--	--	4.05	1,458	1.50

1/ 0.004 gpm/sq.ft. Metal content in barren solution assumed constant.

2/ These products are continually in recycle.

Note: Silver recovery in the dore would be 2,194 troy ounces with a 58.5 percent circuit recovery.

Table A-2.2. Phase I Development, Elusive Claims mine model

Item	Total Cost
Infrastructure	
Access road upgrade	$ 515,200
Mine haulage road, new construction	319,400
Water wells	544,600
Development work	
Site preparation	235,400
Leach pad and pond development	3,543,200
Mine development/preproduction stripping	6,478,700
Equipment	
Mine equipment	7,599,800
Plant equipment	7,465,900
Process Plant	
Concrete foundations	459,000
Process piping	73,800
Structural steel	313,200
Instrumentation	175,100
Insulation	6,200
Electrical	242,400
Construction labor	2,800,400
Mine and mill buildings	883,700
Engineering and design fees	3,798,700
Permitting	3,165,600
Bonds	633,100
Working capital	5,120,800
Total capital investment	44,374,400

Table A-2.3. Phase II Operating Cost Estimates, Elusive claims mine model

Item	Cost/day
Mine Costs	
Labor	$14,247
Repair parts	4,490
Fuel	3,726
Lubricants	1,300
Tires	2,069
Steel	1,008
Explosives	2,072
Sales and use tax	880
Total mine operating cost	$29,792
Total cost per ton ore	$ 5.96
Mill Costs	
Labor	$ 7,980
Electric power	0
Repair parts	2,767
Fuel	2,703
Propane	1,095
Lubricants	1,371
Tires	701
Steel, mobile equipment	26
Reagents	8,589
Plastic liners	624
Plastic pipe	210
Sales and use tax	1,040
Total mill operating cost	$27,105
Total cost per ton ore	5.42

Socioeconomic Impact: A summary of the direct socioeconomic impact realized by mining and processing of the Elusive claims mine model resources is summarized in table A-2.4. Total taxes paid based on price levels required for a 15 percent rate of return are $1,201,116 in Nevada State Proceeds of Mines tax and $8,278,884 in Federal income tax. Property taxes would total $5,839,000.

Table A-2.4. Direct Socioeconomic Impact, Elusive claims mine model

Item	Total Cost
Phase I - Mine/Mill development, 1991	
Construction Labor Force	$ 6,327,600
Engineering and Design fees	3,798,700
Permits	3,165,600
Bonds	633,100
Working capital	5,120,800
Sand and gravel	539,500
Fuel	2,133,300
Repair parts	1,586,800
Lubricants	536,000
Steel items	464,000
Tires	94,600
Explosives	246,800
Piping, metal	129,700
Piping, plastic	343,700
Plastic liners	1,649,100
Metal fences	40,600
Structures	111,500
Lumber	9,000
Electrical	242,400
Concrete	557,900
Structural steel	345,800
Insulation	33,700
Maintenance equipment	167,300
Furnishings	104,800
Instruments	175,100
Process equipment	2,964,900
Mobile equipment	10,555,800
Freight	892,800
Sales and use tax	1,403,500
Total phase I expense	$44,374,400
Phase II - Mine/Mill operations, 1992-2002	Annual Cost
Labor	$ 8,001,700
Repair parts	2,612,300
Fuel	2,314,200
Propane	394,200
Lubricants	961,800
Tires	997,300
Steel	372,500
Explosives	745,800
Reagents	3,092,100
Plastic liners	224,500
Plastic pipe	75,600
Sales and use tax	691,100
Total phase II expenses (annually)	$20,483,100

Cinnabar Hills mine model

Introduction: The mine/mill model developed for the Cinnabar Hills mine is based on the following assumptions:

1) An oxide reserve of 9,900,000 tons of ore grading 0.08 opt. gold and 0.75 opt. silver.

2) Resources are contained in three discrete zones - zone 1 averaging 900 feet by 400 feet by 150 feet and minable with a 1:1 stripping ratio, zone 2 averaging 700 feet by 250 feet by 200 feet and minable with a 2:1 stripping ratio, and zone 3 averaging 600 feet by 250 feet by 200 feet and minable by a 2:1 stripping ratio.

3) Ore is amenable to heap leaching.

Preproduction: Preproduction development includes the following: 1) upgrading of 8 miles of access road; 2) sinking a deep (1,000 foot) water well 4 miles from the plant site; and 3) on site power generation using diesel generators.

Additional development would include construction of 2.5 miles of mine haul roads, leach pad and pond development, site preparation, preproduction stripping, and gold recovery plant construction.

Mining/Milling: Following preproduction development, open pit mining would commence at a rate of 5,000 tons per day ore and 7,750 tons per day waste, three shifts per day, 360 days per year. Mining would use 6-1/2 inch rotary drills, 7 - yard loaders and 35 ton rear dump trucks. Broken ore would be hauled to the crushing plant. Mine run ore would be crushed in three stages, two shifts per day, 360 days per year. Crushing would utilize a 48-inch by 60-inch jaw, and two 5.5-foot cone crushers. Crushing would yield a 80 percent minus 3/8 inch which would be conveyed to the agglomeration plant where cement would be added prior to heap leaching.

From the agglomeration plant, ore would be loaded into 85 ton rear dump trucks for haulage to the leach pads.

Alkaline sodium cyanide, NaCN, drip solution would be applied to the heap at a rate of about 2,344.6 gallons per minute and be maintained at a concentration of 0.1 percent NaCN and a pH of 11. Pregnant solution collected in the ponds would average 1,875.7 gallons per minute (allowing for approximately 469 gallons per minute of evaporation loss).

From the ponds, pregnant solution would be pumped through five (5), 4.5 foot by 14 foot carbon adsorption columns charged with 6 by 12 mesh carbon. Spent leach solution would be routed to an intermediate pond where makeup water (469 gallons per minute), solution from the rinse circuit, and additional NaCN and lime would be added to maintain an optimum system flow rate (0.1 percent NaCN and a pH of 11).

The gold-laden carbon from the adsorption columns would be loaded in strip tanks where a solution of 0.1 percent NaCN and 1.0 percent NaOH would be applied. Stripped carbon would be removed to a propane-fired, 2.5-foot by 22-foot carbon regeneration kiln before reuse in the carbon adsorption columns.

The gold-laden strip solution would be pumped to one of two 350-gallon electrowinning cells where the gold would be plated out on steel wool cathodes. The cathodes would then be delivered to a 125 Kw induction furnace for smelting into dore. The final dore bullion would then be shipped to the Handy and Harmen refinery in El Monte, CA.

Circuit gold recovery would be approximately 75 percent. A metallurgical balance is presented in table A-2.5. Capital and operating cost estimates are presented in tables A-2.6 and A-2.7, respectively.

Table A-2.5. Heap Leach Metallurgical Balance, Cinnabar Hills mine model

Item	st/d	gpm soln.	Assay opt.	Units Au oz/day	Units Au oz/year	Distrb. wt.pct
Heap leach						
Feed	5,000.0	--	0.080	400.00	144,000	100.00
Drip soln. 1/	6,381.5	2,345	0.001	4.80	1,728	1.20
Recycle 2/	--	--	--	4.80	1,728	1.20
Evaporation	1,276.3	469	--	--	--	--
Makeup water	1,276.3	469	--	--	--	--
Preg. soln.	5,105.2	1,876	0.060	304.00	109,440	76.00
Heap tail	5,000.0	--	0.019	96.00	34,560	24.00
Carbon adsorption						
Preg. soln.	5,105.2	1,876	0.060	304.00	109,440	76.00
Loaded carbon	1.0	--	297.736	304.00	109,440	76.00
Barren soln. 2/	5,105.2	1,876	0.001	4.80	1,188	1.20
Carbon desorption						
Loaded carbon	1.0	--	297.736	304.00	109,440	76.00
Strip soln.	149.2	55	2.038	304.00	109,440	76.00
Strip carbon 2/	1.0	--	5.485	5.60	2,016	1.40
Electrowinning						
Strip soln.	149.2	55	2.038	304.00	109,440	76.00
Strip electrodes 2/	--	--	--	0.40	144	0.10
Fe/Au cathode	--	--	--	304.00	109,440	76.00
Smelting						
Dore Bullion	--	--	--	298.00	107,280	74.50
Slag	--	--	--	6.00	2,160	1.50

1/ 0.004 gpm/sq.ft. Metal content in barren solution assumed constant.

2/ These products are continually in recycle.

Note: Silver recovery in the dore would be 2,194 troy ounces with a 58.5 percent circuit recovery.

Table A-2.6. Phase I Development, Cinnabar Hills mine model

Item	Total Cost
Infrastructure	
Access road upgrade	$ 915,900
Mine haulage road, new construction	319,400
Water wells	600,300
Development work	
Site preparation	235,400
Leach pad and pond development	3,543,200
Mine development/preproduction stripping	6,478,700
Equipment	
Mine equipment	7,599,800
Plant equipment	7,465,900
Process Plant	
Concrete foundations	459,000
Process piping	73,800
Structural steel	313,200
Instrumentation	175,100
Insulation	6,200
Electrical	242,400
Construction labor	2,800,400
Mine and mill buildings	883,700
Engineering and design fees	3,853,500
Permitting	3,211,200
Bonds	642,300
Working capital	4,638,700
Total capital investment	44,458,200

Table A-2.7. Phase II Operating Cost Estimates, Cinnabar Hills mine model

Item	Cost/day
Mine Costs	
Labor	$12,006
Repair parts	3,523
Fuel	3,214
Lubricants	1,101
Tires	1,679
Steel	729
Explosives	1,480
Sales and use tax	704
Total mine operating cost	$24,436
Total cost per ton ore	$ 4.89
Mill Costs	
Labor	$ 7,980
Electric power	0
Repair parts	2,767
Fuel	2,703
Propane	1,095
Lubricants	1,371
Tires	701
Steel, mobile equipment	26
Reagents	8,589
Plastic liners	624
Plastic pipe	210
Sales and use tax	1,040
Total mill operating cost	$27,105
Total cost per ton ore	5.42

Socioeconomic Impact: A summary of the direct socioeconomic impact realized by mining and processing of the Cinnabar Hills mine resources is summarized in table A-2.8. Total taxes paid based on price levels required for a 15 percent rate of return are $624,884 in Nevada State Proceeds of Mines tax and $4,307,116 in Federal income tax. Property taxes would total $3,129,000.

Table A-2.8. Direct Socioeconomic Impact, Cinnabar Hills mine model

Item	Total Cost
Phase I - Mine/Mill development, 1991	
Construction Labor Force	$ 6,373,600
Engineering and Design fees	3,853,500
Permits	3,211,200
Bonds	642,300
Working capital	4,638,700
Sand and gravel	784,500
Fuel	2,177,800
Repair parts	1,618,200
Lubricants	547,700
Steel items	469,600
Tires	94,600
Explosives	246,800
Piping, metal	178,700
Piping, plastic	343,700
Plastic liners	1,649,100
Metal fences	40,600
Structures	111,500
Lumber	9,000
Electrical	242,400
Concrete	557,900
Structural steel	345,800
Insulation	33,700
Maintenance equipment	167,300
Furnishings	104,800
Instruments	175,100
Process equipment	2,964,900
Mobile equipment	10,555,800
Freight	892,800
Sales and use tax	1,426,800
Total phase I expense	$44,458,200
Phase II - Mine/Mill operations, 1992-1997	**Annual Cost**
Labor	$ 7,195,000
Repair parts	2,264,200
Fuel	2,129,900
Propane	394,200
Lubricants	890,200
Tires	856,800
Steel	272,100
Explosives	532,800
Reagents	3,092,100
Plastic liners	224,500
Plastic pipe	75,600
Sales and use tax	627,700
Total phase II expenses (annually)	$18,554,900

Jet claim group mine model

Introduction: The mine/mill model developed for mining gold from the Jet claim group is based on the following assumptions:

1) An oxide reserve of 5,600,000 tons of ore grading 0.055 opt. gold and 1.0 opt. silver.

2) A sulfide reserve of 7,200,000 tons of ore grading 0.1 troy ounces of gold/ton and 2.0 troy ounces of silver per ton.

3) An oxide zone stripping ratio of 1.5:1 and a sulfide stripping ratio of 3.3:1.

4) Oxide ore amenable to heap leaching.

5) Sulfide ore amenable to flotation-roasting-leaching.

Preproduction: Preproduction development would consist of the following: 1) upgrading of 7 miles of access road; 2) sinking a shallow water well 4 miles from the plant site; and 3) on site power generation using diesel generators.

Additional development would include construction of 2.5 miles of mine haul roads, leach pad and pond development, site preparation, preproduction stripping, and gold recovery plant construction.

Mining and Heap Leaching: Following preproduction development, open pit mining would commence at a rate of 5,000 tons per day ore and 7,500 tons per day waste, three shifts per day, 360 days per year. Mining would use 6-1/2 inch rotary drills, 7 - yard loaders and 35 ton rear dump trucks. Broken ore would be hauled to the crushing plant. Mine run ore would be crushed in three stages, two shifts per day, 360 days per year. Crushing would utilize a 48-inch by 60-inch jaw, and two 5.5-foot cone crushers. Crushing would yield a 80 percent minus 3/8 inch which would be conveyed to the agglomeration plant where cement would be added prior to heap leaching.

From the agglomeration plant, ore would be loaded into 85 ton rear dump trucks for haulage to the leach pads.

Alkaline sodium cyanide, NaCN, drip solution would be applied to the heap at a rate of about 2,344.6 gallons per minute and be maintained at a concentration of 0.1 percent NaCN and a pH of 11. Pregnant solution collected in the ponds would average 1,875.7 gallons per minute (allowing for approximately 469 gallons per minute of evaporation loss).

From the ponds, pregnant solution would be pumped through five (5), 4.5 foot by 14 foot carbon adsorption columns charged with 6 by 12 mesh carbon. Spent leach solution would be routed to an intermediate pond where makeup water (469 gallons per minute), solution from the rinse circuit, and additional NaCN and lime would be added to maintain an optimum system flow rate (0.1 percent NaCN and a pH of 11).

The gold-laden carbon from the adsorption columns would be loaded in strip tanks where a solution of 0.1 percent NaCN and 1.0 percent NaOH would be applied. Stripped carbon would be removed to a propane-fired, 2.5-foot by 22-foot carbon regeneration kiln before reuse in the carbon adsorption columns.

The gold-laden strip solution would be pumped to one of two 350-gallon electrowinning cells where the gold would be plated out on steel wool cathodes. The cathodes would then be delivered to a 125 Kw induction furnace for smelting into dore. The final dore bullion would then be shipped to the Handy and Harmen refinery in El Monte, CA.

Circuit gold recovery would be approximately 75 percent. A metallurgical balance is presented in table A-2.9. Capital and operating cost estimates are presented in tables A-2.10 and A-2.11, respectively.

Table A-2.9. Heap Leach Metallurgical Balance,
Jet claim group mine model

Item	st/d	gpm soln.	Assay opt.	Units Au oz/day	Units Au oz/year	Distrb. wt.pct
Heap leach						
Feed	5,000.0	--	0.055	275.00	99,000	100.00
Drip soln. 1/	6,381.5	2,345	0.001	3.30	1,188	1.20
Recycle 2/	--	--	--	3.30	1,188	1.20
Evaporation	1,276.3	469	--	--	--	--
Makeup water	1,276.3	469	--	--	--	--
Preg. soln.	5,105.2	1,876	0.041	209.00	75,240	76.00
Heap tail	5,000.0	--	0.013	66.00	23,760	24.00
Carbon adsorption						
Preg. soln.	5,105.2	1,876	0.041	209.00	75,240	76.00
Loaded carbon	1.0	--	204.693	209.00	75,240	76.00
Barren soln. 2/	5,105.2	1,876	0.001	3.30	1,188	1.20
Carbon desorption						
Loaded carbon	1.0	--	204.693	209.00	75,240	76.00
Strip soln.	149.2	55	1.401	209.00	75,240	76.00
Strip carbon 2/	1.0	--	3.771	3.85	1,386	1.40
Electrowinning						
Strip soln.	149.2	55	1.401	209.00	75,240	76.00
Strip electrodes 2/	--	--	--	0.28	99	0.10
Fe/Au cathode	--	--	--	209.00	75,240	76.00
Smelting						
Dore Bullion	--	--	--	204.88	73,755	74.50
Slag	--	--	--	4.13	1,485	1.50

1/ 0.004 gpm/sq.ft. Metal content in barren solution assumed constant.

2/ These products are continually in recycle.

Note: Silver recovery in the dore would be 2,925 troy ounces with a 58.5 percent circuit recovery.

Table A-2.10. Phase I development, Jet claim group mine model

Item	Total Cost
Infrastructure	
Access road upgrade	$ 801,400
Mine haulage road, new construction	319,400
Water wells	578,800
Development work	
Site preparation	620,700
Leach pad and pond development	3,543,200
Mine development/preproduction stripping	2,058,000
Equipment	
Mine equipment	7,599,800
Plant equipment	7,465,900
Process Plant	
Concrete foundations	459,000
Process piping	73,800
Structural steel	313,200
Instrumentation	175,100
Insulation	6,200
Electrical	242,400
Construction labor	2,800,400
Mine and mill buildings	1,927,800
Engineering and design fees	3,478,200
Permitting	2,898,500
Bonds	391,600
Working capital	4,440,800
Total capital investment	40,194,400

Table A-2.11. Phase II Operating Cost Estimates, Jet claim group model

Item	Cost/day
Mine Costs	
Labor	$12,006
Repair parts	3,523
Fuel	3,214
Lubricants	1,101
Tires	1,679
Steel	729
Explosives	1,480
Sales and use tax	704
Total mine operating cost	$24,436
Total cost per ton ore	$ 4.89
Mill Costs	
Labor	$ 7,980
Electric power	0
Repair parts	2,767
Fuel	2,703
Propane	1,095
Lubricants	1,371
Tires	701
Steel, mobile equipment	26
Reagents	6,509
Plastic liners	624
Plastic pipe	210
Sales and use tax	920
Total mill operating cost	$24,906
Total cost per ton ore	4.98

Subsequent Development: As oxide ore reserves are depleted construction of a 5,000 ton per day flotation plant and a 200 ton per day concentrate roasting and carbon in leach gold recovery plant would be constructed in preparation of mining sulfide ore.

Mining and Flotation/Roast/Leaching: Following construction of the flotation/roasting facilities, mining of the sulfide ore would commence at a rate of 5,000 tons per day ore and 16,500 tons per day waste, three shifts per day, 360 days per year. Additional drilling equipment would require purchase of two 6-1/2 inch rotary drills. Additional loading and hauling equipment would be accomplished using the 7 yard loaders and 85 ton rear dump trucks used for previous heap leaching operations.

Broken ore would be hauled to the crushing plant. Mine run ore would be crushed in the jaw crusher and then delivered to the 22' by 7' SAG (semiautogenous) mill for grinding. Ground ore would then be passed through duplex mineral jigs to remove any free gold prior to flotation. Flotation would produce approximately 182 tons of concentrate assaying 2.43 ounces of gold/ton and 48.6 ounces of silver/ton. The 4,818 tons of tails, assaying 0.0018 troy ounces of gold/ton and 0.5544 troy ounces of silver/ton would be thickened and pumped to the tailings pond.

The sulfide concentrates would be thickened and filtered and then delivered to the fluid be roaster where 154 tons of matte assaying 2.724 troy ounces of gold/ton and 54.479 ounces of silver/ton would be produced. The sulfide matte would then be treated in the existing CIL plant.

Circuit gold recovery would be approximately 91 percent. A metallurgical balance is presented in table A-2.12. Capital and operating cost estimates are presented in tables A-2.13 and A-2.14, respectively.

Table A-2.12. Flotation/Roast/Leach Metallurgical Balance, Jet claim group mine model

Item	St/d	Assay opt.	Units/d tr.oz.	Recovery Wt.Pct.
Crusher feed	5,000.00	0.1000	500.00	100.00
SAG Mill	5,000.00	0.1000	500.00	100.00
Jig Circuit				
Free Gold	--	--	50.00	10.00
Tail	5,000.00	0.0900	450.00	90.00
Flotation				
Concentrate	181.67	2.4300	441.45	88.29
Tail	4,818.33	0.0018	8.55	1.71
Roaster				
Product	153.93	2.7240	419.29	83.86
Gasses	19.64	0.0045	0.09	0.02
Dust product	8.10	2.7240	22.07	4.41
Carbon in leach				
Feed	162.03	2.7240	441.36	88.27
Solids	162.03	0.1362	22.07	4.41
Solution	300.26	--	419.29	83.86
Metal production				
Dore (includes jig conc.)		--	458.81	91.76
Slag	--	--	10.48	2.10

Table A-2.13. Phase IV Development, Jet claim group mine model

Item	Total Cost
Equipment	
Mine equipment	$ 7,599,800
Plant equipment	9,473,900
Process Plant	
Concrete foundations	1,028,000
Process piping	911,200
Structural steel	744,500
Instrumentation	476,600
Insulation	46,300
Electrical	1,099,400
Construction labor	4,870,700
Engineering and design fees	2,449,100
Permitting	2,040,900
Bonds	391,600
Total capital investment	$40,194,400

Table A-2.14. Phase IV Operating Cost Estimates, Jet claim group mine model

Item	Cost/day
Mine Costs	
Labor	$15,994
Repair parts	5,525
Fuel	5,062
Lubricants	1,692
Tires	2,315
Steel	1,258
Explosives	2,436
Sales and use tax	1,097
Total mine operating cost	$35,378
Total cost per ton ore	$ 7.08
Mill Costs	
Labor	$11,628
Repair parts	4,189
Fuel	6,841
Propane	1,095
Lubricants	723
Reagents	6,460
Sales and use tax	682
Total mill operating cost	$31,619
Total cost per ton ore	$ 6.32

Socioeconomic Impact: A summary of the direct socioeconomic impact realized by mining and processing of the Jet claim group mine model resources is summarized in table A-2.15. Total taxes paid based on price levels required for a 15 percent rate of return are $4,733,042 in Nevada State Proceeds of Mines tax and $32,898,958 in Federal income tax. Property taxes would total $5,299,000.

Table A-2.15. Direct Socioeconomic Impact, Jet claim group mine model

Item	Total Cost
Phase I - Mine/Mill development, 1991	
Construction Labor Force	$ 5,804,200
Engineering and Design fees	3,478,200
Permits	2,898,500
Bonds	391,600
Working capital	4,440,800
Sand and gravel	714,400
Fuel	838,100
Repair parts	716,400
Lubricants	218,800
Steel items	292,300
Tires	94,600
Explosives	246,800
Piping, metal	164,500
Piping, plastic	343,700
Plastic liners	1,649,100
Metal fences	40,600
Structures	244,800
Lumber	20,100
Electrical	242,400
Concrete	679,600
Structural steel	386,400
Insulation	75,000
Maintenance equipment	167,300
Furnishings	176,000
Instruments	175,100
Process equipment	2,964,900
Mobile equipment	10,555,800
Freight	892,800
Sales and use tax	1,282,000
Total phase I expense	$40,194,400
Phase II - Mine/Mill operations, 1992-1994	Annual Cost
Labor	$ 7,195,000
Repair parts	2,264,200
Fuel	2,129,900
Propane	394,200
Lubricants	890,200
Tires	856,800
Steel	272,100
Explosives	532,800
Reagents	2,343,300
Plastic liners	224,500
Plastic pipe	75,600
Sales and use tax	584,600
Total phase II expenses (annually)	$17,763,100

Table A-2.15. Direct Socioeconomic Impact, Jet claim group mine model (Cont'd.)

Item	Total Cost
Phase III - Mine/Mill development, 1994	
Construction Labor Force	$ 5,203,900
Engineering and Design fees	2,449,100
Permits	2,040,900
Bonds	391,600
Fuel	354,600
Repair parts	231,400
Lubricants	82,400
Steel items	56,600
Piping, metal	1,020,500
Electrical	1,099,400
Concrete	1,027,900
Structural steel	744,500
Insulation	46,300
Maintenance equipment	205,300
Instruments	476,600
Process equipment	8,143,900
Mobile equipment	493,000
Freight	659,600
Sales and use tax	563,400
Total phase I expense	$25,291,100
Phase IV - Mine/Mill operations, 1995-1998	Annual Cost
Labor	$ 9,943,900
Repair parts	3,496,900
Fuel	4,285,200
Propane	394,200
Lubricants	869,300
Tires	833,300
Steel	452,700
Explosives	877,100
Reagents	2,325,600
Sales and use tax	640,600
Total phase II expenses (annually)	$24,118,900

La Plata project mine model

Introduction: The mine/mill model developed for the La Plata project mine model is based on the following assumptions:

1) A reserve of 4,700,000 tons of ore grading 0.65% tungsten trioxide and 0.40% molybdenum per ton.

2) Ore is amenable to trackless room and pillar mining with 75% extraction, first pass mining and 10% additional extraction using pillar-robbing.

3) Ore amenable to single product flotation to produce a tungsten-moldbenum concentrate.

Preproduction: Preproduction development would include the following: 1) upgrading of 15 miles of access road; 2) sinking a 600 foot deep water well 5 miles from the plant site; and 3) installing on-site power generation.

Additional development would include driving a 2,500-foot long, 14-foot by 12-foot main haulage decline, driving three- 600-foot long, 10-foot by 8-foot crosscuts, and construction of a 722 ton per day flotation plant.

Mining and processing: Following preproduction development, room and pillar mining would commence at a rate of 1,000 tons per day, 2 shift per day, 260 days per year. Mining would recover about 85 percent of the resource yielding a 16 year mine life. From the development headings, broken ore would be loaded and transported to the main haulage decline using 5.2 yard LHD's. At the decline, the ore would be transported to the surface using 27 ton articulated haul trucks.

Mine run ore would be crushed in three stages, one shift per day, 360 days per year. Crushing would utilize a 42-inch by 48-inch jaw, 5.5-foot cone crusher, and a 40-inch by 24-inch roll crusher. Crushing would yield a 80 percent minus 3/8 inch which would be conveyed to the grinding circuit. Grinding would use a 8-foot by 12-foot rod mill and an 8-foot by 8-foot ball mill. Ground ore would then be floated using sodium carbonate, sodium silicate and caustic starch as reagents to produce a tungsten-molybdenum concentrate.

Flotation would produce approximately 27.54 tons of concentrate assaying 15 percent tungsten trioxide and 7.34 percent molybdenum. The 694.68 tons of tails, assaying 0.08 percent tungsten trioxide and 0.12 percent molybdenum would be thickened and pumped to the tailings pond.

The concentrates would be thickened and filtered and shipped to the Pine Creek chemical plant near Bishop, CA.

Tungsten trioxide and molybdenum recovery would average 88 and 70 percent, respectively. A metallurgical balance is presented in table A-2.16. Capital and operating cost estimates are presented in tables A-2.17 and A-2.18, respectively.

Table A-2.16. Flotation plant, Metallurgical Balance, La Plata project mine models

Item	Tons	Tungsten trioxide			Molybdenum		
		Wt.Pct	Tons	Recovery	Wt.Pct	Tons	Recovery
Feed	722.22	0.65	4.69	100.00	0.40	2.89	100.00
R.Conc.	80.31	5.29	4.25	90.43	3.04	2.44	84.45
R.Tail	641.91	0.07	0.45	9.57	0.07	0.45	15.55
C.Conc.	27.54	15.00	4.13	88.00	7.34	2.02	70.00
C.Tail	694.68	0.08	0.56	12.00	0.12	0.87	30.00

Table A-2.17. Phase I Development, La Plata project mine model

Item	Total Cost
Infrastructure	
Access road upgrade	$ 1,717,400
Mine haulage road, new construction	127,800
Water wells	588,000
Development work	
Site preparation	57,600
Tailings impoundment	912,700
Mine development	
Main haulage decline	490,000
Crosscuts	348,600
Equipment	
Mine equipment	5,304,900
Plant equipment	4,026,100
Process Plant	
Concrete foundations	298,300
Process piping	354,600
Structural steel	361,900
Instrumentation	209,000
Insulation	18,300
Electrical	607,400
Construction labor	2,087,000
Mine and mill buildings	1,335,600
Engineering and design fees	2,297,400
Permitting	1,914,500
Bonds	382,900
Working capital	2,407,100
Total capital investment	$26,147,400

Table A-2.18. Phase II Operating Cost Estimates, La Plata project mine model

Item	Cost/day
Mine Costs (260 days per year)	
Labor	$ 8,385
Repair parts	1,138
Fuel	1,070
Lubricants	186
Tires	245
Steel items	636
Steel pipe	11
Explosives	1,215
Vent tubing, air and water hose	13
Timber	8
Sales and use tax	271
Total mine operating cost	$13,177
Total cost per ton ore	$ 13.18
Mill Costs (360 days per year)	
Labor	$ 6,350
Repair parts	1,375
Fuel	1,810
Steel	411
Lubricants	275
Reagents	6,158
Sales and use tax	493
Total mill operating cost	$16,872
Total cost per ton ore	23.37
Transport Costs (360 days per year)	
Labor	$ 170
Repair parts	63
Fuel	44
Lube	21
Tires	49
Depreciation and overhead	140
Sales and use tax	11
Total transport cost	$497.00
Total cost per ton concentrate	18.05

Socioeconomic Impact: A summary of the direct socioeconomic impact realized by mining and processing of La Plata resources is summarized in table A-2.19. Total taxes paid based on price levels required for a 15 percent rate of return are $1,056,805 in Nevada State Proceeds of Mines tax and $7,284,195 in Federal income tax. Property taxes would total $4,192,000.

Table A-2.19. Direct Socioeconomic Impact,
La Plata project mine model

Item	Total Cost
Phase I - Mine/Mill development, 1991	
Construction Labor Force	$ 3,610,000
Engineering and Design fees	2,297,400
Permits	1,914,500
Bonds	382,900
Working capital	2,407,100
Sand and gravel	1,119,700
Fuel	490,400
Repair parts	330,800
Lubricants	118,100
Steel items	292,600
Tires	2,200
Explosives	45,800
Piping, metal	718,900
Metal fences	22,800
Structures	163,100
Lumber	13,100
Electrical	607,400
Concrete	741,900
Structural steel	409,500
Insulation	75,800
Ventilation tubing	42,800
Furnishings	161,800
Instruments	209,000
Process equipment	3,957,900
Mine/mobile equipment	4,675,600
Freight	613,500
Sales and use tax	723,000
Total phase I expense	$26,147,400
Phase II - Mine/Mill operations, 1992-2007	Annual Cost
Labor	$ 4,527,400
Repair parts	813,500
Fuel	945,400
Lubricants	154,900
Tires	91,300
Steel	313,300
Explosives	315,900
Reagents	2,216,900
Plastic pipe	3,300
Steel pipe	2,800
Lumber	2,000
Sales and use tax	251,900
Total phase II expenses (annually)	$ 9,628,500

Summit King Mine Model

Introduction: The mine/mill model developed for the Summit King mine is based on the following assumptions:

1) A reserve of 824,000 tons of ore grading 0.35 troy ounces of gold/ton and 2.5 troy ounces of silver per ton and 1.0 percent lead.

2) Amenable to shrinkage stope mining with an 80 percent ore recovery rate.

3) Ore amenable to gravity concentration followed by flotation to produce a lead silver concentrate.

Preproduction: Preproduction development includes the following: 1) upgrading of 3 miles of access road; 2) sinking a shallow water well 3 miles from the plant site; and 3) construction of 3 miles of transmission line.

Additional development includes sinking a 14-foot by 1,200-foot circular shaft, four- 9-foot by 10-foot trackless haulageways 2320-feet, 2,380-feet, 2,485-feet, and 2,590-feet in length, a 12-foot by 120-foot circular raise, a 12-foot by 180-foot circular raise, a 5-foot by 5-foot by 600-foot timbered raise, stope development, and construction of a 400 ton per day gravity and single product flotation plant.

Mining/Milling: Following preproduction development, shrinkage stope mining would commence at a rate of 400 tons per day, 1 shift per day, 260 days per year. Mining would recover about 80 percent of the resource yielding a 7 year mine life. From the stopes, broken ore would be transported to the shaft using 2 yard LHD's and then hoisted to the surface. At the surface, a loader would transport the ore to the processing plant.

Mine run ore would be crushed in two stages, one shifts per day, 260 days per year. Crushing would utilize a 24-inch by 36-inch jaw, and a 3-foot cone crusher. Crushing would yield a 80 percent minus 3/8 inch which would be conveyed to the ball mill for grinding. Ground ore would then be passed through duplex mineral jigs and then tabled to produce a clean gold/silver concentrate. Jig and table tails would then be delivered to the float plant where a clean lead/silver concentrate would be made.

Flotation would produce approximately 7.78 tons of concentrate assaying 36 percent lead, 1.73 opt. gold and 58.6 opt. silver. The 392.22 tons of tails, assaying 0.0514 opt. gold and 0.78 opt. silver and 0.31 percent lead would be thickened and pumped to the tailings pond.

The sulfide concentrates would be thickened and filtered and shipped to the ASARCO smelter in East Helena, MT. The gold/silver gravity concentrate containing 106.4 troy ounces of gold and 240 troy ounces of silver would be shipped to the Handy and Harmen refinery in El Monte, CA.

Circuit gold recovery would be approximately 91 percent. A metallurgical balance is presented in table A-2.20. Capital and operating cost estimates are presented in tables A-2.21 and A-2.22, respectively.

Table A-2.20. Gravity/flotation plant, Metallurgical Balance, Summit King mine model

Ore production	400 Tons		
Grade	0.35 opt. Au	2.5 opt. Ag	1.00% Wt. Pct

Item	St/D	Gold			Silver			Lead		
		Assay opt.	Units/d Tr. Oz.	Recovery Wt. Pct	Assay opt.	Units/d Tr. Oz.	Recovery Wt. Pct	Assay opt.	Units/d Lbs.	Recovery Wt. Pct
Crusher Feed	400.00	0.3500	140.00	100.00%	2.50	1,000.00	100.00%	1.00%	8,000	100.00%
SAG Mill	400.00	0.3500	140.00	100.00	2.50	1,000.00	100.00	1.00	8,000	100.00
Mineral jigs										
Free gold	-	-	56.00	40.00	-	200.00	20.00	-	0	0.00
Middling	20.00	2.8000	56.00	40.00	10.00	200.00	20.00	0.20	80	1.00
Tail	380.00	0.0737	28.00	20.00	1.58	600.00	60.00	1.04	7,920	99.00
Tables										
Feed	20.00	5.6000	112.00	80.00	20.00	400.00	40.00	-	80	1.00
Concentrate	-	-	106.40	76.00	-	240.00	24.00	-	0	0.00
Tail	20.00	0.2800	5.60	4.00	8.00	160.00	16.00	0.20	80	1.00
Flotation										
Feed	400.00	0.0840	33.60	24.00	1.90	760.00	76.00	1.00	8,000	100.00
Concentrate	7.78	1.7280	13.44	9.60	58.63	456.00	45.60	36.00	5,600	70.00
Tail	392.22	0.0514	20.16	14.40	0.78	304.00	30.40	0.31	2,400	30.00
Products										
Free gold/silver	-	-	106.40	76.00	-	240.00	24.00	-	0	0.00
Concentrate	7.78	1.7280	13.44	9.60	58.63	456.00	45.60	36.00	5,600	70.00
Tails	392.22	0.0514	20.16	14.40	0.78	304.00	30.40	0.31	2,400	30.00

Table A-2.21. Phase I Development
Summit King mine model

Item	Total Cost
Infrastructure	
Access road upgrade	$ 343,500
Mine haulage road, new construction	191,600
Transmission line	931,200
Water wells	557,100
Development work	
Site preparation	55,400
Tailings impoundment	156,100
Mine development	
Circular shaft	7,079,900
Haulageway, 720 level	253,400
Haulageway, 840 level	259,900
Haulageway, 1020 level	271,400
Haulageway, 1200 level	282,900
Circular raise, 120 foot	67,900
Circular raise, 180 foot	101,600
Timbered raise	62,900
Stope development, 720 & 840 levels	489,000
Stope development, 1020 & 1200 levels	499,000
Equipment	
Mine equipment	2,839,900
Plant equipment	1,487,800
Process Plant	
Concrete foundations	195,200
Process piping	59,600
Structural steel	176,000
Instrumentation	87,400
Electrical	163,000
Construction labor	676,700
Mine and mill buildings	209,100
Engineering and design fees	2,100,500
Permitting	1,750,400
Bonds	350,100
Working capital	910,000
Total capital investment	$22,615,200

Table A-2.22. Phase II Operating Cost Estimates,
Summit King mine Model

Item	Cost/day
Mine Costs	
Labor	$ 2,153
Repair parts	114
Electricity	20
Fuel	28
Lubricants	14
Tires	71
Steel items	890
Steel pipe	165
Explosives	4,501
Vent tubing, air and water hose	202
Lights and wires	44
Timber	185
Sales and use tax	371
Total mine operating cost	$ 8,758
Total cost per ton ore	$ 21.90
Mill Costs	
Labor	$ 3,591
Repair parts	620
Fuel	27
Electricity	431
Steel	272
Lubricants	21
Reagents	212
Sales and use tax	67
Total mill operating cost	$ 5,242
Total cost per ton ore	$ 13.11

Socioeconomic Impact: A summary of the direct socioeconomic impact realized by mining and processing of Summitt King resources is summarized in table A-2.23. Total taxes paid based on price levels required for a 15 percent rate of return are $947,843 in Nevada State Proceeds of Mines tax and $6,533,157 in Federal income tax. Property taxes would total $1,302,000.

Table A-2.23. Direct Socioeconomic Impact, Summit King mine model

Item	Total Cost
Phase I - Mine/Mill development, 1991	
Construction Labor Force	$ 3,465,800
Engineering and Design fees	2,100,500
Permits	1,750,400
Bonds	350,100
Working capital	910,000
Sand and gravel	315,000
Electricity	829,700
Fuel	148,100
Repair parts	182,800
Lubricants	39,700
Steel items	837,000
Tires	102,400
Explosives	560,600
Piping, metal	333,500
Piping, plastic	63,500
Metal fences	2,700
Structures	22,300
Lumber	71,700
Electrical	198,200
Transmission line	633,100
Concrete	661,500
Structural steel	182,600
Insulation	7,300
Maintenance equipment	184,200
Furnishings	47,800
Instruments	87,400
Process equipment	1,581,400
Mobile equipment	5,902,800
Freight	418,500
Sales and use tax	624,800
Total phase I expense	$22,615,200
Phase II - Mine/Mill operations, 1992-1998	**Annual Cost**
Labor	$ 1,493,500
Electric power	117,300
Repair parts	190,700
Fuel	14,400
Lubricants	9,100
Tires	18,400
Steel	302,200
Explosives	1,170,200
Reagents	55,100
Plastic pipe	55,400
Steel pipe	43,000
Lumber	48,100
Wiring, lights	11,500
Sales and use tax	114,000
Total phase II expenses (annually)	$ 3,640,100

Appendix 3
Assumptions, Socioeconomic Studies

1. Assumptions

In order to use the IMPLAN input-output modeling programs, numerous assumptions were made to relate as near as possible to present-day mine operations. Only mining properties that showed a 15% DCF-ROR with current or lower than current metal prices were considered. With the five models, the following assumptions were made:

1. The 1982 4/ data base for Churchill County, Nevada produces a reasonable economic impact analysis.
2. Housing and social services are available for all new residents.
3. Construction can be completed in one year.
4. Construction crews who move to the study area will also bring their families.
5. Nevada and near by states have all of the necessary support industries and services in place.
6. All new jobs will be filled by persons moving into the county.
7. Demand Margins follow general national trends for the suppliers and services provided to the mines from within the study area.
8. Line items estimated in the mine model which represented local purchases were entered in the study. The following table summarizes these sectors and the percentage of the total purchased locally:

Table A-3.1

Sector	Percent from Within Study Area Phase 1	Phase 2
Trucking/Freight	20%	0
Fuel	10	20%
Lubricants	50	20
Sand/Gravel	100	0
Lumber	100	0
Metal Fencing	100	0
Tires	25	20
Repair Parts	5	20
Pipe	0	100
Labor	67	67

2. IMPLAN Model

4/ Update of 1982 data base has not been completed at the time of the study.

The regional economic model used was of Churchill County, Nevada, 1982 base. IMPLAN data are organized by industry sectors. A total of 528 sectors are listed for each county with numerous no-value entries for small counties such as Churchill. Each sector is organized with the following:

Final Demand - personal consumption, investment, government expenditures, and foreign explorts

Final Payments - wages, salaries, taxes (excluding income taxes), profits and foreign imports

Industry Output - employment in number of jobs

National level data on industry production are combined with local data to estimate inter-industry links at the county level. A PC (X-T or higher) with at least 582,000 bytes free RAM and a 10 MB hard drive is the minimum hardware required to run the program.

The regional economic multipliers are calculated using incorporated and entered information. Several types of multipliers are calculated including:

Output Multiplier -Ratio of total outputs to direct (mining) outputs; output means gross revenues

Income Multiplier -Ratio of total incomes to mining incomes (employee compensation)

Employment Multiplier -Ratio of total employment to mining employment

In the case of Churchill County, the employment multipliers included a large number of part-time jobs in the wholesale trade area. Although this multiplier was not useful in comparing with other multipliers, the effect on the output and income was valid. However, using average annual wages to determine the full-time equivalent employee, the ratio appears valid. For example, the Cinnabar Hills construction operation showed an employment multiplier of other wholesale trade of 7:1. When adjusting to average annual wages, the ratio is less than 1 to 1.

Table A-3.2 lists significant output multipliers.

Table A-3.2
Total Regional Multipliers for Study Area

The multipliers were derived by combining all proposed mine developments in Churchill County.

TYPE III MULTIPLIERS (DIRECT, INDIRECT & INDUCED)

SECTOR	OUTPUT	TOTAL INCOME	EMPLOYMENT
Food & Agriculture	1.70	2.45	1.75
Gas/Lubrication	1.55	1.69	2.10
Recreation	1.71	1.61	1.37
Hotels/Lodging	1.98	2.21	1.43
Eating/Drinking	1.73	1.85	1.40
Hospitals	1.75	1.72	1.37

The multipliers were rounded to show comparisons. Indirect and direct multipliers were very similar in these sectors. Analysis of the multipliers shows that the major impacts relate to household consumption and not mine input.

Downstream activities were not considered in this study. Transportation of gold doré, the mine product, to a smelter outside of the area is an insignificant cost. There is no local consumption of the mine product.

Appendix 4

Principles of a Resource/Reserve Classification For Minerals

By the U.S. Bureau of Mines and
the U.S. Geological Survey

GEOLOGICAL SURVEY CIRCULAR 831

A revision of the classification system published as U.S. Geological Survey Bulletin 1450-A

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CECIL D. ANDRUS, *Secretary*

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ILLUSTRATIONS

Principles of a Resource/Reserve Classification for Minerals

By the U.S. BUREAU OF MINES and the U.S. GEOLOGICAL SURVEY

INTRODUCTION

Through the years, geologists, mining engineers, and others operating in the minerals field have used various terms to describe and classify mineral resources, which as defined herein include energy materials. Some of these terms have gained wide use and acceptance, although they are not always used with precisely the same meaning.

Staff members of the U.S. Bureau of Mines and the U.S. Geological Survey collect information about the quantity and quality of all mineral resources, but from different perspectives and with different purposes. In 1976, a team of staff members from both agencies developed a common classification and nomenclature, which was published as U.S. Geological Survey Bulletin 1450–A–"Principles of the Mineral Resource Classification System of the U.S. Bureau of Mines and U.S. Geological Survey." Experience with this resource classification system showed that some changes were necessary in order to make it more workable in practice and more useful in long-term planning. Therefore, representatives of the U.S. Geological Survey and the U.S. Bureau of Mines collaborated to revise Bulletin 1450–A.

Long-term public and commercial planning must be based on the probability of discovering new deposits, on developing economic extraction processes for currently unworkable deposits, and on knowing which resources are immediately available. Thus, resources must be continuously reassessed in the light of new geologic knowledge, of progress in science and technology, and of shifts in economic and political conditions. To best serve these planning needs, known resources should be classified from two standpoints: (1) purely geologic or physical/chemical characteristics–such as grade, quality, tonnage, thickness, and depth–of the material in place: and (2) profitability analyses based on costs of extracting and marketing the material in a given economy at a given time. The former constitutes important objective scientific information of the resource and a relatively unchanging foundation upon which the latter more variable economic delineation can be based.

The revised classification system, designed generally for all mineral materials, is shown graphically in figures 1 and 2 (see page 5); its components and their usage are described in the text. The classification of mineral and energy resources is necessarily arbitrary, because definitional criteria do not always coincide with natural boundaries. The system can be used to report the status of mineral and energy-fuel resources for the Nation or for specific areas.

RESOURCE/RESERVE DEFINITIONS

A dictionary definition of resource, "something in reserve or ready if needed," has been adapted for mineral and energy resources to comprise all materials, including those only surmised to exist, that have present or anticipated future value.

Resource.–A concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

Original Resource.–The amount of a resource before production.

Identified Resources.–Resources whose location, grade, quality, and quantity are known or estimated from specific geologic evidence. *Identified resources* include economic, marginally economic, and subeconomic components. To reflect varying degrees of geologic

(**Identified Resources** – Continued)

certainty, these economic divisions can be subdivided into *measured, indicated,* and *inferred.*[1]

Demonstrated. – A term for the sum of *measured* plus *indicated.*

Measured. – Quantity is computed from dimensions revealed in outcrops, trenches, workings, or drill holes; grade and(or) quality are computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, depth, and mineral content of the resource are well established.

Indicated. – Quantity and grade and(or) quality are computed from information similar to that used for measured resources, but the sites for inspection, sampling, and measurement are farther apart or are otherwise less adequately spaced. The degree of assurance, although lower than that for measured resources, is high enough to assume continuity between points of observation.

Inferred. – Estimates are based on an assumed continuity beyond measured and(or) indicated resources, for which there is geologic evidence. *Inferred resources* may or may not be supported by samples or measurements.

Reserve Base. – That part of an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. The *reserve base* is the in-place demonstrated (measured plus indicated) resource from which reserves are estimated. It may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. The *reserve base* includes those

[1]The terms "proved," "probable," and "possible", which are commonly used by industry in economic evaluations of ore or mineral fuels in specific deposits or districts, have been loosely interchanged with the terms *measured, indicated,* and *inferred.* The former terms are not a part of this classification system.

(**Reserve Base** – Continued)

resources that are currently economic (*reserves*), marginally economic (*marginal reserves*), and some of those that are currently subeconomic (*subeconomic resources*). The term "geologic reserve" has been applied by others generally to the *reserve-base* category, but it also may include the *inferred-reserve-base* category; it is not a part of this classification system.

Inferred Reserve Base. – The in-place part of an identified resource from which inferred reserves are estimated. Quantitative estimates are based largely on knowledge of the geologic character of a deposit and for which there may be no samples or measurements. The estimates are based on an assumed continuity beyond the reserve base, for which there is geologic evidence.

Reserves. – That part of the reserve base which could be economically extracted or produced at the time of determination. The term *reserves* need not signify that extraction facilities are in place and operative. *Reserves* include only recoverable materials; thus, terms such as "extractable reserves" and "recoverable reserves" are redundant and are not a part of this classification system.

Marginal Reserves. – That part of the reserve base which, at the time of determination, borders on being economically producible. Its essential characteristic is economic uncertainty. Included are resources that would be producible, given postulated changes in economic or technologic factors.

Economic. – This term implies that profitable extraction or production under defined investment assumptions has been established, analytically demonstrated, or assumed with reasonable certainty.

Subeconomic Resources. – The part of identified resources that does not meet the economic criteria of reserves and marginal reserves.

Undiscovered Resources. – Resources, the existence of which are only postulated, comprising deposits that are separate from identified resources. *Undiscovered resources* may be postulated in deposits of such grade and physical location as to render them economic, marginally economic, or subeconomic. To reflect varying degrees of geologic certainty,

(Undiscovered Resources – Continued)

undiscovered resources may be divided into two parts:

Hypothetical Resources. – Undiscovered resources that are similar to known mineral bodies and that may be reasonably expected to exist in the same producing district or region under analogous geologic conditions. If exploration confirms their existence and reveals enough information about their quality, grade, and quantity, they will be reclassified as identified resources.

Speculative Resources. – Undiscovered resources that may occur either in known types of deposits in favorable geologic settings where mineral discoveries have not been made, or in types of deposits as yet unrecognized for their economic potential. If exploration confirms their existence and reveals enough information about their quantity, grade, and quality, they will be reclassified as identified resources.

Restricted Resources/Reserves. – That part of any resource/reserve category that is restricted from extraction by laws or regulations. For example, *restricted reserves* meet all the requirements of reserves except that they are restricted from extraction by laws or regulations.

GUIDELINES FOR CLASSIFICATION OF MINERAL RESOURCES

1. All naturally occurring metals, nonmetals, and fossil fuels in sufficient concentration can be classified in one or more of the categories.

2. Where the term *reserves* is used alone, without a modifying adjective such as indicated, marginal, or inferred, it is to be considered synonymous with the demonstrated-economic category, as shown in figure 1.

3. Definitions of resource categories can be modified for a particular commodity in order to conform with accepted usage involving special geological and engineering characteristics. Such modified definitions for particular commodities will be given in forthcoming government publications.

4. Quantities, qualities, and grades may be expressed in different terms and units to suit different purposes, but usage must be clearly stated and defined.

5. The geographic area to which any resource/reserve estimate refers must be defined.

6. All estimates must show a date and author.

7. The *reserve base* is an encompassing resource category delineated by physical and chemical criteria. A major purpose for its recognition and appraisal is to aid in long-range public and commercial planning. For most mineral commodities, different grades and tonnages, or other appropriate resource parameters, can be specified for any given deposit or area, or for the Nation, depending on the specific objectives of the estimators; therefore, the position of the lower boundary of the reserve base, which extends into the subeconomic category, is variable, depending on those objectives. The intention is to define a quantity of in-place material, any part of which may become economic, depending on the extraction plans and economic assumptions finally used. When those criteria are determined, the initial reserve-base estimate will be divided into three component parts: reserves, marginal reserves, and a remnant of subeconomic resources. For the purpose of Federal commodity assessment, criteria for the reserve base will be established for each commodity.

8. *Undiscovered resources* may be divided in accordance with the definitions of *hypothetical* and *speculative resources,* or they may be divided in terms of relative probability of occurrence.

9. *Inferred reserves* and the *inferred reserve base* are postulated extensions of reserves and of the reserve base. They are identified resources quantified with a relatively low degree of certainty. Postulated quantities of resources not based on reserve/reserve-base extensions, but rather on geologic inference alone, should be classified as undiscovered.

10. Locally, limited quantities of materials may be produced, even though economic analysis has indicated that the deposit would be too thin, too low grade, or too deep to be classified as a reserve. This situation might arise when the production facilities are already established or when favorable local circumstances make it possible to produce material that elsewhere could not be extracted profitably. Where such production is taking place, the quantity of in-place material shall be included in the reserve base, and the quantity that is potentially producible shall be included as a reserve. The profitable production of such materials locally, however, should not be used as a rationale in other

areas for classifying as reserves, those materials that are similar in thickness, quality, and depth.

11. Resources classified as reserves must be considered economically producible at the time of classification. Conversely, material not currently producible at a profit cannot be classified as reserves. There are situations, however, in which mining plans are being made, lands are being acquired, or mines and plants are being constructed to produce materials that do not meet economic criteria for reserve classification under current costs and prices, but would do so under reasonable future expectations. For some other materials, economic producibility is uncertain only for lack of detailed engineering assessment. The marginal-reserves category applies to both situations. When economic production appears certain for all or some of a marginal reserve, it will be reclassified as reserves.

12. Materials that are too low grade or for other reasons are not considered potentially economic, in the same sense as the defined resource, may be recognized and their magnitude estimated, but they are not classified as resources. A separate category, labeled *other occurrences,* is included in figures 1 and 2.

13. In figure 1, the boundary between *subeconomic* and *other occurrences* is limited by the concept of *current or potential feasibility of economic production,* which is required by the definition of a resource. The boundary is obviously uncertain, but limits may be specified in terms of grade, quality, thickness, depth, percent extractable, or other economic-feasibility variables.

14. Varieties of mineral or energy commodities, such as bituminous coal as distinct from lignite, may be separately quantified when they have different characteristics or uses.

15. The amount of past cumulative production is not, by definition, a part of the resource. Nevertheless, a knowledge of what has been produced is important to an understanding of current resources, in terms of both the amount of past production and the amount of residual or remaining in-place resource. A separate space for cumulative production is shown in figure 1. Residual material left in the ground during current or future extraction should be recorded in the resource category appropriate to its economic-recovery potential.

16. In classifying reserves and resources, it is necessary to recognize that some minerals derive their economic viability from their coproduct or byproduct relationships with other minerals. Such relationships must be clearly explained in footnotes or in an accompanying text.

17. Considerations other than economic and geologic, including legal, regulatory, environmental, and political, may restrict or prohibit the use of all or part of a deposit. Reserve and resource quantities known to be restricted should be recorded in the appropriate classification category; the quantity restricted and the reason for the restriction should be noted.

18. The classification system includes more divisions than will commonly be reported or for which data are available. Where appropriate, divisions may be aggregated or omitted.

19. The data upon which resource estimates are based and the methods by which they are derived are to be documented and preserved.

RESOURCES OF (commodity name)

[A part of reserves or any resource category may be restricted from extraction by laws or regulations (see text)]

AREA: (mine, district, field, State, etc.) UNITS: (tons, barrels, ounces, etc.)

Cumulative Production	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range (or)	
	Measured	Indicated		Hypothetical	Speculative
ECONOMIC	Reserves		Inferred Reserves		
MARGINALLY ECONOMIC	Marginal Reserves		Inferred Marginal Reserves		
SUB-ECONOMIC	Demonstrated Subeconomic Resources		Inferred Subeconomic Resources		

Other Occurrences	Includes nonconventional and low-grade materials

Author:

Date:

FIGURE 1.—Major elements of mineral-resource classification, excluding *reserve base* and *inferred reserve base.*

RESOURCES OF (commodity name)

[A part of reserves or any resource category may be restricted from extraction by laws or regulations (see text)]

AREA: (mine, district, field, State, etc.) UNITS: (tons, barrels, ounces, etc.)

Cumulative Production	IDENTIFIED RESOURCES			UNDISCOVERED RESOURCES	
	Demonstrated		Inferred	Probability Range (or)	
	Measured	Indicated		Hypothetical	Speculative
ECONOMIC	Reserve		Inferred		
MARGINALLY ECONOMIC			Reserve		
SUB-ECONOMIC	Base		Base		

Other Occurrences	Includes nonconventional and low-grade materials

Author:

Date:

FIGURE 2.—*Reserve base* and *inferred reserve base* classification categories.

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